Karnataka PGCET 2026 MCA

Question Paper with Solutions

Conducted by Karnataka Examinations Authority (KEA)

General Instructions

(i) The examination will be conducted in Computer-Based Test (CBT) mode.

(ii) Each question carries +1 mark for a correct answer. There is no negative marking for incorrect answers.

(iii) The total number of questions is 120.

(iv) The duration of the exam is 1 hour and 30 minutes (90 minutes).

1. Match the following List-I (verb forms) with List-II (non-finites):

List - I (Verb form)	List - II (Non-finites)
(a) Present participle	(i) Verb form used as a noun without "to"
(b) Infinitive	(ii) Verb form ending in -ing used as an adjecti or for continuous tense
(c) Gerund	(iii) Base form of a verb often preceded by "to"
(d) Perfect participle	(iv) Having + past participle showing complete action before another action

Codes:

(A) a - iv, b - ii, c - iii, d - i

(B) a - iv, b - i, c - ii, d - iii

(C) a - ii, b - iii, c - i, d - iv

(D) a - ii, b - i, c - iii, d - iv

Correct Answer: (C) a - ii, b - iii, c - i, d - iv

Solution:

Concept:

Non-finite verbs are verb forms that do not express tense, person, or number independently.

Unlike finite verbs, they do not function as the principal verb of a sentence. Instead, they perform different grammatical functions such as acting as nouns, adjectives, or parts of verb phrases. The major categories of non-finites include infinitives, gerunds, present participles, past participles, and perfect participles.
To correctly match the items, we must carefully examine both the structural form and the grammatical function of each non-finite verb.

Step 1: Identify the function of the Present Participle.
A present participle is formed by adding the suffix *-ing* to the base form of a verb.
Examples:

- Running water
- A crying child
- She is singing.

The present participle performs two important functions:

1. It helps form continuous tenses.
2. It can function adjectivally by describing a noun.

Looking at List-II, statement (ii) says:

> "Verb form ending in -ing used as an adjective or for continuous tense."

This exactly describes a present participle.
Therefore,

$$(a) \rightarrow (ii)$$

Step 2: Identify the function of the Infinitive.
An infinitive represents the base form of a verb. It is generally preceded by the word "to".
Examples:

- to read
- to write

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- to learn
- to speak

The infinitive is considered the most basic verbal form and may function as a noun, adjective, or adverb depending upon context.
In List-II, statement (iii) reads:

> "Base form of a verb often preceded by 'to'."

This is the precise definition of an infinitive.
Hence,

$$(b) \rightarrow (iii)$$

Step 3: Identify the function of the Gerund.
A gerund also ends in *-ing*, but unlike a present participle, it functions entirely as a noun.
Examples:

- Swimming is good exercise.
- Reading improves knowledge.
- He enjoys painting.

In each sentence, the *-ing* word behaves like a noun rather than an adjective.
List-II statement (i) says:

> "Verb form used as a noun without 'to'."

Since a gerund is a noun form derived from a verb, this description matches perfectly.
Therefore,

$$(c) \rightarrow (i)$$

Step 4: Identify the function of the Perfect Participle.
A perfect participle is formed by using:

$$\text{Having} + \text{Past Participle}$$

Examples:

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- Having completed the work, he went home.
- Having finished the examination, she relaxed.
- Having studied hard, the student performed well.

This structure indicates that one action was completed before another action occurred.
In List-II, statement (iv) states:

"Having + past participle showing completed action before another action."

This is the exact definition of a perfect participle.
Hence,

$$(d) \rightarrow (iv)$$

Step 5: Form the final matching sequence.
Combining all the correct matches:

(a) Present participle	$\rightarrow$	(ii)
(b) Infinitive	$\rightarrow$	(iii)
(c) Gerund	$\rightarrow$	(i)
(d) Perfect participle	$\rightarrow$	(iv)

Thus, the complete matching arrangement is

$$a-ii,\ b-iii,\ c-i,\ d-iv$$

This corresponds to **Option (C)**.

Quick Tip: A quick way to distinguish a Gerund from a Present Participle is to identify its grammatical role. If the *-ing* form behaves like a noun, it is a Gerund. If it describes a noun or helps form a continuous tense, it is a Present Participle.

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2. Match the following clauses with their functions:

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List - I (Clauses)	List - II (Functions)
(a) Noun clause	(i) Modifies a noun and usually begins with *who, which, that*
(b) Adverbial clause	(ii) Functions as a noun within a sentence
(c) Relative clause	(iii) Modifies a verb, adjective or adverb (time, reason, condition, etc)
(d) Conditional clause	(iv) Expresses a condition often introduced by '*if*' or '*unless*'

(A) a - ii, b - iii, c - i, d - iv

(B) a - iv, b - ii, c - iii, d - i

(C) a - iii, b - iv, c - ii, d - i

(D) a - ii, b - iv, c - i, d - iii

Correct Answer: (A) a - ii, b - iii, c - i, d - iv

Solution:

Concept:

A clause is a group of words that contains a subject and a predicate. Clauses may be independent or dependent. Independent clauses can stand alone as complete sentences, whereas dependent clauses cannot express a complete thought independently and therefore function as parts of larger sentences.

Dependent clauses are classified according to the role they perform in a sentence. Some clauses act like nouns, some function like adjectives by describing nouns, and others function like adverbs by modifying verbs, adjectives, or entire clauses. Understanding the grammatical function of each clause helps us correctly match the items given in the question.

Step 1: Identify the function of the Noun Clause.

A noun clause is a subordinate clause that performs the same function as a noun within a sentence.

It may act as:

- Subject of a sentence
- Object of a verb
- Object of a preposition
- Complement of a verb

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Examples:

- *What he said* was true.
- I know *that she is honest*.
- The problem is *whether they will agree*.

In each example, the highlighted clause functions as a noun.
Looking at List-II, statement (ii) says:

> Functions as a noun within a sentence.

Therefore,

$$(a) \rightarrow (ii)$$

Step 2: Identify the function of the Adverbial Clause.
An adverbial clause modifies a verb, an adjective, or another adverb. It provides additional information regarding:

- Time
- Place
- Reason
- Purpose
- Condition
- Contrast
- Manner

Examples:

- We left *when the meeting ended*.
- She stayed home *because she was ill*.
- He works hard *so that he may succeed*.

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These clauses provide circumstances surrounding the action.

In List-II, statement (iii) states:

> Modifies a verb, adjective or adverb (time, reason, condition, etc.).

Hence,

$$(b) \rightarrow (iii)$$

Step 3: Identify the function of the Relative Clause.

A relative clause is also known as an adjective clause because it modifies a noun or pronoun.

It usually begins with relative pronouns such as:

who, whom, whose, which, that

Examples:

- The boy *who won the prize* is my friend.
- The book *that I purchased* is interesting.
- The house *which stands on the hill* is beautiful.

In every case, the clause describes or modifies a noun.

List-II statement (i) says:

> Modifies a noun and usually begins with *who, which, that*.

Therefore,

$$(c) \rightarrow (i)$$

Step 4: Identify the function of the Conditional Clause.

A conditional clause expresses a condition that must be fulfilled for another action or event to occur.

Such clauses are commonly introduced by:

if, unless, provided that, in case

Examples:

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- *If it rains*, we will stay indoors.
- *Unless you study*, you may not succeed.
- *If she arrives early*, we will begin the meeting.

These clauses establish a condition for the main clause.
List-II statement (iv) reads:

Expresses a condition often introduced by *if* or *unless*.

Thus,

$$(d) \rightarrow (iv)$$

Step 5: Form the final matching sequence.
Combining all the correct matches:

(a) Noun clause	$\rightarrow$	(ii)
(b) Adverbial clause	$\rightarrow$	(iii)
(c) Relative clause	$\rightarrow$	(i)
(d) Conditional clause	$\rightarrow$	(iv)

Therefore,

$$a-ii, \quad b-iii, \quad c-i, \quad d-iv$$

This arrangement corresponds exactly to **Option (A)**.

Quick Tip: A quick identification method is to look at the function of the clause. If it behaves like a noun, it is a Noun Clause. If it describes a noun, it is a Relative Clause. If it modifies a verb or gives information about time, reason, place, or condition, it is an Adverbial Clause. If it specifically introduces a condition using words like *if* or *unless*, it is a Conditional Clause.

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3. Choose the correct word to complete the sentence:

His speech was so _____ that everyone lost interest halfway through.

(A) Engaging

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(B) Monotonous

(C) Lively

(D) Exciting

Correct Answer: (B) Monotonous

Solution:

Concept:

In vocabulary-based fill-in-the-blank questions, the correct answer is determined by carefully analyzing the context of the sentence and identifying the relationship between the blank and the information that follows. One of the most important contextual clues in English grammar and vocabulary is the structure *"so ... that"*, which indicates a cause-and-effect relationship. In the given sentence, the result is clearly stated:

> "everyone lost interest halfway through"

Therefore, the missing word must describe a quality of the speech that would naturally cause listeners to become bored, inattentive, or uninterested. To arrive at the correct answer, each option must be examined individually and compared with the overall meaning of the sentence.

Step 1: Analyze the contextual clue provided in the sentence.

The sentence states:

> "His speech was so _____ that everyone lost interest halfway through."

The phrase *"lost interest"* conveys a negative reaction from the audience. It suggests that the speech failed to maintain attention and was probably dull, repetitive, or uninteresting. Hence, the word filling the blank should have a negative meaning associated with boredom or lack of variety.

Step 2: Evaluate Option (A) – Engaging.

The word **Engaging** means:

- Interesting
- Attractive
- Able to capture and hold attention

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- Pleasant and enjoyable

Example:

> "The teacher gave an engaging presentation that kept the students attentive throughout the class."

If a speech is engaging, listeners usually become more interested rather than losing interest.
Thus, the statement

> "His speech was so engaging that everyone lost interest halfway through."

creates a contradiction.
Therefore, Option (A) is incorrect.

Step 3: Evaluate Option (B) – Monotonous.
The word **Monotonous** refers to something that is:

- Repetitive
- Lacking variety
- Dull
- Tedious
- Unchanging in tone or style

Example:

> "The lecture became monotonous because the speaker continued repeating the same points."

A monotonous speech often causes listeners to lose concentration and become bored because there is little variation in delivery, content, or tone.
Substituting the word into the sentence:

> "His speech was so monotonous that everyone lost interest halfway through."

The sentence now becomes perfectly logical and meaningful.
Therefore, Option (B) is a strong match for the given context.

Step 4: Evaluate Option (C) – Lively.
The word **Lively** means:

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- Energetic
- Animated
- Full of enthusiasm
- Interesting and active

Example:

> "The lively discussion encouraged everyone to participate actively."

A lively speech generally increases audience involvement and attention.
Thus, the statement

> "His speech was so lively that everyone lost interest halfway through."

does not make logical sense.
Hence, Option (C) is incorrect.

Step 5: Evaluate Option (D) – Exciting.
The word **Exciting** means:

- Thrilling
- Stimulating
- Interesting
- Capable of creating enthusiasm

Example:

> "The exciting announcement captured everyone's attention immediately."

An exciting speech would normally make people more attentive rather than causing them to lose interest.
Therefore,

> "His speech was so exciting that everyone lost interest halfway through."

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is illogical.

Hence, Option (D) is incorrect.

Step 6: Determine the most appropriate answer.

After examining all four options, we observe:

- Engaging → Positive meaning; contradicts the result.
- Monotonous → Dull and repetitive; perfectly explains the result.
- Lively → Positive meaning; contradicts the result.
- Exciting → Positive meaning; contradicts the result.

Therefore, the only word that logically fits the context is:

Monotonous

Hence, the correct answer is **Option (B)**.

Quick Tip: In sentence-completion questions, always focus on context clues. Expressions such as *"so ... that"*, *"because"*, *"therefore"*, and *"as a result"* often reveal whether the missing word should carry a positive or negative meaning. Matching the tone of the blank with the outcome stated in the sentence helps eliminate incorrect options quickly.

Read the following passage and answer the questions (4-6):

> Technology has transformed the way people communicate. In the past, letters took days or even weeks to reach their destination. Today, messages can be sent instantly through e-mails and mobile applications. While this has made communication faster and more convenient, it has also reduced face-to-face interactions. Many people now prefer texting over meeting in person, which may affect social relationships in the long run.

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4. How were messages sent in the past?

(A) Through mobile apps

(B) Through emails

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(C) Through letters

(D) Through video calls

Correct Answer: (C) Through letters

Solution:

Concept:

Reading comprehension questions require us to identify information that is explicitly stated in the passage. To answer such questions correctly, we should locate the relevant sentence and carefully analyze the information provided by the author. In this passage, the author compares communication methods used in the past with those used in the present.

Step 1: Locate the relevant information in the passage.

The passage states:

> "In the past, letters took days or even weeks to reach their destination."

This sentence directly describes the method of communication used in earlier times.

Step 2: Evaluate Option (A) – Through mobile apps.

Mobile applications are modern communication tools that operate through smartphones and internet connectivity.

Examples include:

- WhatsApp
- Telegram
- Signal

Since the passage contrasts the past with modern communication technologies, mobile apps cannot represent the communication method used in the past.

Therefore, Option (A) is incorrect.

Step 3: Evaluate Option (B) – Through emails.

Emails are a form of electronic communication that require computers, smartphones, and internet access.

The passage mentions emails as a modern method of communication, not as a traditional one.

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Therefore, Option (B) is incorrect.

Step 4: Evaluate Option (C) – Through letters.

The passage clearly states that in the past, people relied on letters to communicate.

Letters were physically transported and often required several days or weeks to reach the recipient.

This information exactly matches the statement given in the passage.

Therefore, Option (C) is correct.

Step 5: Evaluate Option (D) – Through video calls.

Video calls are a modern technology that depend on internet connectivity and digital devices.

They were not used as a communication method in the past.

Therefore, Option (D) is incorrect.

Step 6: Determine the correct answer.

The passage explicitly states that communication in the past was carried out through letters.

Thus,

Through letters

Hence, the correct answer is **Option (C)**.

Quick Tip: For factual reading comprehension questions, identify the exact sentence in the passage that relates to the question. Answers directly stated in the passage are usually the most reliable.

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5. What is one advantage of modern communication?

(A) It is slower

(B) It is more expensive

(C) It is instant

(D) It requires travel

Correct Answer: (C) It is instant

Solution:

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Concept:

Reading comprehension questions often require identifying advantages, disadvantages, causes, or effects mentioned in a passage. To answer correctly, we must focus on the author's statements and determine which option reflects the idea expressed in the text.

Step 1: Locate the relevant information in the passage.

The passage states:

> "Today, messages can be sent instantly through e-mails and mobile applications."

The keyword *instantly* highlights a major advantage of modern communication systems.

Step 2: Evaluate Option (A) – It is slower.

Modern communication systems allow messages to be delivered within seconds.

The passage emphasizes speed as a benefit.

Therefore, describing modern communication as slower contradicts the passage.

Hence, Option (A) is incorrect.

Step 3: Evaluate Option (B) – It is more expensive.

The passage does not mention higher costs as an advantage of modern communication.

Furthermore, this option does not represent a benefit.

Therefore, Option (B) is incorrect.

Step 4: Evaluate Option (C) – It is instant.

The passage explicitly states that messages can be sent instantly through modern communication platforms.

This means information can reach another person almost immediately without significant delay.

Therefore, this option directly matches the information given in the passage.

Hence, Option (C) is correct.

Step 5: Evaluate Option (D) – It requires travel.

Modern communication enables people to communicate without physically travelling.

In fact, one of its major benefits is that communication can occur remotely.

Therefore, Option (D) is incorrect.

Step 6: Determine the correct answer.

The passage clearly identifies instant communication as an important advantage of modern technology.

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Thus,

It is instant

Hence, the correct answer is **Option (C)**.

Quick Tip: When a passage mentions words such as *faster*, *instant*, *efficient*, or *convenient*, they often indicate advantages. Focus on such keywords while answering comprehension questions.

6.

What is one disadvantage of modern communication mentioned in the passage?

(A) Increased travel

(B) Reduced face-to-face interaction

(C) Higher costs

(D) Lack of technology

Correct Answer: (B) Reduced face-to-face interaction

Solution:

Concept:

Reading comprehension questions often require identifying both the advantages and disadvantages discussed in a passage. While an author may praise certain developments, they may also highlight concerns or negative consequences associated with those developments. Therefore, it is important to carefully locate statements that indicate drawbacks or problems.

Step 1: Locate the relevant statement in the passage.

The passage states:

> "While this has made communication faster and more convenient, it has also reduced face-to-face interactions."

This sentence directly mentions a disadvantage associated with modern communication.

Step 2: Evaluate Option (A) – Increased travel.

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Modern communication technologies enable people to communicate remotely without needing to travel physically.
Therefore, increased travel is not a disadvantage mentioned in the passage.
Hence, Option (A) is incorrect.

Step 3: Evaluate Option (B) – Reduced face-to-face interaction.
The passage explicitly states that modern communication has reduced face-to-face interactions.
This means people increasingly communicate through texts, emails, and applications rather than meeting in person.
Since this information is directly stated in the passage, it is the correct answer.
Therefore, Option (B) is correct.

Step 4: Evaluate Option (C) – Higher costs.
The passage does not mention increased expenses or higher costs associated with modern communication.
Therefore, this option is not supported by the passage.
Hence, Option (C) is incorrect.

Step 5: Evaluate Option (D) – Lack of technology.
Modern communication depends heavily on technology.
In fact, the passage discusses how technological advancements have transformed communication.
Therefore, lack of technology cannot be considered a disadvantage mentioned in the passage.
Hence, Option (D) is incorrect.

Step 6: Determine the correct answer.
The passage clearly identifies reduced face-to-face interaction as a drawback of modern communication.
Thus,

Reduced face-to-face interaction

Hence, the correct answer is **Option (B)**.

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Quick Tip: When a passage contains words such as *however*, *but*, *although*, or *while*, pay special attention to the information that follows, as it often introduces a limitation, drawback, or contrasting viewpoint.

7.

OBFUSCATE nearly means:

(a) Illuminate

(b) Confound

(c) Explicate

(d) Muddle

(A) (a) and (b) are correct
(B) (b) and (c) are correct
(C) (b) and (d) are correct
(D) (a) and (c) are correct

Correct Answer: (C) (b) and (d) are correct

Solution:

Concept:
Vocabulary questions involving synonyms require us to identify words that have meanings similar or nearly identical to the given word. The word **Obfuscate** means to make something unclear, confusing, difficult to understand, or deliberately obscure.
To determine the correct answer, we must examine the meaning of each word individually.

Step 1: Analyze word (a) – Illuminate.
The word **Illuminate** means:

- To shed light on
- To clarify
- To make something easier to understand

Example:

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"The teacher's explanation illuminated the difficult concept."

Since illuminate means to make something clear, it is opposite in meaning to obfuscate.
Therefore, (a) is incorrect.

Step 2: Analyze word (b) – Confound.
The word **Confound** means:

- To confuse
- To bewilder
- To make difficult to understand

Example:

"The complicated instructions confounded the participants."

This meaning closely matches the meaning of obfuscate.
Therefore, (b) is correct.

Step 3: Analyze word (c) – Explicate.
The word **Explicate** means:

- To explain
- To interpret
- To clarify in detail

Example:

"The professor explicated the theory thoroughly."

Since explicate means to make something clear, it is opposite in meaning to obfuscate.
Therefore, (c) is incorrect.

Step 4: Analyze word (d) – Muddle.
The word **Muddle** means:

- To confuse

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- To mix up
- To make unclear

Example:

"The contradictory statements muddled the issue."

This meaning is very close to the meaning of obfuscate.
Therefore, (d) is correct.

Step 5: Determine the correct combination.
We found that:

$$(b) \text{ Confound}$$

and

$$(d) \text{ Muddle}$$

are the words that closely match the meaning of obfuscate.
Therefore,

$$(b) \text{ and } (d)$$

form the correct combination.
Hence, the correct answer is **Option (C)**.

Quick Tip: To solve synonym questions quickly, first identify whether the target word carries a positive, negative, or neutral meaning. Then eliminate options with the opposite tone before making the final selection.

8.

Choose the antonyms of LOQUACIOUS.

(a) Garrulous

(b) Voluble

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(c) Reticent

(d) Taciturn

(A) (a) and (b) are correct

(B) (b) and (c) are correct

(C) (c) and (d) are correct

(D) (d) and (a) are correct

Correct Answer: (C) (c) and (d) are correct

Solution:

Concept:

An antonym is a word that has the opposite meaning of another word. The word **Loquacious** means talkative, communicative, and inclined to speak a great deal. Therefore, its antonyms must refer to people who speak very little or are reserved in conversation.

Step 1: Analyze word (a) – Garrulous.

Garrulous means excessively talkative, especially about trivial matters.

This meaning is similar to loquacious.

Therefore, (a) is not an antonym.

Step 2: Analyze word (b) – Voluble.

Voluble refers to someone who speaks fluently, easily, and at length.

This is also similar to loquacious.

Therefore, (b) is not an antonym.

Step 3: Analyze word (c) – Reticent.

Reticent means quiet, reserved, and unwilling to speak much.

This meaning is opposite to loquacious.

Therefore, (c) is correct.

Step 4: Analyze word (d) – Taciturn.

Taciturn refers to a person who is habitually silent and speaks very little.

This is also opposite to loquacious.

Therefore, (d) is correct.

Step 5: Determine the correct combination.

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The antonyms of loquacious are:

(c) Reticent

and

(d) Taciturn

Thus, the correct combination is:

(c) and (d)

Hence, the correct answer is **Option (C)**.

Quick Tip: Remember the vocabulary group: *Loquacious, Garrulous, and Voluble* all relate to excessive talking, whereas *Reticent* and *Taciturn* describe people who are quiet and reserved.

9.

Choose the correct meaning of the phrase "a blessing in disguise".

(A) Hidden danger

(B) A very obvious problem

(C) A happy occasion

(D) Something that seems bad but turns out to be good

Correct Answer: (D) Something that seems bad but turns out to be good

Solution:

Concept:

Idioms are fixed expressions whose meanings cannot always be understood from the literal meanings of the individual words. To answer idiom-based questions correctly, it is important to understand the figurative meaning of the entire phrase rather than interpreting each word separately.

The idiom **"a blessing in disguise"** refers to a situation that appears unfortunate, unpleasant, or disadvantageous at first but eventually produces a positive outcome.

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Step 1: Understand the meaning of the idiom.

The phrase consists of two important ideas:

- A **blessing** means something beneficial or fortunate.
- A **disguise** means something hidden behind a different appearance.

Therefore, the idiom suggests that a beneficial outcome is hidden behind an apparently negative situation.

Step 2: Evaluate Option (A) – Hidden danger.

A hidden danger refers to something that appears safe but later causes harm.

This meaning is opposite to the idiom.

Therefore, Option (A) is incorrect.

Step 3: Evaluate Option (B) – A very obvious problem.

An obvious problem is simply a difficulty that is clearly visible.

The idiom refers to an unexpected positive outcome rather than an obvious problem.

Therefore, Option (B) is incorrect.

Step 4: Evaluate Option (C) – A happy occasion.

A happy occasion is openly joyful from the beginning.

However, the idiom specifically refers to a situation that initially appears bad before revealing its positive side.

Therefore, Option (C) is incorrect.

Step 5: Evaluate Option (D) – Something that seems bad but turns out to be good.

This option perfectly captures the meaning of the idiom.

A situation may initially seem disappointing, unfortunate, or harmful, but later prove beneficial.

For example:

> "Losing that job was a blessing in disguise because it led her to a much better career opportunity."

Therefore, Option (D) is correct.

Step 6: Determine the correct answer.

The idiom **"a blessing in disguise"** means:

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Something that seems bad but turns out to be good

Hence, the correct answer is **Option (D)**.

Quick Tip: Many idioms have meanings that are very different from the literal meanings of their individual words. Always focus on the established figurative meaning of the complete phrase.

10.

Arrange the sentences in the correct order.

(A) The teacher appreciated her efforts.

(B) She worked hard to complete the project on time.

(C) Meena was assigned a project in the class.

(D) She presented it confidently before everyone.

(A) C B D A
(B) B C D A
(C) C D B A
(D) B D C A

Correct Answer: (A) C B D A

Solution:

Concept:
Sentence rearrangement questions test the ability to identify logical sequence, continuity of ideas, chronological order, and pronoun references. To arrange sentences correctly, we first locate the introductory sentence, then determine the sequence of events, and finally identify the concluding statement.

Step 1: Identify the introductory sentence.
Sentence (C) states:

"Meena was assigned a project in the class."

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This sentence introduces the main character, Meena, and establishes the topic of discussion.
The other sentences contain pronouns such as “She” and “her,” which refer back to Meena.
Therefore, sentence (C) must be the opening sentence.

Step 2: Identify the next logical action.
After receiving a project, the natural next step is to work on it.
Sentence (B) states:

> “She worked hard to complete the project on time.”

The pronoun “She” refers to Meena introduced in sentence (C).
Therefore,

$$C \rightarrow B$$

is the logical progression.

Step 3: Identify what happens after completing the project.
Once the project is completed, it is reasonable that Meena would present it.
Sentence (D) states:

> “She presented it confidently before everyone.”

The word “it” refers to the completed project mentioned in sentence (B).
Thus,

$$C \rightarrow B \rightarrow D$$

forms a coherent sequence.

Step 4: Identify the concluding sentence.
Sentence (A) states:

> “The teacher appreciated her efforts.”

The appreciation comes naturally after Meena presents her work.
Therefore, sentence (A) should conclude the sequence.
This gives:

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$$C \rightarrow B \rightarrow D \rightarrow A$$

Step 5: Verify the complete flow.

The final arrangement reads:

1. Meena was assigned a project in the class.
2. She worked hard to complete the project on time.
3. She presented it confidently before everyone.
4. The teacher appreciated her efforts.

This sequence creates a logical and grammatically connected narrative.

Step 6: Determine the correct answer.

The correct order is:

$$\boxed{C \rightarrow B \rightarrow D \rightarrow A}$$

Hence, the correct answer is **Option (A)**.

Quick Tip: In sentence rearrangement questions, first identify the sentence that introduces the main person, place, or idea. Sentences containing pronouns such as *he, she, they, it, his, her, or their* usually appear after the introductory sentence.

11.

Primary classification of programming languages are

(a) Machine language

(b) Assembly language

(c) High level language

(d) Pseudocode and Algorithms

(A) Only (c) and (d) are correct

(B) Only (a) and (b) are correct

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(C) Only (a), (b) and (c) are correct

(D) Only (a) and (d) are correct

Correct Answer: (C) Only (a), (b) and (c) are correct

Solution:

Concept:

Programming languages are classified according to their level of abstraction from the computer hardware. As computer technology evolved, programming languages developed from machine-dependent forms to highly user-friendly forms. The primary classifications of programming languages are generally divided into Machine Language, Assembly Language, and High-Level Language.

Pseudocode and Algorithms, although extremely important in program design and problem-solving, are not actual programming languages because they cannot be directly translated and executed by a computer system.

Step 1: Examine Statement (a) – Machine Language.

Machine Language is the lowest-level programming language and consists entirely of binary digits (0s and 1s).

Characteristics include:

- Directly understood by the CPU.
- No translator is required.
- Hardware dependent.
- Difficult for humans to read and write.

Since Machine Language is one of the fundamental classifications of programming languages, statement (a) is correct.

Step 2: Examine Statement (b) – Assembly Language.

Assembly Language was developed to simplify programming in Machine Language.

Characteristics include:

- Uses mnemonic codes such as `ADD`, `MOV`, and `SUB`.
- Easier to understand than binary code.

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- Requires an assembler to convert instructions into machine code.
- Still closely related to hardware architecture.

Therefore, Assembly Language is also a primary classification of programming language.
Hence, statement (b) is correct.

Step 3: Examine Statement (c) – High Level Language.
High-Level Languages are designed to be user-friendly and independent of specific hardware architectures.
Examples include:

- C
- C++
- Java
- Python
- Pascal

Characteristics include:

- English-like syntax.
- Easy to learn and maintain.
- Portable across different systems.
- Require a compiler or interpreter.

Therefore, statement (c) is also correct.

Step 4: Examine Statement (d) – Pseudocode and Algorithms.
An Algorithm is a logical sequence of steps used to solve a problem.
Pseudocode is an informal representation of an algorithm written in structured English-like statements.
Important points:

- They are planning tools.

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- They help programmers design solutions.
- They are not executable by a computer.
- They do not follow strict programming language syntax.

Therefore, they are not classified as programming languages.
Hence, statement (d) is incorrect.

Step 5: Determine the correct combination.
The correct classifications are:

$$(a),\ (b),\ (c)$$

while

$$(d)$$

is not a programming language classification.

Conclusion:
Only Machine Language, Assembly Language, and High-Level Language are primary classifications of programming languages.
Therefore,

$$\boxed{\text{Only (a), (b) and (c) are correct}}$$

Hence, the correct answer is **Option (C)**.

Quick Tip: If a language can be translated and executed by a computer through hardware, an assembler, compiler, or interpreter, it is considered a programming language. Algorithms and pseudocode are only planning tools and cannot be executed directly.

12.

Match the following with respect to connections between processor and memory.

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List - I (Registers)	List - II (Usage)
(a) IR	(i) Keeps track of execution of a program
(b) MAR	(ii) Holds the instruction that is currently being executed
(c) MDR	(iii) Data to be written into or read out of the addressed location
(d) PC	(iv) Holds the address of the location to be accessed

Codes:

(A) a - iii, b - iv, c - ii, d - i

(B) a - i, b - ii, c - iv, d - iii

(C) a - ii, b - iv, c - iii, d - i

(D) a - iv, b - ii, c - i, d - iii

Correct Answer: (C) a - ii, b - iv, c - iii, d - i

Solution:

Concept:

The Central Processing Unit (CPU) contains several special-purpose registers that facilitate communication between the processor and main memory. These registers are essential components of the fetch-decode-execute cycle and ensure efficient execution of instructions.

The four registers considered here are:

- Instruction Register (IR)
- Memory Address Register (MAR)
- Memory Data Register (MDR)
- Program Counter (PC)

Each register performs a specific and unique task.

Step 1: Match IR (Instruction Register).

The Instruction Register stores the instruction currently being decoded or executed by the CPU.

During instruction execution:

1. The instruction is fetched from memory.
2. It is loaded into IR.
3. The Control Unit decodes it.

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4. Execution begins.

Therefore,

$$\text{IR} \rightarrow \text{Holds the instruction currently being executed}$$

Hence,

$$(a) \rightarrow (ii)$$

Step 2: Match MAR (Memory Address Register).

The Memory Address Register stores the address of the memory location that the CPU wants to access.

Whenever data must be read or written:

- The address is first loaded into MAR.
- The address is transmitted through the address bus.

Therefore,

$$\text{MAR} \rightarrow \text{Holds the address of the location to be accessed}$$

Hence,

$$(b) \rightarrow (iv)$$

Step 3: Match MDR (Memory Data Register).

The Memory Data Register temporarily stores data being transferred between memory and CPU.

It may contain:

- Data read from memory.
- Data waiting to be written to memory.

Therefore,

$$\text{MDR} \rightarrow \text{Data to be written into or read out of memory}$$

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Hence,

$$(c) \rightarrow (iii)$$

Step 4: Match PC (Program Counter).

The Program Counter keeps track of the execution sequence of a program.

It stores:

- The address of the next instruction to be fetched.
- The progression of program execution.

Therefore,

$$\text{PC} \rightarrow \text{Keeps track of execution of a program}$$

Hence,

$$(d) \rightarrow (i)$$

Step 5: Construct the final matching.

$$\begin{aligned} &\text{(a) IR} \quad \rightarrow \quad \text{(ii)} \\ &\text{(b) MAR} \quad \rightarrow \quad \text{(iv)} \\ &\text{(c) MDR} \quad \rightarrow \quad \text{(iii)} \\ &\text{(d) PC} \quad \rightarrow \quad \text{(i)} \end{aligned}$$

Conclusion:

The correct matching is:

$$\boxed{\text{a - ii, b - iv, c - iii, d - i}}$$

Hence, the correct answer is **Option (C)**.

Quick Tip: Remember the keywords: MAR = Address, MDR = Data, IR = Instruction, and PC = Program execution tracking. The register names themselves often reveal their primary function.

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13. In `b = 66.6 / a + 12 * n;`, which operation will be performed first?

(A) `66.6 / a` (B) `12 * n` (C) `a + 12` (D) Depends upon the compiler

Correct Answer: (A) `66.6 / a`

Solution:

Concept: Operator precedence and associativity determine the order in which operations are executed in an expression. Multiplication and division operators have the same precedence level, which is higher than addition and subtraction. When operators have equal precedence, evaluation proceeds from left to right.

Step-by-Step Evaluation:

- **Identify the operators present:** The expression contains division (/), multiplication (*), and addition (+).
- **Apply precedence rules:** Division and multiplication must be evaluated before addition because they belong to the multiplicative precedence level.
- **Apply associativity:** Since division and multiplication have equal precedence, the compiler evaluates them from left to right.
- **Determine the first operation:** Reading the expression from left to right, `66.6 / a` appears before `12 * n`. Therefore, division is performed first.

Conclusion: The first operation executed is `66.6 / a`. Therefore, option **(A)** is correct.

Quick Tip: Whenever multiplication and division appear together without brackets, evaluate them from left to right because they have equal precedence.

---

14. Consider the following instruction.

```
ADD R1, R2, R3
```

What is the meaning of the above instruction?

(A) Add the contents of registers R1 and R2 and place the sum in R3 (B) Add the contents of registers

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R1, R2 and R3 and place the sum in another register (C) Add the contents of registers R2 and R3 and place the sum in R1 (D) Instruction is invalid

Correct Answer: (C) Add the contents of registers R2 and R3 and place the sum in R1

Solution:

Concept: Many assembly language architectures use a three-operand instruction format in which the first operand represents the destination register and the remaining operands represent source registers.

Step-by-Step Analysis:

- **Identify the opcode:** The opcode is `ADD`, which performs arithmetic addition.
- **Identify the destination register:** The first register listed is `R1`. This is where the result will be stored.
- **Identify the source registers:** The second and third registers are `R2` and `R3`. Their contents are used as operands.
- **Perform the operation:** The instruction can be represented as:

$$R1 \leftarrow R2 + R3$$

Thus, the contents of R2 and R3 are added and the result is stored in R1.

Conclusion: The instruction adds the contents of registers **R2** and **R3** and places the result in **R1**. Therefore, option **(C)** is correct.

Quick Tip: In most three-address instruction formats, remember: Destination Register ← Source Register 1 + Source Register 2.

---

15. What is the meaning of 16×8 organization with respect to memory chip?

(A) 8 words of 16 bits each (B) 16 bits × 8 bits (C) 16 words of 8 bits each (D) 16 words of 8 bytes each

Correct Answer: (C) 16 words of 8 bits each

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Solution:

Concept: Memory organization is commonly represented in the form:

$$\text{Number of Words} \times \text{Bits per Word}$$

The first number indicates the total number of addressable memory locations, while the second number indicates the size of each location in bits.

Step-by-Step Evaluation:

- **Interpret the first value:** The number 16 indicates that there are 16 addressable memory words.
- **Interpret the second value:** The number 8 indicates that each word stores 8 bits.
- **Combine the interpretation:** Therefore, the memory chip contains 16 separate memory locations, each capable of storing 8 bits.

Conclusion: A memory organization of 16×8 means **16 words of 8 bits each**. Hence, option **(C)** is correct.

Quick Tip: For memory organization written as $M \times N$, remember: M represents the number of memory locations and N represents the number of bits stored in each location.

---

16. Reservation clerks for Airlines and Hotels check availability for given request and make reservation. These type of users are categorised into _____ with respect to database applications.

(A) Casual end users (B) Parametric end users (C) Sophisticated end users (D) Standalone users

Correct Answer: (B) Parametric end users

Solution:

Concept: Database Management Systems classify users according to how they interact with the database and the complexity of operations they perform.

Step-by-Step Analysis:

- **Parametric End Users:** These users repeatedly execute predefined database transactions

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using forms, menus, and standard interfaces. Examples include bank tellers, reservation clerks, and data-entry operators.

- **Casual End Users:** These users access the database occasionally and may issue different queries whenever needed.
- **Sophisticated End Users:** These users possess advanced knowledge of database systems and often develop complex queries or applications.
- **Standalone Users:** These users maintain personal databases using ready-made software packages.
- **Evaluate the given scenario:** Reservation clerks repeatedly perform tasks such as checking availability, making reservations, and updating booking information through predefined interfaces.

Conclusion: Since reservation clerks perform repetitive transactions through fixed database forms and screens, they are classified as **Parametric End Users**. Therefore, option **(B)** is correct.

Quick Tip: If a user repeatedly performs the same database operation using predefined menus or forms, that user is generally classified as a Parametric (Naive) End User.

17.

The _____ data model which makes it possible to organize data in a collection of records with fixed structure.

(1) Relational Data Model

(2) Network Data Model

(3) Hierarchical Data Model

(4) Object Data Model

Correct Answer: (1) Relational Data Model

Solution:

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Concept:

Data models in Database Management Systems (DBMS) define the logical structure of a database and determine how data is stored, organized, and manipulated.

- **Relational Data Model:** Introduced by E.F. Codd in 1970, this model represents data as a collection of relations (commonly referred to as tables). Each relation consists of rows (records/tuples) and columns (attributes). Every record in a relation follows the same predefined structure.
- **Network Data Model:** Organizes data using a graph-like structure in which records are connected through links, allowing complex many-to-many relationships.
- **Hierarchical Data Model:** Organizes data in a tree-like structure where each child record has only one parent record.
- **Object Data Model:** Represents information in the form of objects that contain both data and methods, following object-oriented principles.

Step 1: Understanding the meaning of "collection of records with fixed structure".

The question emphasizes that the data is organized as a collection of records and that each record follows a fixed structure. A fixed structure means that all records contain the same set of fields or attributes.

For example, in a student table:

Roll No. Name Class Marks

every student record must contain these same columns. The structure remains identical for all records.

Step 2: Identifying the data model that uses fixed-format records.

The Relational Data Model stores data in tables (relations). Each row represents a record, while each column represents an attribute.

Since the schema defines the columns beforehand, every record must conform to the same structure. Therefore, the relational model naturally satisfies the requirement of maintaining records with a fixed structure.

Step 3: Eliminating the other options.

- The **Network Data Model** focuses on relationships between records rather than fixed tabular structures.

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- The **Hierarchical Data Model** organizes records in a parent-child tree structure and is not specifically defined by fixed tabular records.
- The **Object Data Model** stores data as objects and is based on object-oriented concepts rather than fixed relational records.

Therefore, the model that specifically organizes data into records having a fixed structure is the **Relational Data Model**.
Hence, the correct answer is:

Relational Data Model

Quick Tip: Whenever a question mentions tables, rows, columns, tuples, relations, or records having a fixed structure, the answer is generally the **Relational Data Model**.

18.

_____ language is used to define the logical, external and physical schemas and access authorizations.

(1) Data Manipulation Language (DML)

(2) Data Definition Language (DDL)

(3) Logical Definition Language (LDL)

(4) Data-Driven Language (DDL)

Correct Answer: (2) Data Definition Language (DDL)

Solution:

Concept:
A Database Management System (DBMS) provides different categories of languages for managing databases. Each language is designed for a specific purpose.

- **Data Definition Language (DDL):** Used to define, create, modify, and remove database structures such as schemas, tables, indexes, views, and constraints.

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- **Data Manipulation Language (DML):** Used to retrieve, insert, update, and delete data stored inside database tables.
- **Logical Definition Language (LDL):** Not a standard DBMS language category.
- **Data-Driven Language:** Not recognized as a standard database language used for schema definition.

Step 1: Understanding the role of schemas in a database.
A schema is the overall design or blueprint of a database.
Database systems generally deal with:

- Physical Schema
- Logical (Conceptual) Schema
- External Schema

These schemas describe how data is stored, organized, and presented to users.
Step 2: Determining which language defines schemas.
The language responsible for creating and defining database structures is Data Definition Language (DDL).
Examples of DDL commands include:

```
CREATE, ALTER, DROP, TRUNCATE
```

These commands establish the structure of the database and therefore define schemas.
Step 3: Understanding access authorization.
Access authorization refers to permissions and privileges granted to users.
Database systems use definition-related commands and authorization mechanisms to establish who can access various database objects.
Thus, schema definition and authorization management are associated with DDL-related database administration functions.
Step 4: Eliminating incorrect options.

- DML works with data, not schema definitions.
- LDL is not a standard database language.
- Data-Driven Language is not a recognized schema-definition language.

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Therefore, the language used to define logical, external, and physical schemas along with access authorizations is:

Data Definition Language (DDL)

Quick Tip: Remember: **DDL defines the structure**, while **DML manipulates the data**. If the question asks about creating tables, schemas, or database design, think of **DDL**.

19.

Arrange the given list of memories as per the size.

(a) Cache memory

(b) Registers

(c) Secondary memory

(d) Primary memory

(1) (b), (a), (d), (c)

(2) (b), (a), (c), (d)

(3) (a), (b), (c), (d)

(4) (d), (b), (a), (c)

Correct Answer: (1) (b), (a), (d), (c)

Solution:

Concept:

Computer memory is organized in a hierarchy based on speed, cost, and storage capacity.

As we move down the memory hierarchy:

- Storage capacity increases.
- Cost per bit decreases.
- Access speed decreases.

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Step 1: Analyzing Registers.

Registers are located directly inside the CPU and are the fastest memory units available.

Their storage capacity is extremely small, usually measured in bytes.

Hence, registers have the smallest size.

$$\text{Registers} = \text{Smallest Capacity}$$

Step 2: Analyzing Cache Memory.

Cache memory stores frequently used instructions and data close to the CPU.

Its capacity is larger than registers but much smaller than main memory.

$$\text{Registers} < \text{Cache Memory}$$

Step 3: Analyzing Primary Memory.

Primary memory (RAM) stores currently running programs and active data.

Modern computers usually have RAM capacities ranging from several gigabytes to hundreds of gigabytes.

Thus,

$$\text{Cache Memory} < \text{Primary Memory}$$

Step 4: Analyzing Secondary Memory.

Secondary memory includes SSDs, HDDs, and other permanent storage devices.

Its capacity is significantly larger than RAM and is usually measured in gigabytes or terabytes.

Therefore,

$$\text{Primary Memory} < \text{Secondary Memory}$$

Step 5: Writing the complete order.

Combining all comparisons:

$$\text{Registers} < \text{Cache Memory} < \text{Primary Memory} < \text{Secondary Memory}$$

Using the given labels:

$$(b) < (a) < (d) < (c)$$

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Hence, the correct arrangement is:

$$\boxed{(b), (a), (d), (c)}$$

Quick Tip: The increasing order of memory size is always:

Registers → Cache → RAM → Secondary Storage

The larger the memory, the slower it generally becomes.

20.

The control unit of a computer is designed to go through an instruction cycle that is divided into following phases.

(a) Fetch the instruction from memory

(b) Decode the instruction

(c) Execute the instruction

(1) Only (b) and (c) are correct

(2) Only (c) is correct

(3) Only (a) is correct

(4) (a), (b) and (c) are correct

Correct Answer: (4) (a), (b) and (c) are correct

Solution:

Concept:

The CPU executes every program instruction through a sequence known as the **Instruction Cycle** or **Fetch–Decode–Execute Cycle**.

This cycle is controlled by the Control Unit (CU) and repeats continuously while the computer is running.

Step 1: Understanding the Fetch Phase.

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The first step is fetching the instruction from memory.

The Program Counter (PC) stores the address of the next instruction to be executed.

The Control Unit reads this instruction from memory and places it into the Instruction Register (IR).

Therefore, statement (a) is correct.

Fetch Phase

Step 2: Understanding the Decode Phase.

After the instruction is fetched, the Control Unit interprets its meaning.

The opcode is analyzed so that the processor can determine what operation is required.

This process is called decoding.

Therefore, statement (b) is correct.

Decode Phase

Step 3: Understanding the Execute Phase.

Once the instruction has been decoded, the processor performs the required operation.

The Arithmetic Logic Unit (ALU) or other functional units carry out the task.

This phase is called execution.

Therefore, statement (c) is correct.

Execute Phase

Step 4: Determining the final answer.

Since fetching, decoding, and execution are all mandatory phases of the instruction cycle,

$$(a),\ (b),\ (c)$$

are all correct.

Hence, the correct answer is:

(4) (a), (b) and (c) are correct

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Quick Tip: The instruction cycle can always be remembered as:

$$\text{Fetch} \rightarrow \text{Decode} \rightarrow \text{Execute}$$

Every CPU instruction must pass through these three fundamental stages.

21.

Full form of WAMP is _____ with respect to web applications.

(1) Windows, Apache, MySQL and PHP

(2) Word, Adobe, MySQL and PHP

(3) Windows, Apache, Mainstream and Program

(4) Windows, Adobe, MySQL and PHP

Correct Answer: (1) Windows, Apache, MySQL and PHP

Solution:

Concept:

In web application development, a software stack refers to a collection of technologies that work together to build, host, and run dynamic websites and web applications. A typical web stack consists of four major components:

1. An Operating System
2. A Web Server
3. A Database Management System
4. A Server-Side Programming Language

WAMP is one of the most widely used software stacks for developing and testing web applications on Windows-based systems.

Step 1: Understanding the acronym WAMP.

The acronym WAMP is formed from the first letter of each software component included in the stack.

$$W = \text{Windows}$$

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Windows serves as the operating system platform on which the entire stack runs.

$$A = \text{Apache}$$

Apache is a popular open-source web server responsible for handling HTTP requests and serving web pages to users.

$$M = \text{MySQL}$$

MySQL is a Relational Database Management System (RDBMS) used for storing and managing application data.

$$P = \text{PHP}$$

PHP is a server-side scripting language used for generating dynamic web content and interacting with databases.

Step 2: Examining each option.

- **Option (1):** Windows, Apache, MySQL and PHP — All four components are correct.
- **Option (2):** Word and Adobe are not components of the WAMP stack.
- **Option (3):** Mainstream and Program are not recognized technologies in the WAMP acronym.
- **Option (4):** Adobe incorrectly replaces Apache.

Step 3: Selecting the correct answer.

Since WAMP officially stands for:

$$\boxed{\text{Windows, Apache, MySQL and PHP}}$$

the correct option is:

$$\boxed{(1)}$$

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Quick Tip: Remember the common web development stacks:

$$\text{WAMP} = \text{Windows} + \text{Apache} + \text{MySQL} + \text{PHP}$$

$$\text{LAMP} = \text{Linux} + \text{Apache} + \text{MySQL} + \text{PHP}$$

$$\text{MAMP} = \text{macOS} + \text{Apache} + \text{MySQL} + \text{PHP}$$

Only the operating system changes while the remaining components usually remain the same.

22.

Which of the following are valid hexadecimal numbers?

(i) 1A3F

(ii) 29GF

(iii) FF12

(iv) 7BHE

(1) (i), (ii) and (iv)

(2) (i), (ii) and (iii)

(3) (i) and (iii)

(4) (i), (iii) and (iv)

Correct Answer: (3) (i) and (iii)

Solution:

Concept:

The hexadecimal number system is a base-16 number system. Since sixteen distinct symbols are required, hexadecimal uses:

$$0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F$$

where

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$$A = 10, \quad B = 11, \quad C = 12, \quad D = 13, \quad E = 14, \quad F = 15$$

Any character beyond the letter F is not permitted in a hexadecimal number.

Step 1: Checking number (i): 1A3F

The characters present are:

$$1,\ A,\ 3,\ F$$

All of these belong to the valid hexadecimal set.

Therefore,

$$1A3F$$

is a valid hexadecimal number.

Step 2: Checking number (ii): 29GF

The characters present are:

$$2,\ 9,\ G,\ F$$

The letter G does not belong to the hexadecimal digit set.

Therefore,

$$29GF$$

is not a valid hexadecimal number.

Step 3: Checking number (iii): FF12

The characters present are:

$$F,\ F,\ 1,\ 2$$

All characters belong to the hexadecimal digit set.

Therefore,

$$FF12$$

is a valid hexadecimal number.

Step 4: Checking number (iv): 7BHE

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The characters present are:

$$7,\ B,\ H,\ E$$

The letter H is not allowed in hexadecimal notation.

Therefore,

$$7BHE$$

is not a valid hexadecimal number.

Step 5: Writing the final result.

Valid hexadecimal numbers are:

$$(i) \quad \text{and} \quad (iii)$$

Hence, the correct option is:

$$\boxed{\text{(3) } (i) \text{ and } (iii)}$$

Quick Tip: A hexadecimal number can contain only:

$$0-9 \quad \text{and} \quad A-F$$

If you find letters such as G, H, I, J, etc., the number is immediately invalid.

23.

The decimal number 25_{10} is represented in binary as _____.

(1) 1 1 0 0 1

(2) 1 0 1 0 1

(3) 1 1 1 0 0

(4) 1 0 0 1 1

Correct Answer: (1) 1 1 0 0 1

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Solution:

Concept:

To convert a decimal number into binary, we repeatedly divide the number by 2 and record the remainders. The binary representation is obtained by reading the remainders from bottom to top.

Step 1: Perform repeated division by 2.

$$25 \div 2 = 12$$

Remainder:

$$1$$

$$12 \div 2 = 6$$

Remainder:

$$0$$

$$6 \div 2 = 3$$

Remainder:

$$0$$

$$3 \div 2 = 1$$

Remainder:

$$1$$

$$1 \div 2 = 0$$

Remainder:

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$$1$$

Step 2: Write remainders in reverse order.

Reading from bottom to top:

$$1 \quad 1 \quad 0 \quad 0 \quad 1$$

Therefore,

$$25_{10} = 11001_2$$

Step 3: Verification using powers of 2.

$$11001_2$$

$$= (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$$

$$= 16 + 8 + 0 + 0 + 1$$

$$= 25$$

Hence, the conversion is correct.

$$\boxed{11001_2}$$

Quick Tip: To verify a binary number quickly, multiply each bit by its corresponding power of 2 and add the results. If the sum equals the original decimal number, the conversion is correct.

24.

Arrange the following steps in correct order to binary:

(i) Repeat division until becomes 0

(ii) Divide the number by 2

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(iii) Write the remainder

(iv) Write the remainder in reverse order

(1) (i) → (ii) → (iii) → (iv)

(2) (ii) → (iii) → (i) → (iv)

(3) (iii) → (i) → (iv) → (ii)

(4) (iv) → (ii) → (iii) → (i)

Correct Answer: (2) (ii) → (iii) → (i) → (iv)

Solution:

Concept:

Decimal-to-binary conversion follows a systematic algorithm based on repeated division by 2. Every step must be performed in a specific order to obtain the correct binary representation.

Step 1: Identify the first operation.

The process begins by dividing the decimal number by 2.

Therefore, the first step is:

$$(ii)$$

Step 2: Record the remainder.

After every division, the remainder must be noted because it becomes part of the binary representation.

Therefore, the second step is:

$$(iii)$$

Step 3: Continue the process.

The quotient obtained from the division is again divided by 2.

This procedure is repeated until the quotient becomes zero.

Therefore, the third step is:

$$(i)$$

Step 4: Construct the binary number.

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The remainders are generated from least significant bit to most significant bit.

To obtain the final binary number, the remainders are written in reverse order.

Therefore, the final step is:

$$(iv)$$

Step 5: Write the complete sequence.

Hence, the correct order is:

$$(ii) \rightarrow (iii) \rightarrow (i) \rightarrow (iv)$$

Therefore, the correct answer is:

$$\boxed{(2)}$$

Quick Tip: For decimal-to-binary conversion always remember:

Divide → Write Remainder → Repeat → Reverse

This simple sequence helps in solving conversion questions quickly.

25.

Match the Characters in List-I with their correct ASCII Property in List-II.

List - I	List - II
(a) 'A'	(i) ASCII 32 (Decimal)
(b) 'a'	(ii) ASCII 48 (Decimal)
(c) '0' (Zero)	(iii) ASCII 65 (Decimal)
(d) ' ' (Space)	(iv) ASCII differ from (i) by 32

(1) a - i, b - iii, c - iv, d - ii

(2) a - i, b - iv, c - iii, d - ii

(3) a - iii, b - iv, c - i, d - ii

(4) a - iii, b - iv, c - ii, d - i

Correct Answer: (4) a - iii, b - iv, c - ii, d - i

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Solution:

Concept:

ASCII (American Standard Code for Information Interchange) assigns a unique decimal value to every character used in computers.

Some important ASCII values are:

$$\text{Space} = 32$$

$$'0' = 48$$

$$'A' = 65$$

$$'a' = 97$$

Also,

$$97 - 65 = 32$$

Thus lowercase letters have ASCII values exactly 32 greater than their corresponding uppercase letters.

Step 1: Match character 'A'.

The ASCII value of capital A is:

$$65$$

Therefore,

$$a \rightarrow (iii)$$

Step 2: Match character 'a'.

The ASCII value of lowercase a is:

$$97$$

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Since

$$97 - 65 = 32$$

it differs from uppercase A by 32.

Therefore,

$$b \rightarrow (iv)$$

Step 3: Match character '0'.

The ASCII value of zero is:

$$48$$

Therefore,

$$c \rightarrow (ii)$$

Step 4: Match the space character.

The ASCII value of a blank space is:

$$32$$

Therefore,

$$d \rightarrow (i)$$

Step 5: Write the complete matching.

$$a \rightarrow iii$$

$$b \rightarrow iv$$

$$c \rightarrow ii$$

$$d \rightarrow i$$

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Hence, the correct option is:

$$\boxed{(4)\ a-iii,\ b-iv,\ c-ii,\ d-i}$$

Quick Tip: Memorize these three important ASCII values:

$$\text{Space} = 32, \qquad '0' = 48, \qquad 'A' = 65$$

Also remember that lowercase letters are always 32 greater than their corresponding uppercase letters.

26.

A floating point number typically consists of

(i) Sign bit

(ii) Parity bit

(iii) Mantissa (Significand)

(iv) Exponent

(1) (i), (ii) and (iv)

(2) (i), (iii) and (iv)

(3) (ii), (iii) and (iv)

(4) (i), (ii) and (iii)

Correct Answer: (2) (i), (iii) and (iv)

Solution:

Concept:

Floating-point representation is a method used by computers to store and process very large or very small real numbers efficiently. Instead of storing a number directly, the value is represented in a form similar to scientific notation.

A floating-point number is generally represented as:

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$$\text{Value} = (-1)^{\text{Sign}} \times \text{Mantissa} \times \text{Base}^{\text{Exponent}}$$

In modern computer systems, particularly those following the IEEE 754 standard, a floating-point number is divided into three fundamental fields:

1. Sign Bit
2. Exponent
3. Mantissa (Significand)

Step 1: Analyzing the Sign Bit.

The sign bit determines whether the number is positive or negative.

$$0 \Rightarrow \text{Positive Number}$$

$$1 \Rightarrow \text{Negative Number}$$

Since every floating-point number requires a sign indicator, the sign bit is an essential component.

Therefore,

$$(i) \text{ is correct.}$$

Step 2: Analyzing the Parity Bit.

A parity bit is primarily used for error detection during data transmission and memory operations.

Its purpose is to detect accidental changes in stored or transmitted bits.

A parity bit is not part of the mathematical representation of a floating-point number.

Therefore,

$$(ii) \text{ is incorrect.}$$

Step 3: Analyzing the Mantissa (Significand).

The mantissa contains the significant digits of the number and determines the precision of the representation.

For example, in scientific notation:

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$$6.25 \times 10^3$$

the value 6.25 represents the significand or mantissa.

Thus, the mantissa is a mandatory component of floating-point representation.

Therefore,

$$(iii) \text{ is correct.}$$

Step 4: Analyzing the Exponent.

The exponent determines the scale or magnitude of the number.

It specifies how many positions the decimal or binary point should effectively move.

Without the exponent field, very large and very small numbers could not be represented efficiently.

Therefore,

$$(iv) \text{ is correct.}$$

Step 5: Determining the correct combination.

The valid components are:

$$(i),\ (iii),\ (iv)$$

Hence, the correct answer is:

$$\boxed{(2)\ (i),\ (iii) \text{ and } (iv)}$$

Quick Tip: Remember the three basic parts of a floating-point number:

$$\text{Sign Bit} + \text{Exponent} + \text{Mantissa}$$

A parity bit is used for error detection and is not a component of floating-point representation.

27.

Arrange the steps to find two's complement of a binary number:

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(i) Take 1's complement

(ii) Write the binary number

(iii) Add 1

(iv) Obtain final result

(1) (iv) → (i) → (iii) → (ii)

(2) (ii) → (iii) → (i) → (iv)

(3) (ii) → (i) → (iii) → (iv)

(4) (i) → (ii) → (iii) → (iv)

Correct Answer: (3) (ii) → (i) → (iii) → (iv)

Solution:

Concept:

Two's complement is the most widely used method for representing signed binary numbers in computers. It allows both positive and negative integers to be represented using the same binary arithmetic circuitry.

The fundamental rule is:

$$\text{Two's Complement} = \text{One's Complement} + 1$$

To obtain the two's complement of a binary number, a specific sequence of operations must be followed.

Step 1: Write the original binary number.

Before performing any operation, the given binary number must be written.

This corresponds to:

$$(ii)$$

Step 2: Find the 1's complement.

The next step is to invert every bit.

$$0 \rightarrow 1$$

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$$1 \rightarrow 0$$

This operation produces the 1's complement.

This corresponds to:

$$(i)$$

Step 3: Add 1 to the result.

After obtaining the 1's complement, add binary 1.

This converts the 1's complement into the 2's complement.

This corresponds to:

$$(iii)$$

Step 4: Obtain the final result.

The binary number obtained after addition is the required two's complement.

This corresponds to:

$$(iv)$$

Step 5: Writing the correct sequence.

Thus, the complete order is:

$$(ii) \rightarrow (i) \rightarrow (iii) \rightarrow (iv)$$

Hence, the correct answer is:

$$\boxed{(3)}$$

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Quick Tip: To find a two's complement quickly:

1. Write the binary number.
2. Invert all bits.
3. Add 1.

This shortcut always produces the correct two's complement representation.

28.

The result of $101_2 \times 10_2$ is _____.

(1) 1010_2

(2) 1000_2

(3) 1110_2

(4) 1100_2

Correct Answer: (1) 1010_2

Solution:

Concept:

Binary multiplication follows the same principles as decimal multiplication, except that only two digits are available:

$$0 \quad \text{and} \quad 1$$

The basic multiplication rules are:

$$0 \times 0 = 0$$

$$0 \times 1 = 0$$

$$1 \times 0 = 0$$

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$$1 \times 1 = 1$$

Step 1: Perform binary multiplication directly.

Given:

$$101_2 \times 10_2$$

Since

$$10_2 = 2_{10}$$

multiplying by 10_2 is equivalent to shifting the number one position to the left.

$$101_2 \rightarrow 1010_2$$

Thus,

$$101_2 \times 10_2 = 1010_2$$

Step 2: Verification using decimal conversion.

Convert 101_2 to decimal:

$$101_2 = 1(2^2) + 0(2^1) + 1(2^0)$$

$$= 4 + 0 + 1$$

$$= 5_{10}$$

Convert 10_2 to decimal:

$$10_2 = 2_{10}$$

Multiply:

$$5 \times 2 = 10$$

Convert 10_{10} back to binary:

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$$10_{10} = 1010_2$$

The answer is verified.

Hence,

$$\boxed{1010_2}$$

Quick Tip: Multiplying a binary number by:

$$10_2$$

simply shifts the number one bit to the left.

Similarly,

$$100_2$$

shifts by two positions and

$$1000_2$$

shifts by three positions.

29.

Match the binary operations in List-I with correct results in List-II.

List - I		List - II	
(a)	1 + 1	(i)	1
(b)	10 - 1	(ii)	10
(c)	1 × 0	(iii)	11
(d)	11 ÷ 1	(iv)	0

(1) a - ii, b - i, c - iv, d - iii

(2) a - iii, b - ii, c - iv, d - i

(3) a - ii, b - iii, c - i, d - iv

(4) a - i, b - v, c - ii, d - iii

Correct Answer: (1) a - ii, b - i, c - iv, d - iii

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Solution:

Concept:

Binary arithmetic follows the same mathematical principles as decimal arithmetic but uses only two digits:

$$0 \quad \text{and} \quad 1$$

Let us evaluate each operation individually.

Step 1: Evaluate (a) $1+1$.

In binary:

$$1+1=10_2$$

Thus,

$$a \rightarrow ii$$

Step 2: Evaluate (b) $10-1$.

Convert to decimal:

$$10_2=2_{10}$$

$$2-1=1$$

Therefore,

$$10_2-1_2=1_2$$

Thus,

$$b \rightarrow i$$

Step 3: Evaluate (c) 1×0.

Any number multiplied by zero gives zero.

$$1 \times 0=0$$

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Thus,

$$c \rightarrow iv$$

Step 4: Evaluate (d) $11 \div 1$.

Any number divided by one remains unchanged.

$$11 \div 1 = 11$$

Thus,

$$d \rightarrow iii$$

Step 5: Writing the final matching.

$$a \rightarrow ii$$

$$b \rightarrow i$$

$$c \rightarrow iv$$

$$d \rightarrow iii$$

Hence, the correct option is:

$$\boxed{(1)}$$

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Quick Tip: Memorize these important binary arithmetic facts:

$$1 + 1 = 10$$

$$1 \times 0 = 0$$

$$N \div 1 = N$$

These simple rules help solve many binary arithmetic questions instantly.

30.

Which scheduling algorithm works on the principles of time slices?

(1) FCFS

(2) Round Robin

(3) SJF

(4) Priority Scheduling

Correct Answer: (2) Round Robin

Solution:

Concept:

CPU scheduling is a mechanism used by the operating system to decide which process should receive CPU time whenever multiple processes are waiting for execution.

Different scheduling algorithms use different criteria for selecting processes.

One important concept in modern operating systems is the **time slice** or **time quantum**.

A time slice is a fixed amount of CPU time allocated to a process before the CPU is reassigned to another process.

Step 1: Understanding FCFS Scheduling.

FCFS stands for First-Come First-Served.

Processes are executed strictly in the order in which they arrive.

Once a process gets the CPU, it continues execution until completion or blocking.

No time slices are used.

Therefore, FCFS is incorrect.

Step 2: Understanding Round Robin Scheduling.

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Round Robin scheduling is specifically designed for time-sharing systems.

Each process receives a fixed time quantum.

After the quantum expires:

- The running process is interrupted.
- It is moved to the end of the ready queue.
- The next process receives CPU time.

This cyclic allocation continues until all processes finish execution.

Therefore, Round Robin directly operates on the principle of time slices.

Step 3: Understanding SJF Scheduling.

Shortest Job First selects the process having the smallest CPU burst time.

Its selection criterion is execution time, not time quantum.

Therefore, SJF is incorrect.

Step 4: Understanding Priority Scheduling.

Priority Scheduling allocates the CPU according to process priority values.

The process with the highest priority executes first.

Its primary criterion is priority, not time slices.

Therefore, Priority Scheduling is incorrect.

Step 5: Determining the final answer.

Among all the given scheduling algorithms, only Round Robin uses a fixed time quantum for process execution.

Hence, the correct answer is:

Round Robin

or

(2)

Quick Tip: Whenever a question mentions **time slice**, **time quantum**, or **time-sharing systems**, immediately think of **Round Robin Scheduling**. It is the scheduling algorithm most closely associated with fair CPU sharing among multiple processes.

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31.

Which of the following are the characteristics of Real Time Operating Systems (RTOS)?

(i) Deterministic response

(ii) High latency allowed

(iii) Strict timing constraints

(iv) Used in embedded systems

(1) (i) and (iii) only

(2) (i), (iii) and (iv) only

(3) (ii) and (iv) only

(4) (i), (ii) and (iii) only

Correct Answer: (2) (i), (iii) and (iv) only

Solution:

Concept:

A Real Time Operating System (RTOS) is a specialized operating system designed for applications where the correctness of a computation depends not only on the logical correctness of the result but also on the time at which the result is produced. In real-time environments, tasks must be completed within predefined deadlines, and failure to meet these deadlines may lead to system malfunction.

Unlike general-purpose operating systems that focus primarily on maximizing throughput and resource utilization, RTOS focuses on predictability, reliability, and timely response. RTOS is widely used in embedded systems such as industrial automation systems, robotics, automotive control systems, medical devices, avionics, telecommunications equipment, and consumer electronics.

- **Deterministic Response:** The system must provide predictable and guaranteed response times.

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- **Low Latency:** Interrupts and events must be serviced within a very short and bounded time.
- **Strict Timing Constraints:** Tasks must complete before their specified deadlines.
- **Embedded System Usage:** RTOS is commonly deployed in embedded devices that perform dedicated functions.

Step 1: Analyzing statement (i) – Deterministic response.

One of the most important features of an RTOS is deterministic behavior. Determinism means that the operating system can guarantee a known maximum response time for handling interrupts, scheduling tasks, and executing critical operations.

Whenever a particular event occurs, the response time remains predictable and bounded rather than varying unpredictably.

Therefore, statement (i) is correct.

Step 2: Analyzing statement (ii) – High latency allowed.

Latency refers to the delay between the occurrence of an event and the system's response to that event.

In real-time systems, latency must be extremely low because delayed responses may lead to incorrect operation or even system failure.

For example:

- Airbag deployment systems require immediate response.
- Industrial robots must react within precise timing limits.
- Medical monitoring devices cannot tolerate excessive delays.

Since RTOS is specifically designed to minimize latency rather than allow high latency, statement (ii) is incorrect.

Step 3: Analyzing statement (iii) – Strict timing constraints.

A defining characteristic of RTOS is the existence of strict timing requirements.

Tasks are often associated with deadlines that must be met. In many real-time applications, producing the correct result after the deadline is considered equivalent to producing an incorrect result.

Examples include:

- Flight control systems

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- Missile guidance systems
- Traffic signal controllers
- Cardiac pacemakers

Therefore, statement (iii) is correct.

Step 4: Analyzing statement (iv) – Used in embedded systems.

RTOS is extensively used in embedded systems because embedded devices often interact directly with hardware sensors and actuators that require precise timing.

Examples include:

- Washing machines
- Automotive engine control units
- Smart televisions
- Industrial controllers
- Medical instruments

Hence, statement (iv) is also correct.

Step 5: Identifying the correct combination.

After evaluating all statements:

(i) Deterministic response ✓

(ii) High latency allowed ×

(iii) Strict timing constraints ✓

(iv) Used in embedded systems ✓

Thus, the correct set of characteristics is:

$$(i),\ (iii) \text{ and } (iv)$$

Therefore, the correct answer is:

Option (2)

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Quick Tip: Remember the keyword for RTOS: **Predictability**. An RTOS is designed to provide deterministic behavior, low latency, and guaranteed deadline compliance. Whenever you see terms such as **strict timing**, **deadline**, **embedded systems**, or **deterministic response**, think of a Real Time Operating System.

32.

Arrange the steps in process state transition.

(i) Running

(ii) Ready

(iii) New

(iv) Waiting

(1) (i) → (ii) → (iii) → (iv)

(2) (iii) → (ii) → (i) → (iv)

(3) (iv) → (i) → (ii) → (iii)

(4) (ii) → (i) → (iii) → (iv)

Correct Answer: (2) (iii) → (ii) → (i) → (iv)

Solution:

Concept:

A process is a program that is currently being executed. During its lifetime, a process passes through several states managed by the operating system. These states help the operating system track the progress of every process and allocate system resources efficiently.

The standard process states are:

- **New:** The process is being created.
- **Ready:** The process is prepared to execute and is waiting for CPU allocation.

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- **Running:** The CPU is currently executing the process instructions.
- **Waiting (Blocked):** The process is waiting for an event such as I/O completion.
- **Terminated:** The process has completed execution.

Step 1: Identifying the initial state.

Whenever a user starts a program, the operating system first creates a process and allocates a Process Control Block (PCB).

At this stage, the process enters the **New** state.

Therefore, the first state is:

(iii) New

Step 2: Moving to the Ready state.

After creation, the operating system loads the necessary information into memory and places the process in the ready queue.

The process is now ready to execute but is waiting for CPU allocation.

Thus, the next state is:

(ii) Ready

Step 3: Transitioning to Running state.

The CPU scheduler selects one process from the ready queue and assigns the CPU to it.

The process now starts executing instructions.

Hence, the process enters:

(i) Running

Step 4: Transitioning to Waiting state.

While executing, the process may need to perform an I/O operation such as:

- Reading a file
- Receiving network data
- Waiting for keyboard input

During this period, the process cannot continue execution and enters the Waiting (Blocked) state.

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Thus, the next state becomes:

$$(iv)\ \text{Waiting}$$

Step 5: Constructing the correct sequence.

Combining all transitions:

$$\text{New} \rightarrow \text{Ready} \rightarrow \text{Running} \rightarrow \text{Waiting}$$

or

$$(iii) \rightarrow (ii) \rightarrow (i) \rightarrow (iv)$$

Hence, the correct answer is:

$$\boxed{\text{Option (2)}}$$

Quick Tip: A simple way to remember the process lifecycle is:

$$\text{New} \rightarrow \text{Ready} \rightarrow \text{Running} \rightarrow \text{Waiting}$$

Think of it as: **Created → Waiting for CPU → Executing → Waiting for Resource**.

33.

Match the operating systems in List-I with their correct characteristics in List-II.

	List - I		List - II
(a)	Batch OS	(i)	Immediate response required
(b)	Real Time OS	(ii)	No user interaction
(c)	Time Sharing OS	(iii)	Multiuser share CPU
(d)	Distributed OS	(iv)	Multiple systems connected

Codes:

(1) a - ii, b - i, c - iii, d - iv

(2) a - ii, b - i, c - iv, d - iii

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(3) a - iii, b - iv, c - i, d - ii

(4) a - iii, b - i, c - iv, d - ii

Correct Answer: (1) a - ii, b - i, c - iii, d - iv

Solution:

Concept:

Different operating systems are designed to satisfy different computing requirements. Understanding their characteristics helps in identifying their applications and behavior.

Let us analyze each operating system individually and match it with its defining feature.

Step 1: Matching (a) Batch Operating System.

A Batch Operating System executes jobs in groups called batches.

The user submits jobs and does not interact with the computer while the jobs are running.

Characteristics include:

- No direct user interaction
- Jobs processed sequentially
- Suitable for repetitive tasks

Therefore:

$$\text{Batch OS} \rightarrow \text{No user interaction}$$

Hence:

$$a \rightarrow ii$$

Step 2: Matching (b) Real Time Operating System.

A Real Time Operating System must respond immediately to external events.

Examples include:

- Air traffic control systems
- Industrial automation
- Medical monitoring systems

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Thus:

$$\text{Real Time OS} \rightarrow \text{Immediate response required}$$

Hence:

$$b \rightarrow i$$

Step 3: Matching (c) Time Sharing Operating System.

Time-sharing systems divide CPU time among multiple users.

Each user receives a small time quantum, creating the illusion that everyone has dedicated access to the machine.

Therefore:

$$\text{Time Sharing OS} \rightarrow \text{Multiuser share CPU}$$

Hence:

$$c \rightarrow iii$$

Step 4: Matching (d) Distributed Operating System.

A Distributed Operating System manages multiple interconnected computers and presents them as a single unified system.

Characteristics include:

- Resource sharing
- Parallel processing
- Network-based communication

Therefore:

$$\text{Distributed OS} \rightarrow \text{Multiple systems connected}$$

Hence:

$$d \rightarrow iv$$

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Step 5: Writing the final matching.

$$a \to ii, \qquad b \to i, \qquad c \to iii, \qquad d \to iv$$

This corresponds exactly to:

Option (1)

Quick Tip: Remember these standard associations:

- **Batch OS** → No user interaction
- **RTOS** → Immediate response
- **Time Sharing OS** → Multiple users share CPU
- **Distributed OS** → Multiple interconnected systems

These four matches frequently appear in competitive examinations.

34.

In a class exam, Ramya's average mark was 90 per paper. If she had obtained 4 more marks in Maths paper and 20 more marks in Physics paper, then her average per paper would have been 94. How many papers were there in the exam?

(1) 6

(2) 8

(3) 9

(4) 7

Correct Answer: (1) 6

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Solution:

Concept:

The average of a set of observations is defined as:

$$\text{Average} = \frac{\text{Total Sum of Observations}}{\text{Number of Observations}}$$

From this formula:

$$\text{Total Sum} = \text{Average} \times \text{Number of Observations}$$

Whenever some marks are added or removed, the total sum changes accordingly, causing a change in the average.

Step 1: Assume the number of papers.

Let the number of papers be:

$$n$$

Given that Ramya's average mark was 90 per paper.

Therefore, the total marks obtained originally are:

$$90n$$

Step 2: Calculate the increase in total marks.

According to the question:

- Additional marks in Mathematics $= 4$
- Additional marks in Physics $= 20$

Hence, total additional marks:

$$4 + 20 = 24$$

Therefore, the new total marks become:

$$90n + 24$$

Step 3: Use the new average.

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After adding these marks, the average becomes:

$$94$$

Since the number of papers remains unchanged,

$$\text{New Total Marks} = 94n$$

Therefore:

$$94n = 90n + 24$$

Step 4: Solve the equation.

Subtract $90n$ from both sides:

$$94n - 90n = 24$$

$$4n = 24$$

Dividing both sides by 4:

$$n = \frac{24}{4}$$

$$n = 6$$

Step 5: Verification.

Original total marks:

$$90 \times 6 = 540$$

Additional marks:

$$24$$

New total marks:

$$540 + 24 = 564$$

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New average:

$$\frac{564}{6} = 94$$

The condition is satisfied perfectly.

Therefore, the number of papers is:

$$\boxed{6}$$

Hence, the correct answer is:

$$\boxed{\text{Option (1)}}$$

Quick Tip: For average-based questions involving extra marks:

$$\text{Number of Items} = \frac{\text{Change in Total Sum}}{\text{Change in Average}}$$

Here,

$$\frac{24}{94-90} = \frac{24}{4} = 6$$

This shortcut can solve many average problems within a few seconds.

---

35. In a two digit number, the digit in the unit's place is equal to the square of the digit in ten's place and the difference between the numbers obtained by interchanging the digits is 54. What is 40% of the original number?

(1) 23.4

(2) 15.6

(3) 37.2

(4) 39

Correct Answer: (2) 15.6

Solution:

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Concept:

A two-digit number can be represented as:

$$N = 10x + y$$

where x is the ten's digit and y is the unit's digit.

When the digits are interchanged, the new number becomes:

$$N' = 10y + x$$

Step 1: Form the equations

Given that the unit's digit is the square of the ten's digit:

$$y = x^2$$

Also, the difference between the interchanged number and the original number is 54:

$$(10y + x) - (10x + y) = 54$$

$$9(y - x) = 54$$

$$y - x = 6$$

Step 2: Solve for the digits

Substituting $y = x^2$:

$$x^2 - x = 6$$

$$x^2 - x - 6 = 0$$

$$(x - 3)(x + 2) = 0$$

Since a digit cannot be negative,

$$x = 3$$

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Therefore,

$$y = 3^2 = 9$$

Hence, the original number is:

$$39$$

Step 3: Find 40% of the number

$$40\% \text{ of } 39 = \frac{40}{100} \times 39$$

$$= 15.6$$

Therefore, the required value is:

$$\boxed{15.6}$$

Quick Tip: For any two-digit number, the difference between the number formed by reversing its digits and the original number is always a multiple of 9:

$$(10y + x) - (10x + y) = 9(y - x)$$

Use this shortcut to solve digit-reversal problems quickly.

36.

A set of letters and numbers are arranged in certain order where some of them are missing.

$$1 \quad \_ \quad 7g \quad \_ \quad c8 \quad \_ \quad \_ \quad b$$

Choose the correct order of appearing in the missing places.

(1) 3 h a 2

(2) a h 2 3

(3) a 3 h 2

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(4) 2 3 h a

Correct Answer: (3) a 3 h 2

Solution:

Concept:

The sequence follows the relationship between letters and their corresponding alphabetical positions:

$$a = 1, \quad b = 2, \quad c = 3, \quad d = 4, \quad e = 5, \quad f = 6, \quad g = 7, \quad h = 8$$

Step 1: Observe the given pairs

The sequence can be grouped as:

$$(1, \_) \quad (7, g) \quad (\_, c) \quad (8, \_) \quad (\_, b)$$

Notice that:

$$7 \leftrightarrow g$$

since g is the 7th letter of the alphabet.

Thus, each number is paired with its corresponding letter.

Step 2: Fill the blanks

- 1 corresponds to a

$$\text{Blank } 1 = a$$

- c is the 3rd letter

$$\text{Blank } 2 = 3$$

- 8 corresponds to h

$$\text{Blank } 3 = h$$

- b is the 2nd letter

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$$\text{Blank } 4 = 2$$

Step 3: Write the missing terms in order

$$a,\ 3,\ h,\ 2$$

Hence, the correct arrangement is:

$$\boxed{a\ 3\ h\ 2}$$

which corresponds to **Option (3)**.

Quick Tip: In alphanumeric series, always check whether letters correspond to their alphabetical positions:

$$a = 1,\ b = 2,\ c = 3,\ \ldots,\ z = 26$$

Many reasoning questions are based on this simple relationship.

---

37. In a certain code language, SHORE is written as PELOB, then match the following original letters in List-I that are coded in List-II.

List-I		List-II	
(a)	B	(i)	W
(b)	Z	(ii)	G
(c)	Q	(iii)	N
(d)	J	(iv)	Y

Codes: (1) a - iv, b - i, c - ii, d - iii

(2) a - iv, b - i, c - iii, d - ii

(3) a - iii, b - i, c - ii, d - iv

(4) a - ii, b - iii, c - i, d - iv

Correct Answer: (2) a - iv, b - i, c - iii, d - ii

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Solution:

Concept:

Coding-decoding questions are solved by identifying the relationship between the original word and its coded form. The given example shows that every letter is shifted by a fixed number of positions in the English alphabet.

Step 1: Determine the coding rule

Given:

$$\text{SHORE} \rightarrow \text{PELOB}$$

Let us compare corresponding letters:

Original	S	H	O	R	E
Code	P	E	L	O	B

Converting to alphabetical positions:

$$S(19) \rightarrow P(16)$$

$$H(8) \rightarrow E(5)$$

$$O(15) \rightarrow L(12)$$

$$R(18) \rightarrow O(15)$$

$$E(5) \rightarrow B(2)$$

Each coded letter is obtained by moving **3 positions backward** in the alphabet.

Thus,

$$\text{Code Letter} = \text{Original Letter} - 3$$

Step 2: Apply the rule to List-I

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- **(a) B**

$$B \rightarrow Y$$

(three positions backward with wrap-around)

Hence,

$$a \rightarrow iv$$

- **(b) Z**

$$Z \rightarrow W$$

Hence,

$$b \rightarrow i$$

- **(c) Q**

$$Q \rightarrow N$$

Hence,

$$c \rightarrow iii$$

- **(d) J**

$$J \rightarrow G$$

Hence,

$$d \rightarrow ii$$

Step 3: Final Matching

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$$a \to iv, \qquad b \to i, \qquad c \to iii, \qquad d \to ii$$

This corresponds to **Option (2)**.

Quick Tip: When a coding-decoding problem shows a constant shift between letters, convert the letters into their alphabetical positions and check the difference. Here, every coded letter is obtained by moving three positions backward in the alphabet.

38.

No reptiles can fly. All birds can fly.

Which of the following must be true?

(1) No birds are reptiles

(2) All reptiles can fly

(3) All flying creatures are birds

(4) Some birds are reptiles

Correct Answer: (1) No birds are reptiles

Solution:

Concept:

This is a syllogism problem based on set relationships.

Let:

$$R = \text{Reptiles}, \quad F = \text{Flying creatures}, \quad B = \text{Birds}$$

Given:

$$R \cap F = \emptyset$$

(No reptiles can fly)

and

$$B \subseteq F$$

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(All birds can fly)

Since all birds belong to the set of flying creatures and no reptile belongs to the set of flying creatures, birds and reptiles cannot overlap.

$$B \cap R = \emptyset$$

Therefore,

$$\boxed{\text{No birds are reptiles}}$$

Hence, Option (1) is correct.

Quick Tip: If Set A is completely inside Set B and Set B has no common elements with Set C, then Set A and Set C can never overlap.

39.

Which one of the following number is completely divisible by 45?

(1) 181566

(2) 331145

(3) 242865

(4) 2023550

Correct Answer: (3) 242865

Solution:

Concept:

A number is divisible by 45 if it is divisible by both 5 and 9.

$$45 = 5 \times 9$$

Rules:

- Divisible by 5 $\Rightarrow$ last digit must be 0 or 5.
- Divisible by 9 $\Rightarrow$ sum of digits must be divisible by 9.

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Checking Option (3):

$$242865$$

Last digit $= 5$

Therefore, divisible by 5.

Sum of digits:

$$2+4+2+8+6+5=27$$

Since

$$27 \div 9 = 3$$

the number is divisible by 9.

Hence,

$$242865$$

is divisible by both 5 and 9.

Therefore, it is divisible by 45.

$$\boxed{242865}$$

Hence, Option (3) is correct.

Quick Tip: To test divisibility by 45, simply check divisibility by 5 and 9 separately.

40.

A class of 30 students comprises of boys who can play cricket, hockey and/or football. 3 boys play only cricket, 3 boys play only hockey and 2 play only football. 4 boys could play all 3 games, while 11 could play football and cricket and 10 boys could play football and hockey. How many boys played cricket and hockey but not football?

(1) 1

(2) 3

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(3) 4

(4) 5

Correct Answer: (4) 5

Solution:

Concept:

Use a three-set Venn diagram.

Let:

- Cricket $= C$
- Hockey $= H$
- Football $= F$

Given:

$$\text{Only Cricket} = 3$$

$$\text{Only Hockey} = 3$$

$$\text{Only Football} = 2$$

$$C \cap H \cap F = 4$$

Also,

$$|C \cap F| = 11$$

Therefore,

$$(C \cap F \text{ only}) = 11 - 4 = 7$$

Similarly,

$$|H \cap F| = 10$$

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Hence,

$$(H \cap F \text{ only}) = 10 - 4 = 6$$

Let

$$x = (C \cap H \text{ only})$$

Since total students are 30,

$$3 + 3 + 2 + 7 + 6 + 4 + x = 30$$

$$25 + x = 30$$

$$x = 5$$

Therefore,

$$\boxed{5}$$

Hence, the number of boys who played cricket and hockey but not football is 5.

Quick Tip: For three-set Venn diagram problems, fill the central intersection first, then subtract it from the pairwise intersections before using the total.

---

41. Five groups of letters are given. One of these groups is different from the other four. Find the odd one.

YDEUZ, ASHBR, OZPEQ, AXCMF, HLXEF

(1) YDEUZ

(2) ASHBR

(3) OZPEQ

(4) AXCMF

Correct Answer: (4) AXCMF

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Solution:

Concept:

In classification problems, we compare the internal relationships among the letters of each group. A useful approach is to convert the letters into their alphabetical positions:

$$A = 1,\ B = 2,\ \ldots,\ Z = 26$$

and check for any common pattern.

Step 1: Examine the letter positions.

$$\text{YDEUZ} : 25,\ 4,\ 5,\ 21,\ 26$$

$$\text{ASHBR} : 1,\ 19,\ 8,\ 2,\ 18$$

$$\text{OZPEQ} : 15,\ 26,\ 16,\ 5,\ 17$$

$$\text{AXCMF} : 1,\ 24,\ 3,\ 13,\ 6$$

$$\text{HLXEF} : 8,\ 12,\ 24,\ 5,\ 6$$

Step 2: Look for consecutive alphabet pairs.

- **YDEUZ**: D(4) and E(5) are consecutive; Y(25) and Z(26) are consecutive.
- **ASHBR**: A(1) and B(2) are consecutive; S(19) and R(18) are consecutive.
- **OZPEQ**: O(15), P(16), and Q(17) occur consecutively.
- **HLXEF**: E(5) and F(6) are consecutive.
- **AXCMF**: A(1), X(24), C(3), M(13), F(6) contain **no pair of consecutive letters**.

Step 3: Identify the odd group.

All the groups except **AXCMF** contain at least one pair of consecutive alphabet letters. Therefore, **AXCMF** is different from the others.

$$\boxed{\text{AXCMF}}$$

Hence, the correct answer is **Option (4)**.

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Quick Tip: In odd-one-out letter-group questions, convert letters into their alphabetical positions and look for common patterns such as consecutive letters, equal gaps, symmetry, or reverse-order relationships. The group that breaks the common pattern is the answer.

---

42. If 15^{th} August, 2023 was on Tuesday, then on which day of the week would the Independence Day be celebrated in the year 2040?

(1) Tuesday

(2) Wednesday

(3) Thursday

(4) Friday

Correct Answer: (2) Wednesday

Solution:

Concept:

To determine the day of the week for a future date, we calculate the total number of odd days between the two dates.

- A normal year contributes 1 odd day.
- A leap year contributes 2 odd days.
- A leap year occurs when the year is divisible by 4 (for non-centurial years).

Step 1: Calculate the number of years between the two dates.

$$2040 - 2023 = 17 \text{ years}$$

Thus, the period from 15^{th} August 2023 to 15^{th} August 2040 spans 17 years.

Step 2: Count the leap years in this interval.

The leap years occurring before 15^{th} August 2040 are:

$$2024,\ 2028,\ 2032,\ 2036,\ 2040$$

Hence,

$$\text{Number of leap years} = 5$$

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Step 3: Calculate the total odd days.

Every year contributes one odd day, and each leap year contributes one additional odd day.

$$\text{Total Odd Days} = 17 + 5 = 22$$

Now,

$$22 \mod 7 = 1$$

Therefore, there is a net advancement of 1 day.

Step 4: Determine the required day.

Given:

$$15^{\text{th}} \text{ August, } 2023 = \text{Tuesday}$$

Adding 1 day:

$$\text{Tuesday} + 1 = \text{Wednesday}$$

Hence, Independence Day in the year 2040 will be celebrated on **Wednesday**.

Quick Tip: For the same date in different years, use the shortcut:

$$\text{Odd Days} = (\text{Year Difference} + \text{Number of Leap Years}) \pmod 7$$

Then move forward that many days from the given weekday.

---

43. Consider the following equations I and II.

$$\text{I}: \sqrt{1\frac{9}{16}} = 1\frac{1}{4}$$

$$\text{II}: \sqrt[3]{2744} = 2 \times 7\sqrt{7}$$

(1) I and II are correct

(2) I is incorrect, II is correct

(3) I is correct, II is incorrect

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(4) I and II are incorrect

Correct Answer: (3) I is correct, II is incorrect

Solution:

Concept:

To verify the correctness of the given equations, evaluate both sides independently.

Step 1: Check Equation I.

Convert the mixed fraction into an improper fraction:

$$1\frac{9}{16} = \frac{16+9}{16} = \frac{25}{16}$$

Taking square root:

$$\sqrt{\frac{25}{16}} = \frac{5}{4}$$

Now,

$$1\frac{1}{4} = \frac{5}{4}$$

Hence,

$$\sqrt{1\frac{9}{16}} = 1\frac{1}{4}$$

Therefore, Equation I is correct.

Step 2: Check Equation II.

$$2744 = 14^3$$

Therefore,

$$\sqrt[3]{2744} = 14$$

But,

$$2 \times 7\sqrt{7} = 14\sqrt{7}$$

Since

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$$14 \neq 14\sqrt{7},$$

Equation II is incorrect.

Step 3: Conclusion.

Equation I is correct and Equation II is incorrect.

Option (3)

Quick Tip: Remember the perfect cube:

$$14^3 = 2744$$

This allows you to evaluate $\sqrt[3]{2744}$ instantly.

---

44. If $A \star B$ means A and B are of the same age, and $A - B$ means B is younger than A, then Himani $\star$ Mahesh $-$ Jay means:

(1) Himani is younger than Jay

(2) Mahesh is younger than Jay

(3) Jay is the youngest

(4) Jay is the oldest

Correct Answer: (3) Jay is the youngest

Solution:

Concept:

Translate the symbols into age relations.

$$A \star B \Rightarrow A \text{ and } B \text{ are of the same age}$$

$$A - B \Rightarrow B \text{ is younger than } A$$

Step 1: Interpret the first relation.

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$$\text{Himani} \star \text{Mahesh}$$

means

$$H = M$$

where H and M denote the ages of Himani and Mahesh respectively.

Step 2: Interpret the second relation.

$$\text{Mahesh} - \text{Jay}$$

means Jay is younger than Mahesh.

$$M > J$$

Step 3: Combine the relations.

Since

$$H = M$$

and

$$M > J,$$

we get

$$H = M > J$$

Thus, Jay is younger than both Himani and Mahesh.

$$\boxed{\text{Jay is the youngest}}$$

Hence, the correct answer is **Option (3)**.

Quick Tip: Convert coded relations immediately into mathematical symbols such as $=$, $>$, and $<$. This makes the comparison straightforward.

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45. If the sum of two numbers is 10 and the difference of their squares is 20, then these numbers are:

(1) 8 and 2

(2) 6 and 4

(3) 7 and 3

(4) 5 and 5

Correct Answer: (2) 6 and 4

Solution:

Concept:

Use the identity

$$a^2 - b^2 = (a - b)(a + b)$$

Step 1: Form the equations.

Let the numbers be x and y.

Given:

$$x + y = 10$$

and

$$x^2 - y^2 = 20$$

Using the identity:

$$(x - y)(x + y) = 20$$

Substituting $x + y = 10$,

$$10(x - y) = 20$$

$$x - y = 2$$

Step 2: Solve simultaneously.

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$$x + y = 10$$

$$x - y = 2$$

Adding,

$$2x = 12$$

$$x = 6$$

Substituting into $x + y = 10$,

$$y = 4$$

Thus, the two numbers are

$$\boxed{6 \text{ and } 4}$$

Hence, the correct answer is **Option (2)**.

Quick Tip: If both $x + y$ and $x^2 - y^2$ are given, first use

$$x^2 - y^2 = (x - y)(x + y)$$

to find $x - y$, then solve the two linear equations.

---

46. A figure consists of a triangle attached to a square such that the triangle points up. If the figure is rotated 90° clockwise, then where will the triangle point?

(1) Left

(2) Right

(3) Downward

(4) Upward

Correct Answer: (2) Right

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Solution:

Concept:

A clockwise rotation turns an object in the same direction as the hands of a clock.

$$\text{Up} \rightarrow \text{Right} \rightarrow \text{Down} \rightarrow \text{Left}$$

for every successive 90° clockwise rotation.

Step 1: Identify the initial direction.

The triangle initially points upward.

$$\text{Direction} = \text{Up}$$

Step 2: Apply the rotation.

A 90° clockwise rotation moves the direction one quarter-turn clockwise.

$$\text{Up} \xrightarrow{90^\circ \text{ clockwise}} \text{Right}$$

Step 3: Conclusion.

After rotation, the triangle points to the right.

$$\boxed{\text{Right}}$$

Hence, the correct answer is **Option (2)**.

Quick Tip: Think of a clock face: moving 90° clockwise from 12 o'clock reaches 3 o'clock, which corresponds to the right direction.

---

47. Distribution of total number of cellular phones sold by six stores in December, 2025 is given in the following pie chart.

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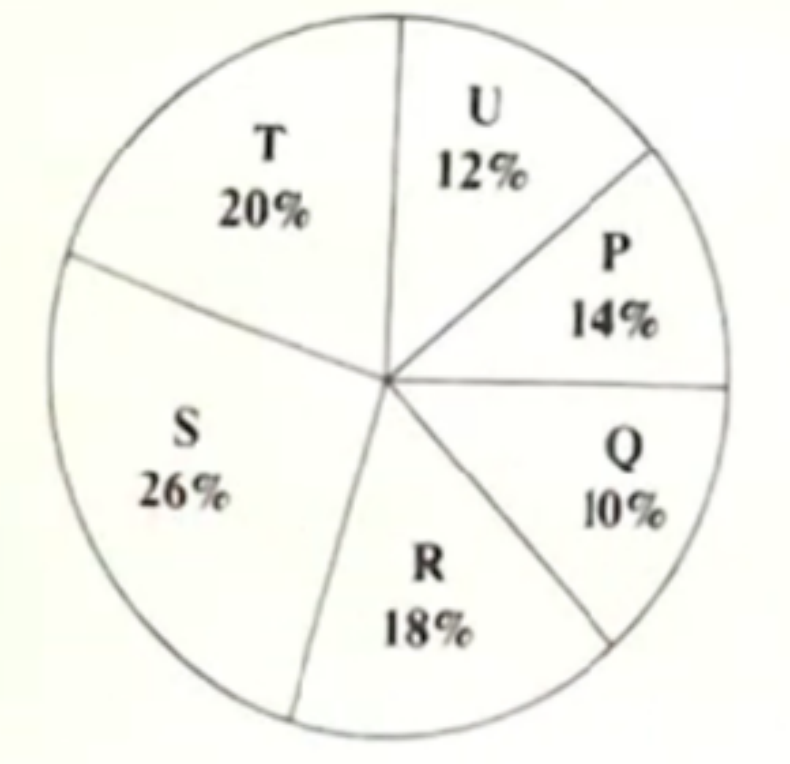

What is the central angle corresponding to the total number of cellular phones sold by S?

(1) 99.2°

(2) 93.6°

(3) 105.6°

(4) 97.4°

Correct Answer: (2) 93.6°

Solution:

Concept:

A pie chart is a circular graphical representation of data in which the entire circle represents the total value or 100% of the data. Since a complete circle contains 360°, each category occupies a sector proportional to its percentage share.

The central angle corresponding to any category is calculated using:

$$\text{Central Angle} = \left(\frac{\text{Percentage of the Category}}{100}\right) \times 360^\circ$$

This formula converts the percentage share into an equivalent angular measure.

Step 1: Identify the percentage share of store S.

From the given pie-chart distribution:

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$$T = 20\%, \quad U = 12\%, \quad P = 14\%, \quad Q = 10\%, \quad R = 18\%, \quad S = 26\%$$

Therefore,

$$\text{Percentage corresponding to Store S} = 26\%$$

Step 2: Apply the formula for central angle.

Using

$$\text{Central Angle} = \frac{\text{Percentage}}{100} \times 360^\circ$$

Substituting the value of Store S:

$$\text{Central Angle} = \frac{26}{100} \times 360^\circ$$

$$= 0.26 \times 360^\circ$$

$$= 93.6^\circ$$

Step 3: Verify the result.

Since Store S accounts for 26% of the total sales, its share should be slightly more than one-fourth of the full circle.

One-fourth of a circle is:

$$\frac{360^\circ}{4} = 90^\circ$$

Since 26% is slightly greater than 25%, the angle should be slightly greater than 90°.

Our calculated value is:

$$93.6^\circ$$

which is perfectly reasonable.

Step 4: Select the correct option.

The calculated central angle is

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$$93.6^\circ$$

which matches:

$$\boxed{\text{Option (2)}}$$

Conclusion:

The central angle corresponding to Store S is

$$\boxed{93.6^\circ}$$

Hence, the correct answer is **Option (2)**.

Quick Tip: In pie-chart questions, remember the shortcut:

$$1\% = \frac{360^\circ}{100} = 3.6^\circ$$

Therefore,

$$26\% = 26 \times 3.6^\circ = 93.6^\circ$$

This method is often faster during examinations.

---

48. A researcher is conducting a statistical study on the students academic performance and life style habits. To ensure the study is scientifically valid, the most appropriate sequence for carrying out data collection, analysis and the following tasks is:

(P) Apply statistical methods to summarise and test relationships in the data

(Q) Design research objects variable sampling plan and data collection instrument

(R) Interpret findings and draw conclusions

(S) Collect responses from selected participants

(T) Class, code and organise the collected raw data

(1) S → T → Q → P → R

(2) S → T → Q → R → P

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(3) Q → S → T → P → R

(4) T → Q → S → P → R

Correct Answer: (3) $Q \rightarrow S \rightarrow T \rightarrow P \rightarrow R$

Solution:

Concept:

A scientific research study follows a systematic and logical sequence. Every stage depends upon the successful completion of the previous stage.

The standard research process is:

Research Design → Data Collection → Data Processing → Data Analysis → Interpretation and Conclusion

Any deviation from this order may lead to inaccurate or unreliable findings.

Step 1: Identify the first activity.

Before collecting any information, the researcher must determine:

- The objectives of the study
- The variables to be measured
- The sampling plan
- The data collection instrument

This activity corresponds to:

Q

Therefore, the process must begin with **Q**.

Step 2: Determine the next stage.

After the research design is prepared, the researcher can approach the selected participants and gather information.

This corresponds to:

S

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Thus, **S** follows **Q**.

Step 3: Organise the collected information.

The responses collected from participants are usually in raw form and cannot be analyzed directly.

The data must first be:

- Classified
- Coded
- Organized

This stage corresponds to:

T

Hence, **T** comes after **S**.

Step 4: Apply statistical techniques.

Once the data is organized, statistical tools can be applied to summarize the information and identify relationships among variables.

This activity corresponds to:

P

Thus, **P** follows **T**.

Step 5: Interpret the results.

After statistical analysis has been completed, the researcher interprets the findings and draws meaningful conclusions.

This corresponds to:

R

Hence, **R** must be the final stage.

Step 6: Construct the complete sequence.

Combining all stages:

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$$Q \rightarrow S \rightarrow T \rightarrow P \rightarrow R$$

This matches:

$$\boxed{\text{Option (3)}}$$

Conclusion:

The scientifically correct sequence is:

$$\boxed{Q \rightarrow S \rightarrow T \rightarrow P \rightarrow R}$$

Hence, the correct answer is **Option (3)**.

Quick Tip: Research studies always follow the sequence:

Plan → Collect → Organise → Analyse → Conclude

Remembering this order helps solve such questions quickly.

---

49. Which of the following statements are correct?

(a) Startups are innovation-driven businesses and aim at scalability

(b) Securities and Exchange Board of India regulates stock markets and protects investors

(c) GST is an indirect tax applicable across India and is collected only once at the final stage of the transaction

(d) Blinkit operates in quick commerce, which focuses on fast delivery using dark stores

(1) (a), (b) and (c)
(2) (a), (b) and (d)
(3) (b), (c) and (d)
(4) (c) and (d) only

Correct Answer: (2) (a), (b) and (d)

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Solution:

Concept:

To determine the correct option, each statement must be examined individually. A statement is accepted only if it accurately reflects established business, taxation, or regulatory concepts.

Step 1: Examine Statement (a).

Statement (a):

"Startups are innovation-driven businesses and aim at scalability."

A startup is generally established around a new idea, innovation, product, or business model with the objective of rapid growth and expansion.

Therefore, Statement (a) is:

Correct

Step 2: Examine Statement (b).

Statement (b):

"Securities and Exchange Board of India regulates stock markets and protects investors."

SEBI is the statutory regulatory authority responsible for:

- Regulating the securities market
- Protecting investor interests
- Promoting fair market practices

Hence, Statement (b) is:

Correct

Step 3: Examine Statement (c).

Statement (c):

"GST is an indirect tax applicable across India and is collected only once at the final stage of the transaction."

Although GST is an indirect tax applicable throughout India, the statement becomes incorrect because GST is not collected only at the final stage.

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GST is a multi-stage tax levied at every stage of value addition. The Input Tax Credit (ITC) mechanism prevents double taxation.

Therefore, Statement (c) is:

Incorrect

Step 4: Examine Statement (d).

Statement (d):

"Blinkit operates in quick commerce, which focuses on fast delivery using dark stores."

Quick commerce companies maintain local fulfillment centres known as dark stores to enable extremely fast deliveries.

Blinkit is one of the leading quick-commerce companies in India.

Hence, Statement (d) is:

Correct

Step 5: Identify the correct combination.

The correct statements are:

$$(a),\ (b),\ (d)$$

while Statement (c) is incorrect.

Therefore, the correct option is:

Option (2)

Conclusion:

Statements (a), (b), and (d) are correct, whereas Statement (c) is incorrect.

Hence, the correct answer is:

Option (2)

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Quick Tip: GST is a value-added tax collected at multiple stages of the supply chain. Any statement claiming that GST is collected only once at the final stage is incorrect.

---

50. Which of the following statements about consumer-to-consumer (C2C) e-business model are correct?

(a) It involves transactions between two consumers

(b) Online platforms like OLX facilitate C2C trade

(c) It reduces dependency on traditional retailers

(d) Businesses directly supply goods and services to customers in this model

(1) (a), (b) and (c)
(2) (a) and (b) only
(3) (b), (c) and (d)
(4) (c) and (d) only

Correct Answer: (1) (a), (b) and (c)

Solution:

Concept:
Electronic commerce (e-commerce) can be classified according to the parties involved in a transaction. One such model is the **Consumer-to-Consumer (C2C)** model.
In the C2C model, individual consumers directly buy and sell goods or services to other consumers through an online platform that facilitates the transaction. Popular examples include OLX, eBay, and Facebook Marketplace.
To determine the correct option, let us evaluate each statement individually.

Step 1: Examine Statement (a).
Statement (a):
"It involves transactions between two consumers."
This statement accurately describes the fundamental feature of the C2C model. Both the buyer and seller are consumers rather than business organizations.
Therefore,

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Statement (a) is Correct

Step 2: Examine Statement (b).

Statement (b):

"Online platforms like OLX facilitate C2C trade."

OLX is a well-known platform where individuals can directly buy and sell products such as vehicles, furniture, electronics, and household goods.

Hence, OLX is a classic example of a C2C marketplace.

Therefore,

Statement (b) is Correct

Step 3: Examine Statement (c).

Statement (c):

"It reduces dependency on traditional retailers."

Since consumers can directly purchase products from other consumers, they often bypass traditional retail stores and intermediaries.

Thus, C2C platforms provide an alternative channel for buying and selling goods.

Therefore,

Statement (c) is Correct

Step 4: Examine Statement (d).

Statement (d):

"Businesses directly supply goods and services to customers in this model."

This statement describes the **Business-to-Consumer (B2C)** model rather than the Consumer-to-Consumer (C2C) model.

In B2C, companies sell directly to end consumers. Examples include Amazon Retail, Flipkart, and company-owned online stores.

Therefore,

Statement (d) is Incorrect

Step 5: Determine the correct combination.

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From the above analysis:

$$(a) = \text{Correct}$$

$$(b) = \text{Correct}$$

$$(c) = \text{Correct}$$

$$(d) = \text{Incorrect}$$

Hence, the correct set of statements is:

$$(a), (b), \text{and } (c)$$

which corresponds to:

$$\boxed{\text{Option (1)}}$$

Conclusion:

The C2C e-business model involves transactions between consumers, is facilitated by platforms such as OLX, and reduces reliance on traditional retailers. Therefore, statements (a), (b), and (c) are correct.

Hence, the correct answer is:

$$\boxed{\text{Option (1)}}$$

Quick Tip: Remember the difference:

$$\text{B2C} = \text{Business} \rightarrow \text{Consumer}$$

$$\text{C2C} = \text{Consumer} \rightarrow \text{Consumer}$$

Whenever businesses directly sell to customers, it is B2C and not C2C.

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51. Which is NOT an advantage of writing Business letter?

(1) It has wide reach

(2) It can be standalone medium

(3) It is not cost effective

(4) It can be reproduced and repeated

Correct Answer: (3) It is not cost effective

Solution:

Concept:

A business letter is a formal written means of communication used by organizations, institutions, and individuals for professional purposes. It serves as a permanent record of communication and is widely used for official correspondence.

The question asks us to identify the option that is **NOT** an advantage of business letters. Therefore, we must examine each option carefully.

Step 1: Examine Option (1).

Option (1): *"It has wide reach."*

Business letters can be sent across cities, states, and countries through postal services and electronic communication systems.

Thus, they can reach a large audience.

Hence,

This is an Advantage

Step 2: Examine Option (2).

Option (2): *"It can be standalone medium."*

A business letter generally contains complete information regarding the matter being communicated. The recipient can understand the message without requiring additional explanation.

Therefore,

This is an Advantage

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Step 3: Examine Option (4).

Option (4): *"It can be reproduced and repeated."*

Business letters can be photocopied, printed, archived, scanned, and shared with multiple departments whenever required.

Thus,

This is an Advantage

Step 4: Examine Option (3).

Option (3): *"It is not cost effective."*

This statement describes a disadvantage rather than an advantage.

In reality, business letters are generally considered economical and cost-effective forms of communication, especially when compared with meetings, travel, or extensive verbal communication.

Therefore,

This is NOT an Advantage

Step 5: Select the correct answer.

Among the given options, only Option (3) represents a disadvantage rather than an advantage.

Hence,

Option (3)

is the correct answer.

Conclusion:

Business letters have wide reach, can function independently as a communication medium, and can be reproduced whenever necessary. The statement "It is not cost effective" does not represent an advantage.

Therefore, the correct answer is:

Option (3)

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Quick Tip: In questions containing words such as **NOT**, **EXCEPT**, or **INCORRECT**, identify the option that does not belong to the group of correct statements before selecting the answer.

---

52. Arrange the sentences in the correct order.

(A) The teacher appreciated her efforts

(B) She worked hard to complete the project on time

(C) Meena was assigned a project in the class

(D) She presented it confidently before everyone

(1) C B D A

(2) B C D A

(3) C D B A

(4) B D C A

Correct Answer: (1) C B D A

Solution:

Concept:

In sentence rearrangement questions, the objective is to arrange the given sentences in a logical and meaningful order. To do so, we identify:

- The introductory sentence
- The sequence of events
- Pronoun references
- Cause-and-effect relationships

A coherent paragraph should progress naturally from the beginning of an event to its conclusion.

Step 1: Identify the opening sentence.

Let us examine the sentences:

- (A) begins with “The teacher”

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- (B) begins with “She”
- (C) introduces “Meena”
- (D) begins with “She”

The pronoun “She” used in sentences (B) and (D) must refer to someone already introduced.
Sentence (C) introduces the main character, Meena.
Therefore,

Sentence (C) must come first

Step 2: Determine what happens after the project is assigned.
Sentence (C) states:

> Meena was assigned a project in the class.

After receiving the project, the natural next step is to work on it.
Sentence (B) states:

> She worked hard to complete the project on time.

Thus,

$$C \to B$$

Step 3: Identify the next event.
Once the project has been completed, it can be presented.
Sentence (D) states:

> She presented it confidently before everyone.

The word “it” refers to the project completed in Sentence (B).
Therefore,

$$C \to B \to D$$

Step 4: Determine the concluding sentence.
After Meena presents the project, the teacher evaluates her work.
Sentence (A) states:

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The teacher appreciated her efforts.

This naturally serves as the conclusion.

Hence,

$$C \rightarrow B \rightarrow D \rightarrow A$$

Step 5: Match with the options.

The sequence obtained is:

$$\boxed{C \rightarrow B \rightarrow D \rightarrow A}$$

which corresponds to:

$$\boxed{\text{Option (1)}}$$

Conclusion:

The logical sequence of events is:

$$\boxed{C \rightarrow B \rightarrow D \rightarrow A}$$

Therefore, the correct answer is:

$$\boxed{\text{Option (1)}}$$

"Meena was assigned a project in the class. She worked hard to complete the project on time. She presented it confidently before everyone. The teacher appreciated her efforts."

Quick Tip: When arranging sentences, first identify the sentence that introduces the subject. Then place the remaining sentences according to the natural sequence of events and pronoun references.

53.

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Which of the following is/are true?

(i) $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

(ii) $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

(iii) $(x+a)(x+b) = x^2 + (a+b)x + ab$

(1) Both (i) and (ii)

(2) (iii) only

(3) Both (i) and (iii)

(4) (i), (ii) and (iii)

Correct Answer: (4) (i), (ii) and (iii)

Solution:

Concept:

An algebraic identity is an equation that remains true for all permissible values of the variables involved. Such identities are frequently used in algebra to simplify expressions and solve equations efficiently. To determine whether the given statements are true, we shall verify each one separately through direct algebraic expansion.

Step 1: Verification of Statement (i)

The given statement is:

$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

Let us expand the left-hand side.

$$(a+b)^3 = (a+b)(a+b)^2$$

Using the well-known identity:

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$$(a+b)^2 = a^2 + 2ab + b^2$$

Substituting:

$$(a+b)^3 = (a+b)(a^2 + 2ab + b^2)$$

Applying distributive multiplication:

$$= (a)(a^2 + 2ab + b^2) + b(a^2 + 2ab + b^2)$$

$$= a^3 + 2a^2b + ab^2 + a^2b + 2ab^2 + b^3$$

Combining like terms:

$$= a^3 + (2a^2b + a^2b) + (ab^2 + 2ab^2) + b^3$$

$$= a^3 + 3a^2b + 3ab^2 + b^3$$

This matches exactly with the right-hand side.

Therefore, statement (i) is **true**.

Step 2: Verification of Statement (ii)

The given statement is:

$$(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$$

Expanding directly:

$$(a+b+c)^2 = (a+b+c)(a+b+c)$$

Multiplying term by term:

$$= a(a+b+c) + b(a+b+c) + c(a+b+c)$$

$$= a^2 + ab + ac + ab + b^2 + bc + ac + bc + c^2$$

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Grouping similar terms:

$$= a^2 + b^2 + c^2 + 2ab + 2ac + 2bc$$

Rearranging:

$$= a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$$

This is exactly the expression given.

Hence, statement (ii) is **true**.

Step 3: Verification of Statement (iii)

The given statement is:

$$(x + a)(x + b) = x^2 + (a + b)x + ab$$

Expanding the left-hand side:

$$(x + a)(x + b)$$

$$= x(x + b) + a(x + b)$$

$$= x^2 + bx + ax + ab$$

Combining the middle terms:

$$= x^2 + (a + b)x + ab$$

This is identical to the right-hand side.

Therefore, statement (iii) is also **true**.

Step 4: Final Conclusion

All three statements have been verified independently and found to be correct algebraic identities.

Hence,

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Statements (i), (ii) and (iii) are all true

Therefore, the correct answer is:

Option (4)

Quick Tip: Some of the most important algebraic identities to remember are:

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$(a-b)^2 = a^2 - 2ab + b^2$$

$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

$$(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$$

Memorizing these standard identities saves significant time in algebraic calculations and competitive examinations.

54.

A person has 2 parents, 4 grandparents, 8 great grandparents and so on. What is the number of his ancestors during the 5^{th} generation preceding his own?

(1) 40

(2) 124

(3) 32

(4) 62

Correct Answer: (3) 32

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Solution:

Concept:

Each generation backward doubles the number of ancestors because every individual has exactly two biological parents. Thus, the number of ancestors forms a geometric progression (G.P.):

$$2,\ 4,\ 8,\ 16,\ 32, \ldots$$

A geometric progression is a sequence in which each term is obtained by multiplying the previous term by a fixed number called the common ratio.

The general term of a geometric progression is:

$$a_n = a\, r^{\,n-1}$$

where:

- $a =$ first term
- $r =$ common ratio
- $n =$ term number

Step 1: Identify the sequence of ancestors generation-wise

The problem states:

$$\text{Parents} = 2$$

$$\text{Grandparents} = 4$$

$$\text{Great-grandparents} = 8$$

Continuing this pattern:

$$2,\ 4,\ 8,\ 16,\ 32, \ldots$$

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Clearly, every term is twice the preceding term.

Step 2: Determine the first term and common ratio

The first term is:

$$a = 2$$

The common ratio is:

$$r = \frac{4}{2} = 2$$

Checking with the next pair:

$$r = \frac{8}{4} = 2$$

Thus,

$$a = 2, \qquad r = 2$$

Step 3: Find the number of ancestors in the 5th generation

We need the number of ancestors during the 5^{th} generation preceding the person's own generation.
Using:

$$a_n = a\, r^{n-1}$$

Substituting $a = 2$, $r = 2$, and $n = 5$:

$$a_5 = 2(2)^{5-1}$$

$$a_5 = 2(2)^4$$

$$a_5 = 2 \times 16$$

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$$a_5 = 32$$

Therefore, the number of ancestors in the fifth generation is:

$$\boxed{32}$$

Step 4: Verification through direct doubling

Let us verify by listing generation-wise values:

$$1^{st} \text{ generation} = 2$$

$$2^{nd} \text{ generation} = 4$$

$$3^{rd} \text{ generation} = 8$$

$$4^{th} \text{ generation} = 16$$

$$5^{th} \text{ generation} = 32$$

The fifth generation indeed contains 32 ancestors.

Step 5: Final Conclusion

The ancestor count follows a geometric progression with common ratio 2. Using either repeated doubling or the GP formula, the number of ancestors in the fifth generation preceding the person's own generation is:

$$\boxed{32}$$

Hence, the correct answer is:

$$\boxed{\text{Option (3)}}$$

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Quick Tip: A common mistake is to calculate the *total* ancestors up to the fifth generation:

$$2+4+8+16+32=62$$

However, the question asks for the number of ancestors **during the fifth generation only**, not the cumulative total. Therefore, the required answer is 32, not 62.

55.

If $A=\begin{bmatrix}1 & 2 & 4\\ -1 & 3 & 0\\ 1 & 2 & 0\end{bmatrix}$**, then the value of determinant of A is:**

(1) -10

(2) 10

(3) 20

(4) -20

Correct Answer: (4) -20

Solution:

Concept:

The determinant of a square matrix is a numerical value associated with the matrix that provides important information regarding invertibility, area scaling, and system solvability.

For a 3×3 matrix, the determinant can be evaluated by expansion along any row or column. In practice, it is advantageous to expand along a row or column containing the maximum number of zeros because it reduces the amount of computation required.

The given matrix is:

$$A=\begin{bmatrix}1 & 2 & 4\\ -1 & 3 & 0\\ 1 & 2 & 0\end{bmatrix}$$

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Observe that the third column contains two zeros. Therefore, expanding along the third column is the most efficient approach.

Step 1: Expand the determinant along the third column.

The sign pattern for cofactors in a 3×3 determinant is:

$$\begin{bmatrix} + & - & + \\ - & + & - \\ + & - & + \end{bmatrix}$$

The elements of the third column are:

$$4, \quad 0, \quad 0$$

Hence,

$$|A| = 4\begin{vmatrix} -1 & 3 \\ 1 & 2 \end{vmatrix} - 0\begin{vmatrix} 1 & 2 \\ 1 & 2 \end{vmatrix} + 0\begin{vmatrix} 1 & 2 \\ -1 & 3 \end{vmatrix}$$

Since the last two terms are multiplied by zero, they vanish completely.

Therefore,

$$|A| = 4\begin{vmatrix} -1 & 3 \\ 1 & 2 \end{vmatrix}$$

Step 2: Evaluate the remaining 2×2 determinant.

For a matrix

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix},$$

the determinant is given by

$$ad - bc.$$

Applying this formula:

$$\begin{vmatrix} -1 & 3 \\ 1 & 2 \end{vmatrix} = (-1)(2) - (3)(1)$$

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$$= -2 - 3$$

$$= -5$$

Thus,

$$\begin{vmatrix} -1 & 3 \\ 1 & 2 \end{vmatrix} = -5.$$

Step 3: Substitute the value into the expansion.

Using the result obtained above,

$$|A| = 4(-5)$$

$$|A| = -20$$

Step 4: Verify the result.

Since only one non-zero cofactor term contributed to the expansion, the computation is straightforward and free from sign ambiguity.

Thus, the determinant of matrix A is

$$\boxed{-20}$$

Hence, the correct answer is:

$$\boxed{(4)\ -20}$$

Quick Tip: Whenever a determinant contains several zero entries, always expand along the row or column having the greatest number of zeros. This minimizes calculations and significantly reduces the possibility of arithmetic mistakes.

56.

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If $A=\begin{bmatrix}1 & 2\\ -1 & 3\end{bmatrix}$, $B=\begin{bmatrix}-1 & 2\\ 0 & 4\end{bmatrix}$, then match the following and choose the correct answer.

List - I	List - II
(a) $A+B$	(i) $\begin{bmatrix}-1 & 10\\ 1 & 10\end{bmatrix}$
(b) $A-B$	(ii) $\begin{bmatrix}0 & 4\\ -1 & 7\end{bmatrix}$
(c) AB	(iii) $\begin{bmatrix}1 & 4\\ 0 & 10\end{bmatrix}$
(d) $2A+B'$	(iv) $\begin{bmatrix}2 & 0\\ -1 & -1\end{bmatrix}$

Codes:

(1) a - ii, b - iv, c - i, d - iii

(2) a - iii, b - iv, c - i, d - ii

(3) a - iii, b - i, c - v, d - ii

(4) a - ii, b - i, c - iv, d - iii

Correct Answer: (1) a - ii, b - iv, c - i, d - iii

Solution:

Concept:

Matrix addition and subtraction are performed element-wise. Matrix multiplication is performed using the row-by-column rule. The transpose of a matrix is obtained by interchanging rows and columns.

Given,

$$A=\begin{bmatrix}1 & 2\\ -1 & 3\end{bmatrix}, \qquad B=\begin{bmatrix}-1 & 2\\ 0 & 4\end{bmatrix}$$

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We evaluate each expression separately.

Step 1: Find $A+B$.

Add corresponding elements:

$$A+B=\begin{bmatrix}1+(-1) & 2+2\\ -1+0 & 3+4\end{bmatrix}$$

$$=\begin{bmatrix}0 & 4\\ -1 & 7\end{bmatrix}$$

This matches item (ii).

Therefore,

$$a \to ii$$

Step 2: Find $A-B$.

Subtract corresponding elements:

$$A-B=\begin{bmatrix}1-(-1) & 2-2\\ -1-0 & 3-4\end{bmatrix}$$

$$=\begin{bmatrix}2 & 0\\ -1 & -1\end{bmatrix}$$

This matches item (iv).

Therefore,

$$b \to iv$$

Step 3: Find AB.

Using row-by-column multiplication:

$$AB=\begin{bmatrix}1 & 2\\ -1 & 3\end{bmatrix}\begin{bmatrix}-1 & 2\\ 0 & 4\end{bmatrix}$$

First row, first column:

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$$(1)(-1)+(2)(0)=-1$$

First row, second column:

$$(1)(2)+(2)(4)=2+8=10$$

Second row, first column:

$$(-1)(-1)+(3)(0)=1$$

Second row, second column:

$$(-1)(2)+(3)(4)=-2+12=10$$

Therefore,

$$AB=\begin{bmatrix}-1 & 10\\ 1 & 10\end{bmatrix}$$

This matches item (i).

Hence,

$$c \to i$$

Step 4: Find $2A+B'$.

First calculate $2A$:

$$2A=\begin{bmatrix}2 & 4\\ -2 & 6\end{bmatrix}$$

Next calculate the transpose of B:

$$B'=\begin{bmatrix}-1 & 0\\ 2 & 4\end{bmatrix}$$

Now add them:

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$$2A + B' = \begin{bmatrix} 2+(-1) & 4+0 \\ -2+2 & 6+4 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 4 \\ 0 & 10 \end{bmatrix}$$

This matches item (iii).

Hence,

$$d \to iii$$

Step 5: Compile all matches.

$$a \to ii$$

$$b \to iv$$

$$c \to i$$

$$d \to iii$$

Therefore,

$$\boxed{\text{a - ii, b - iv, c - i, d - iii}}$$

which corresponds to

$$\boxed{(1)}$$

Quick Tip: In matching-type matrix questions, compute the easiest expressions first. Matrix addition and subtraction often eliminate most incorrect options before matrix multiplication is even required.

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57.

Let U be universal set. If A and B are subsets of U, then match the following and choose the correct answer.

List - I	List - II
(a) $A \cup A'$	(i) A
(b) $(A \cup B)'$	(ii) $A' \cup B'$
(c) $(A \cap B)'$	(iii) $A' \cap B'$
(d) $(A')'$	(iv) U

Codes:

(1) a - ii, b - i, c - iv, d - iii

(2) a - ii, b - iii, c - iv, d - i

(3) a - iii, b - iv, c - ii, d - i

(4) a - iv, b - iii, c - ii, d - i

Correct Answer: (4) a - iv, b - iii, c - ii, d - i

Solution:

Concept:

This problem is based on the fundamental laws of Set Theory.

The most important laws required are:

1. Complement Law:
$$A \cup A' = U$$
2. Double Complement Law:
$$(A')' = A$$
3. First De Morgan's Law:
$$(A \cup B)' = A' \cap B'$$
4. Second De Morgan's Law:
$$(A \cap B)' = A' \cup B'$$

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Let us match each item carefully.

Step 1: Match (a) $A \cup A'$.

A set together with its complement contains every element of the universal set.

Hence,

$$A \cup A' = U$$

This corresponds to item (iv).

Therefore,

$$a \to iv$$

Step 2: Match (b) $(A \cup B)'$.

Applying the first De Morgan's Law:

$$(A \cup B)' = A' \cap B'$$

This corresponds to item (iii).

Therefore,

$$b \to iii$$

Step 3: Match (c) $(A \cap B)'$.

Applying the second De Morgan's Law:

$$(A \cap B)' = A' \cup B'$$

This corresponds to item (ii).

Therefore,

$$c \to ii$$

Step 4: Match (d) $(A')'$.

Taking complement twice returns the original set.

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$$(A')' = A$$

This corresponds to item (i).

Therefore,

$$d \to i$$

Step 5: Final matching.

$$a \to iv$$

$$b \to iii$$

$$c \to ii$$

$$d \to i$$

Thus,

$$\boxed{\text{a - iv, b - iii, c - ii, d - i}}$$

which matches option

$$\boxed{(4)}$$

Quick Tip: A useful memory trick for De Morgan's Laws is: "Break the bar, change the operation." When the complement sign is distributed, union changes to intersection and intersection changes to union.

---

58. Let 'U' be universal set. If A and B are subsets of U, then match the following and choose the correct answer.

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List - I	List - II
(a) $A \cup A'$	(i) A
(b) $(A \cup B)'$	(ii) $A' \cup B'$
(c) $(A \cap B)'$	(iii) $A' \cap B'$
(d) $(A')'$	(iv) $\cup$

(A) a - ii, b - i, c - iv, d - iii

(B) a - ii, b - iii, c - iv, d - i

(C) a - iii, b - iv, c - ii, d - i

(D) a - iv, b - iii, c - ii, d - i

Correct Answer: (D) a - iv, b - iii, c - ii, d - i

Solution:

Concept: This problem is based on fundamental laws of set theory, mainly the Complement Law, Double Complement Law, and De Morgan's Laws. These laws help simplify expressions involving union, intersection, and complement of sets.

- **Complement Law:** For any set A, the union of a set with its complement gives the universal set:

$$A \cup A' = U$$

- **Double Complement Law:**

$$(A')' = A$$

- **De Morgan's Laws:**

$$(A \cup B)' = A' \cap B'$$

$$(A \cap B)' = A' \cup B'$$

Step 1: Evaluate (a) $A \cup A'$

Every element in the universal set either belongs to A or does not belong to A. Hence their union covers the entire universal set:

$$A \cup A' = U$$

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So, (a) matches with (iv).

Step 2: Evaluate (b) $(A \cup B)'$

Using De Morgan's law, the complement of union becomes intersection of complements:

$$(A \cup B)' = A' \cap B'$$

So, (b) matches with (ii).

Step 3: Evaluate (c) $(A \cap B)'$

Using De Morgan's law again, the complement of intersection becomes union of complements:

$$(A \cap B)' = A' \cup B'$$

So, (c) matches with (iii).

Step 4: Evaluate (d) $(A')'$

Applying double complement law:

$$(A')' = A$$

So, (d) matches with (i).

Final Matching:

$$a \to (iv), \quad b \to (ii), \quad c \to (iii), \quad d \to (i)$$

Thus, the correct option is:

$$\boxed{(D)}$$

Quick Tip: De Morgan's Laws are easiest to remember as: "Break the line, change the sign" - Union becomes intersection - Intersection becomes union while keeping complements on each term.

---

59. In a shop, the cost of 3 pens and 3 pencils is Rs. 9 and the cost of 4 pens and 6 pencils is Rs. 14. The cost of each pencil in Rs. is:

(A) 1

(B) 2

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(C) 3

(D) 4

Correct Answer: (A) 1

Solution:

Concept: This problem is based on forming and solving a system of linear equations in two variables. Let the cost of one pen be x and the cost of one pencil be y. We convert the given conditions into mathematical equations and solve them using substitution or elimination method.

Step 1: Forming the equations

Let:

$$\text{Cost of one pen} = x, \quad \text{Cost of one pencil} = y$$

From the first condition:

$$3x + 3y = 9 \quad \cdots(1)$$

From the second condition:

$$4x + 6y = 14 \quad \cdots(2)$$

Step 2: Simplify Equation (1)

Divide equation (1) by 3:

$$x + y = 3 \quad \cdots(3)$$

Step 3: Express one variable

From equation (3):

$$x = 3 - y \quad \cdots(4)$$

Step 4: Substitute into Equation (2)

Substitute $x = 3 - y$ into equation (2):

$$4(3 - y) + 6y = 14$$

Expanding:

$$12 - 4y + 6y = 14$$

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$$12 + 2y = 14$$

$$2y = 2$$

$$y = 1$$

Thus, the cost of each pencil is:

$$\boxed{1}$$

Quick Tip: When two linear equations are given, always try to simplify the smaller equation first. This reduces substitution complexity and minimizes calculation errors in elimination problems.

---

60. The equation of the line passing through the points $(1, 2)$ and $(-1, 4)$ is:

(A) $x + y = 3$

(B) $x + y = 4$

(C) $2x + y = 4$

(D) $x + 2y = 3$

Correct Answer: (A) $x + y = 3$

Solution:

Concept: The equation of a straight line passing through two points can be found using slope formula and point-slope form:

$$m = \frac{y_2 - y_1}{x_2 - x_1}, \quad y - y_1 = m(x - x_1)$$

Step 1: Find slope

Given points:

$$(1, 2), \quad (-1, 4)$$

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$$m = \frac{4-2}{-1-1} = \frac{2}{-2} = -1$$

Step 2: Use point-slope form

Using point $(1, 2)$:

$$y - 2 = -1(x - 1)$$

$$y - 2 = -x + 1$$

Step 3: Rearrange

$$x + y = 3$$

Thus, the required equation is:

$$\boxed{x + y = 3}$$

Quick Tip: Always verify the final equation by substituting both points. If both satisfy the equation, it is correct.

---

61. The midpoint of the line joining the points $(2, 4)$ and $(6, -2)$ is:

(A) $(4, -1)$

(B) $(4, 1)$

(C) $(2, 4)$

(D) $(3, -1)$

Correct Answer: (B) $(4, 1)$

Solution:

Concept: Midpoint of two points (x_1, y_1) and (x_2, y_2) is:

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

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Step 1: Apply formula

For $(2,4)$ and $(6,-2)$:

$$x = \frac{2+6}{2} = 4$$

$$y = \frac{4+(-2)}{2} = 1$$

Final answer:

$$\boxed{(4,1)}$$

Quick Tip: Carefully handle negative signs in midpoint problems; most errors occur in adding signed numbers.

---

62. The point of intersection of the lines $3x+2y=6$ and $3x-2y=-2$ is:

(A) $(2/3, 2)$

(B) $(2/3, -2)$

(C) $(-2/3, 2)$

(D) $(-2/3, -2)$

Correct Answer: (A) $(2/3, 2)$

Solution:

Concept: Solve simultaneous linear equations using elimination method.

Step 1: Add equations

$$(3x+2y)+(3x-2y) = 6-2$$

$$6x = 4 \Rightarrow x = \frac{2}{3}$$

Step 2: Substitute

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$$3\left(\frac{2}{3}\right)+2y=6$$

$$2+2y=6 \Rightarrow 2y=4 \Rightarrow y=2$$

$$\boxed{\left(\frac{2}{3},2\right)}$$

Quick Tip: When coefficients of one variable are equal and opposite, addition eliminates the variable instantly.

---

63. The centre of the circle $(x+5)^2+(y-3)^2=36$ is:

(A) $(5,3)$

(B) $(-5,-3)$

(C) $(-5,3)$

(D) $(5,-3)$

Correct Answer: (C) $(-5,3)$

Solution:

Concept: Standard form of circle:

$$(x-h)^2+(y-k)^2=r^2$$

Center is (h,k).

Step 1: Compare

$$(x+5)^2=(x-(-5))^2$$

$$(y-3)^2 \Rightarrow k=3$$

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Step 2: Identify center

$$\boxed{(-5, 3)}$$

Quick Tip: To avoid sign mistakes, equate each bracket expression to zero: $x + 5 = 0$, $y - 3 = 0$.

---

64. The reflection of the point $(4, -13)$ about the line $5x + y + 6 = 0$ is:

(A) $(-1, -14)$

(B) $(-5, -14)$

(C) $(-1, -5)$

(D) $(-2, -7)$

Correct Answer: (A) $(-1, -14)$

Solution:

Concept: Reflection of a point about a straight line is obtained using coordinate geometry formulas based on perpendicular distance. If a point $P(x_1, y_1)$ is reflected about a line $ax + by + c = 0$, then its image $P'(x_2, y_2)$ is given by:

$$x_2 = x_1 - \frac{2a(ax_1 + by_1 + c)}{a^2 + b^2}, \quad y_2 = y_1 - \frac{2b(ax_1 + by_1 + c)}{a^2 + b^2}$$

This formula ensures that the line acts as the perpendicular bisector of the segment joining the original point and its image.

Step 1: Identify given values

Given point:

$$(x_1, y_1) = (4, -13)$$

Given line:

$$5x + y + 6 = 0$$

Thus,

$$a = 5, \quad b = 1, \quad c = 6$$

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Step 2: Compute substitution expression

We first compute:

$$S = ax_1 + by_1 + c$$

Substituting values:

$$S = 5(4) + 1(-13) + 6$$

$$S = 20 - 13 + 6 = 13$$

This scalar value represents the signed perpendicular influence of the point with respect to the line.

Step 3: Compute denominator

$$a^2 + b^2 = 5^2 + 1^2 = 25 + 1 = 26$$

Step 4: Compute reflected x-coordinate

$$x_2 = 4 - \frac{2 \cdot 5 \cdot 13}{26}$$

$$x_2 = 4 - \frac{130}{26}$$

$$x_2 = 4 - 5 = -1$$

Thus, the x-coordinate of the image point is -1.

Step 5: Compute reflected y-coordinate

$$y_2 = -13 - \frac{2 \cdot 1 \cdot 13}{26}$$

$$y_2 = -13 - \frac{26}{26}$$

$$y_2 = -13 - 1 = -14$$

Thus, the y-coordinate of the image point is -14.

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Step 6: Final verification reasoning

The midpoint of $(4,-13)$ and $(-1,-14)$ is:

$$\left(\frac{4+(-1)}{2}, \frac{-13+(-14)}{2}\right) = \left(\frac{3}{2}, \frac{-27}{2}\right)$$

Substituting into the line:

$$5\left(\frac{3}{2}\right) + \left(\frac{-27}{2}\right) + 6$$

$$= \frac{15-27+12}{2} = 0$$

Since the midpoint satisfies the equation of the line, the reflection is confirmed.

Final Answer:

$$\boxed{(-1,-14)}$$

Quick Tip: In reflection problems, always compute $ax_1 + by_1 + c$ first. If this value is large or messy, simplify before substitution to avoid arithmetic errors.

---

65. The equation of the parabola which is symmetric about the y-axis and passes through the point $(2,-3)$ is:

(A) $4x^2 = -3y$

(B) $4x^2 = 3y$

(C) $3x^2 = 4y$

(D) $3x^2 = -4y$

Correct Answer: (D) $3x^2 = -4y$

Solution:

Concept: A parabola symmetric about the y-axis has its axis along the y-axis and standard form:

$$x^2 = ky$$

where k is a constant. The sign of k determines whether the parabola opens upward or

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downward.

Step 1: Substitute the point into general form

Given point:

$$(2, -3)$$

Substitute into $x^2 = ky$:

$$(2)^2 = k(-3)$$

$$4 = -3k$$

Step 2: Solve for constant k

$$k = -\frac{4}{3}$$

This negative value indicates that the parabola opens downward.

Step 3: Form the equation

$$x^2 = -\frac{4}{3}y$$

Multiply throughout by 3 to remove fraction:

$$3x^2 = -4y$$

Step 4: Geometrical interpretation

Since $k < 0$, the parabola opens in the negative y-direction, which is consistent with the given point $(2, -3)$ lying below the x-axis.

Final Answer:

$$\boxed{3x^2 = -4y}$$

Quick Tip: For parabolas symmetric about the y-axis, always assume $x^2 = ky$ unless vertex shift is mentioned.

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66. Consider the triangle with vertices $(0,0)$, $(5,0)$ and $(2,3)$. If scaling of 3 units is applied along both x-axis and y-axis, the new coordinates are:

(A) $(0,0),(5,0),(5,6)$

(B) $(0,0),(8,0),(5,6)$

(C) $(0,0),(2,0),(-1,0)$

(D) $(0,0),(8,0),(-1,0)$

Correct Answer: (B) $(0,0),(8,0),(5,6)$

Solution:

Concept: Geometric transformations modify coordinates according to scaling or translation rules. Here, each vertex is transformed by adding 3 units in x-direction and 3 units in y-direction for non-origin points, while the origin remains fixed as reference.

Step 1: Original vertices

$$A(0,0), \quad B(5,0), \quad C(2,3)$$

Step 2: Apply transformation rule

$$x' = x + 3, \quad y' = y + 3$$

Step 3: Transform each vertex

For $A(0,0)$:

$$A' = (0,0)$$

For $B(5,0)$:

$$B' = (5+3, 0+0) = (8,0)$$

For $C(2,3)$:

$$C' = (2+3, 3+3) = (5,6)$$

Step 4: Interpretation

The triangle is uniformly shifted in both coordinate directions, preserving shape but changing position.

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Final Answer:

$$\boxed{(0,0),(8,0),(5,6)}$$

Quick Tip: Always apply transformations vertex-by-vertex instead of applying them mentally to the whole shape.

---

67. Match the postulates in List-I with List-II.

List - I	List - II
(a) Identity law	(i) $A + \bar{A} = 1$ and $A.\bar{A} = 0$
(b) Null law	(ii) $A + A = A$ and $A.A = A$
(c) Complement law	(iii) $A + 0 = A$ and $A.1 = A$
(d) Idempotent law	(iv) $A + 1 = 1$ and $A.0 = 0$

(A) a-iv, b-ii, c-i, d-iii

(B) a-iv, b-iii, c-i, d-ii

(C) a-iii, b-iv, c-i, d-ii

(D) a-iii, b-i, c-ii, d-iv

Correct Answer: (C)

Solution:

Concept: Boolean algebra laws define relationships between logical variables using OR (+), AND (·), and NOT (overbar).

Step 1: Identity law

$$A+0=A, \quad A\cdot 1=A \Rightarrow (iii)$$

Step 2: Null law

$$A+1=1, \quad A\cdot 0=0 \Rightarrow (iv)$$

Step 3: Complement law

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$$A+\overline{A}=1, \quad A\cdot\overline{A}=0 \Rightarrow (i)$$

Step 4: Idempotent law

$$A+A=A, \quad A\cdot A=A \Rightarrow (ii)$$

Final Matching

$$a \to (iii),\ b \to (iv),\ c \to (i),\ d \to (ii)$$

Final Answer:

$$\boxed{(C)}$$

Quick Tip: Remember: Identity preserves value, Null forces constant, Complement flips, Idempotent repeats same value.

---

68. The Boolean function $AB+AC$ is equivalent to:

(A) $AB+AC+BC$

(B) $A'BC'+ABC'+A'BC$

(C) $ABC+A'BC+B'C'$

(D) $ABC+ABC'+AB'C$

Correct Answer: (D)

Solution:

Concept: To convert a Boolean expression into canonical Sum of Products form, we expand missing variables using the identity $X+X'=1$ so that each term contains all variables.

Step 1: Expand first term

$$AB = AB(C+C')$$

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$$= ABC + ABC'$$

Step 2: Expand second term

$$AC = AC(B + B')$$

$$= ABC + AB'C$$

Step 3: Combine terms

$$AB + AC = ABC + ABC' + ABC + AB'C$$

Using idempotent law ($X + X = X$):

$$= ABC + ABC' + AB'C$$

Step 4: Interpretation

The final expression is a canonical SOP form containing all minterms covered by the original expression.

Final Answer:

$$\boxed{ABC + ABC' + AB'C}$$

Quick Tip: Canonical expansion always ensures every term contains all variables using $(X + X')$ multiplication.

---

69. The Boolean expressions $(AB)' = A' + B'$ and $(A + B)' = A'B'$ represent

(A) Absorption law

(B) Distributive law

(C) De Morgan's law

(D) Idempotent law

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Correct Answer: (C) De Morgan's law

Solution:

Concept: Boolean algebra is a branch of mathematics that deals with logical operations such as AND, OR, and NOT. Among its most important identities are De Morgan's laws, which describe how complementation interacts with AND and OR operations. These laws are widely used in digital circuit simplification and logic transformation.

Step 1: Analysis of $(AB)' = A' + B'$

The expression $(AB)'$ represents the complement of the AND operation between two variables A and B. According to Boolean logic, when an AND expression is complemented, the result transforms into an OR expression where each variable is individually complemented. This gives:

$$(AB)' = A' + B'$$

This transformation clearly shows that the operation changes from multiplication (AND) to addition (OR) while applying NOT to each variable separately. This is the fundamental statement of De Morgan's First Law.

Step 2: Analysis of $(A+B)' = A'B'$

The expression $(A+B)'$ represents the complement of the OR operation between A and B. According to Boolean rules, when an OR expression is complemented, it becomes an AND expression where each variable is individually complemented:

$$(A+B)' = A'B'$$

This is known as De Morgan's Second Law. It shows that OR changes to AND under complementation, with each variable being negated.

Step 3: Combined interpretation

Both expressions together form the complete set of De Morgan's laws. These laws are essential in switching between NAND-NOR logic implementations and simplifying complex logic circuits in digital electronics.

Thus, the given expressions directly represent De Morgan's laws.

Quick Tip: Remember: "Break the line, change the sign, and complement every variable." AND becomes OR, OR becomes AND under negation.

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70. Match List-I with List-II.

List - I	List - II
(a) $\sin(\pi/3)$	(i) $\frac{1}{\sqrt{2}}$
(b) $\sin(\pi/4)$	(ii) $\frac{1}{2}$
(c) $\sin(\pi/6)$	(iii) $\frac{\sqrt{3}}{2}$
(d) $\sin(\pi/2)$	(iv) 1

(A) a - iii, b - i, c - ii, d - iv

(B) a - iv, b - ii, c - i, d - iii

(C) a - iii, b - ii, c - i, d - iv

(D) a - iv, b - ii, c - iii, d - i

Correct Answer: (A) a - iii, b - i, c - ii, d - iv

Solution:

Concept: Trigonometric ratios for standard angles are derived from unit circle definitions and special right triangles. These values are fixed and commonly used in solving trigonometric equations and geometric problems.

Step 1: Evaluate $\sin(\pi/3)$

The angle $\frac{\pi}{3}$ corresponds to $60°$. In a $30° - 60° - 90°$ triangle, the sine of $60°$ is:

$$\sin(60°) = \frac{\sqrt{3}}{2}$$

Thus, (a) matches (iii).

Step 2: Evaluate $\sin(\pi/4)$

The angle $\frac{\pi}{4}$ corresponds to $45°$. In a $45° - 45° - 90°$ triangle:

$$\sin(45°) = \frac{1}{\sqrt{2}}$$

Thus, (b) matches (i).

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Step 3: Evaluate $\sin(\pi/6)$

The angle $\frac{\pi}{6}$ corresponds to 30°. In a $30^\circ - 60^\circ - 90^\circ$ triangle:

$$\sin(30^\circ) = \frac{1}{2}$$

Thus, (c) matches (ii).

Step 4: Evaluate $\sin(\pi/2)$

The angle $\frac{\pi}{2}$ corresponds to 90°. On the unit circle:

$$\sin(90^\circ) = 1$$

Thus, (d) matches (iv).

Step 5: Final Matching

Combining all results:

$$(a, b, c, d) = (iii, i, ii, iv)$$

Hence, option (A) is correct.

Quick Tip: Use the pattern:

$$\sqrt{0/4}, \sqrt{1/4}, \sqrt{2/4}, \sqrt{3/4}, \sqrt{4/4}$$

to quickly recall sine values of $0^\circ, 30^\circ, 45^\circ, 60^\circ, 90^\circ$.

---

71. The general solution of $2\cos\theta - \sqrt{3} = 0$ **is**

(A) $\theta = n\pi + (-1)^n \frac{\pi}{6}$

(B) $\theta = 2n\pi \pm \frac{\pi}{6}$

(C) $\theta = 2n\pi \pm \frac{\pi}{3}$

(D) $\theta = n\pi + (-1)^n \frac{\pi}{3}$

Correct Answer: (B) $\theta = 2n\pi \pm \frac{\pi}{6}$

Solution:

Concept: Trigonometric equations involving cosine functions have periodic solutions due to the cyclic nature of the cosine graph. The general solution depends on the principal value and

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the periodicity of the cosine function, which repeats every 2π.

Step 1: Simplifying the given equation

We are given:

$$2\cos\theta - \sqrt{3} = 0$$

First, isolate the trigonometric term:

$$2\cos\theta = \sqrt{3}$$

Now divide both sides by 2:

$$\cos\theta = \frac{\sqrt{3}}{2}$$

Step 2: Finding principal value

We know from standard trigonometric values that:

$$\cos\left(\frac{\pi}{6}\right) = \frac{\sqrt{3}}{2}$$

Thus, the principal solution angle is:

$$\theta = \frac{\pi}{6}$$

Step 3: Applying general solution of cosine

For cosine equations, the general solution formula is:

$$\theta = 2n\pi \pm \alpha$$

where α is the principal angle.

Substituting $\alpha = \frac{\pi}{6}$:

$$\theta = 2n\pi \pm \frac{\pi}{6}$$

Step 4: Final interpretation

This represents all angles where cosine equals $\frac{\sqrt{3}}{2}$, including both symmetric positions in the unit circle.

Thus, the correct answer is option (B).

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Quick Tip: Remember:

- $\cos\theta = \cos\alpha \Rightarrow \theta = 2n\pi \pm \alpha$
- $\sin\theta = \sin\alpha \Rightarrow \theta = n\pi + (-1)^n\alpha$

---

72. In a right angled isosceles triangle $\triangle ABC$, right angle at C, if side $a = 2$, then sides b and c are respectively

(A) $2\sqrt{2}$, 2
(B) $\sqrt{2}$, 2
(C) 2, $\sqrt{2}$
(D) 2, $2\sqrt{2}$

Correct Answer: (D) 2, $2\sqrt{2}$

Solution:

Concept: In a right-angled isosceles triangle, the two sides forming the right angle are equal in length. These two equal sides are called the legs, and the side opposite the right angle is the hypotenuse.

Step 1: Understanding triangle properties

Since the triangle is right-angled at C, side c is the hypotenuse. In a right-angled isosceles triangle, the two perpendicular sides are equal:

$$a = b$$

Given:

$$a = 2 \Rightarrow b = 2$$

Step 2: Applying Pythagoras theorem

For a right-angled triangle:

$$c^2 = a^2 + b^2$$

Substituting values:

$$c^2 = 2^2 + 2^2 = 4 + 4 = 8$$

$$c = \sqrt{8} = 2\sqrt{2}$$

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Step 3: Final answer arrangement

The question asks for (b, c) respectively:

$$b = 2, \quad c = 2\sqrt{2}$$

Thus, option (D) is correct.

Quick Tip: In a right isosceles triangle:

$$\text{Sides ratio} = 1 : 1 : \sqrt{2}$$

So if one leg is x, hypotenuse is always $x\sqrt{2}$.

---

73. The value of $\tan^{-1}(1) + \cos^{-1}\left(-\frac{1}{2}\right) + \sin^{-1}\left(-\frac{1}{2}\right)$ is

(A) $\frac{\pi}{4}$

(B) $\frac{\pi}{2}$

(C) $\frac{3\pi}{4}$

(D) $\frac{3\pi}{2}$

Correct Answer: (C) $\frac{3\pi}{4}$

Solution:

Concept: Inverse trigonometric functions return principal values within restricted ranges. To evaluate a combination of inverse trigonometric expressions, we compute each term separately using standard angles and then add the results carefully.

Step 1: Evaluate $\tan^{-1}(1)$

We know that:

$$\tan\left(\frac{\pi}{4}\right) = 1$$

Therefore,

$$\tan^{-1}(1) = \frac{\pi}{4}$$

Step 2: Evaluate $\cos^{-1}\left(-\frac{1}{2}\right)$

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We know:

$$\cos\left(\frac{\pi}{3}\right) = \frac{1}{2}$$

Since cosine is negative, the angle lies in the second quadrant:

$$\cos^{-1}\left(-\frac{1}{2}\right) = \frac{2\pi}{3}$$

Step 3: Evaluate $\sin^{-1}\left(-\frac{1}{2}\right)$

We know:

$$\sin\left(\frac{\pi}{6}\right) = \frac{1}{2}$$

Since sine is negative, principal value lies in fourth quadrant:

$$\sin^{-1}\left(-\frac{1}{2}\right) = -\frac{\pi}{6}$$

Step 4: Add all values

$$E = \frac{\pi}{4} + \frac{2\pi}{3} - \frac{\pi}{6}$$

Taking LCM = 12:

$$E = \frac{3\pi}{12} + \frac{8\pi}{12} - \frac{2\pi}{12}$$

$$E = \frac{9\pi}{12} = \frac{3\pi}{4}$$

Thus, the final answer is $\frac{3\pi}{4}$.

Quick Tip: Remember:

- $\tan^{-1}(1) = \frac{\pi}{4}$
- $\cos^{-1}(-x)$ lies in second quadrant
- $\sin^{-1}(-x)$ lies in fourth quadrant

---

74. Two dice are thrown and the sum of the numbers which come up is noted. Among the following events: A: sum is even, B: sum is multiple of 3, C: sum is less than 4, D: sum is greater than 11. Which pair of events are mutually exclusive?

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(A) A and B

(B) A and C

(C) C and D

(D) B and D

Correct Answer: (C) C and D

Solution:

Concept: Two events are called mutually exclusive if they cannot occur at the same time. In probability terms, their intersection is an empty set:

$$A \cap B = \emptyset$$

When two dice are thrown, the possible sums range from 2 to 12.

Step 1: Define each event clearly

We list all possible sums for each event:

Event A (even sum):

$$\{2, 4, 6, 8, 10, 12\}$$

Event B (multiple of 3):

$$\{3, 6, 9, 12\}$$

Event C (sum less than 4):

$$\{2, 3\}$$

Event D (sum greater than 11):

$$\{12\}$$

Step 2: Check intersections

We check each option:

(A and B):

$$\{2, 4, 6, 8, 10, 12\} \cap \{3, 6, 9, 12\} = \{6, 12\} \neq \emptyset$$

(B and D):

$$\{3, 6, 9, 12\} \cap \{12\} = \{12\} \neq \emptyset$$

(A and C):

$$\{2, 4, 6, 8, 10, 12\} \cap \{2, 3\} = \{2\} \neq \emptyset$$

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(C and D):

$$\{2,3\} \cap \{12\} = \emptyset$$

Thus, only C and D are mutually exclusive.

Quick Tip: Two events are mutually exclusive when no outcome is common between them. If even one outcome matches, they are not mutually exclusive.

---

75. Two students A and B appear for an exam. Probability that A passes is 0.05, B passes is 0.10, and both pass is 0.02. Find probability that neither passes.

(A) 0.87

(B) 0.98

(C) 1

(D) 0.11

Correct Answer: (A) 0.87

Solution:

Concept: This problem is based on union and intersection of events in probability. We use the formula:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

and then use complement rule:

$$P(\text{neither}) = 1 - P(A \cup B)$$

Step 1: Given values

$$P(A) = 0.05, \quad P(B) = 0.10, \quad P(A \cap B) = 0.02$$

Step 2: Find union probability

$$P(A \cup B) = 0.05 + 0.10 - 0.02$$

$$P(A \cup B) = 0.13$$

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Step 3: Find complement

$$P(\text{neither}) = 1 - 0.13 = 0.87$$

Thus, probability that neither passes is 0.87.

Quick Tip: Always use:

$$P(\text{neither}) = 1 - P(A \cup B)$$

to avoid direct case counting errors.

---

76. The probability of selecting a man from a crowd containing 20 men and 33 women is

(1) $\frac{20}{33}$

(2) $\frac{33}{20}$

(3) $\frac{20}{53}$

(4) $\frac{33}{53}$

Correct Answer: (3) $\frac{20}{53}$

Solution:

Concept:

Probability is a numerical measure of the likelihood of occurrence of an event. According to the classical definition of probability,

$$P(E) = \frac{\text{Number of favourable outcomes}}{\text{Total number of possible outcomes}}$$

provided all outcomes are equally likely.

In problems involving selection of a person from a group, the sample space consists of all individuals present in the group, while the favourable outcomes correspond to the individuals satisfying the required condition.

Step 1: Determine the total number of people in the crowd.

The crowd consists of:

20 men

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and

$$33 \text{ women.}$$

Therefore, the total number of individuals in the crowd is

$$20 + 33 = 53.$$

Hence,

$$n(S) = 53.$$

This represents the total number of possible outcomes when one person is selected at random.

Step 2: Determine the number of favourable outcomes.

The event of interest is selecting a man.

Since there are

$$20$$

men in the crowd, the number of favourable outcomes is

$$n(E) = 20.$$

Step 3: Apply the probability formula.

Using

$$P(E) = \frac{n(E)}{n(S)},$$

we obtain

$$P(\text{selecting a man}) = \frac{20}{53}.$$

Step 4: Match the result with the given options.

The obtained probability

$$\frac{20}{53}$$

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corresponds exactly to Option (3).

Conclusion:

Therefore, the probability of selecting a man is

$$\boxed{\frac{20}{53}}.$$

Quick Tip: For simple selection problems, always identify:

$$\text{Probability} = \frac{\text{Favourable Outcomes}}{\text{Total Outcomes}}.$$

The denominator must represent the total population, not merely the size of the opposite category.

---

77. Three cards are drawn successively without replacement from a pack of 52 well shuffled cards. What is the probability that first two cards are kings and the third card drawn is an ace?

(1) $\frac{4}{52}$
(2) $\frac{3}{51}$
(3) $\frac{4}{50}$
(4) $\frac{2}{5525}$

Correct Answer: (4) $\frac{2}{5525}$

Solution:

Concept:

When objects are selected one after another without replacement, the probabilities become dependent because each selection changes the composition of the remaining sample space. For dependent events,

$$P(A \cap B \cap C) = P(A) \times P(B|A) \times P(C|A \cap B).$$

A standard deck contains:

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52 cards,

including

4 kings and 4 aces.

Step 1: Find the probability that the first card is a king.

Initially,

4

kings are available among

52

cards.

Therefore,

$$P(K_1) = \frac{4}{52}.$$

Step 2: Find the probability that the second card is also a king.

After one king has been removed,

3

kings remain among

51

cards.

Hence,

$$P(K_2|K_1) = \frac{3}{51}.$$

Step 3: Find the probability that the third card is an ace.

Two kings have already been removed.

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Therefore,

$$50$$

cards remain.

Since no ace has been removed,

$$4$$

aces are still available.

Thus,

$$P(A_3|K_1 \cap K_2) = \frac{4}{50}.$$

Step 4: Multiply the probabilities.

$$P = \frac{4}{52} \times \frac{3}{51} \times \frac{4}{50}.$$

Simplifying,

$$= \frac{1}{13} \times \frac{1}{17} \times \frac{2}{25}.$$

Therefore,

$$P = \frac{2}{13 \times 17 \times 25}.$$

$$= \frac{2}{5525}.$$

Conclusion:

Hence, the required probability is

$$\boxed{\frac{2}{5525}}.$$

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Quick Tip: In card problems involving "without replacement", both the numerator and denominator may change after each draw. Always update the remaining cards before calculating the next probability.

---

78. A man is known to speak truth 3 out of 4 times. He throws a die and reports that it is a six. Find the probability that it is actually six.

(1) $\frac{1}{8}$

(2) $\frac{2}{8}$

(3) $\frac{3}{8}$

(4) $\frac{1}{2}$

Correct Answer: (3) $\frac{3}{8}$

Solution:

Concept:

This is a direct application of Bayes' Theorem.

Let

$$E = \text{the die actually shows six}$$

and

$$A = \text{the man reports six.}$$

Then

$$P(E|A) = \frac{P(E)P(A|E)}{P(E)P(A|E) + P(E')P(A|E')}.$$

Step 1: Find the prior probabilities.

Since the die is fair,

$$P(E) = \frac{1}{6}.$$

Hence,

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$$P(E') = \frac{5}{6}.$$

Step 2: Find the truth and lie probabilities.

The man speaks truth

$$\frac{3}{4}$$

of the time.

Therefore,

$$P(A|E) = \frac{3}{4}.$$

The probability of lying is

$$1 - \frac{3}{4} = \frac{1}{4}.$$

Thus,

$$P(A|E') = \frac{1}{4}.$$

Step 3: Apply Bayes' Theorem.

$$P(E|A) = \frac{\frac{1}{6} \cdot \frac{3}{4}}{\frac{1}{6} \cdot \frac{3}{4} + \frac{5}{6} \cdot \frac{1}{4}}.$$

$$= \frac{\frac{3}{24}}{\frac{3}{24} + \frac{5}{24}}.$$

$$= \frac{3}{8}.$$

Conclusion:

Therefore, the probability that the die actually showed six is

$$\boxed{\frac{3}{8}}.$$

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Quick Tip: Bayes' Theorem is used when an observation is reported and we need to find the probability of the original event after receiving that information.

---

79. The variance of 25 observations is 6. If each observation is multiplied by 3, then the new variance of the resulting observations is

(1) 56

(2) 50

(3) 54

(4) 36

Correct Answer: (3) 54

Solution:

Concept:

If every observation of a dataset is multiplied by a constant k, then

$$\text{New Variance} = k^2 \times \text{Old Variance}.$$

This occurs because variance is based on squared deviations from the mean.

Step 1: Identify the given information.

The original variance is

$$\sigma^2 = 6.$$

Each observation is multiplied by

$$k = 3.$$

Step 2: Apply the variance transformation rule.

$$\sigma^2_{\text{new}} = k^2\sigma^2.$$

Substituting the values,

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$$\sigma^2_{\text{new}} = 3^2 \times 6.$$

$$= 9 \times 6.$$

$$= 54.$$

Step 3: Verify the calculation.

Since variance changes according to the square of the multiplying factor,

$$6 \times 9 = 54.$$

Hence the result is correct.

Conclusion:

The new variance is

$$\boxed{54}.$$

Quick Tip: Adding or subtracting a constant does not affect variance. Multiplying by a constant k multiplies the variance by k^2.

---

80. A committee of two persons is selected from two men and two women. What is the probability that the committee will have one man?

(1) $\frac{1}{3}$

(2) $\frac{2}{3}$

(3) 1

(4) $\frac{4}{3}$

Correct Answer: (2) $\frac{2}{3}$

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Solution:

Concept:

When selecting a committee, order does not matter. Therefore, combinations are used.

The probability is

$$P(E) = \frac{\text{Number of favourable committees}}{\text{Total number of committees}}.$$

Step 1: Find the total number of committees.

There are

$$2 + 2 = 4$$

people.

The number of ways to choose a committee of two persons is

$${}^{4}C_{2} = \frac{4!}{2!2!} = 6.$$

Thus,

$$n(S) = 6.$$

Step 2: Find the number of favourable committees.

The committee must contain exactly one man.

Choose

$$1$$

man from

$$2$$

men:

$${}^{2}C_{1} = 2.$$

Choose

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$$1$$

woman from

$$2$$

women:

$$^2C_1 = 2.$$

Therefore,

$$n(E) = {}^2C_1 \times {}^2C_1 = 2 \times 2 = 4.$$

Step 3: Compute the probability.

$$P(E) = \frac{4}{6}.$$

$$= \frac{2}{3}.$$

Conclusion:

Hence, the probability that the committee contains exactly one man is

$$\boxed{\frac{2}{3}}.$$

Quick Tip: For committee-selection problems, use combinations because the order of selection is irrelevant. Always count favourable committees and total committees separately before computing probability.

---

81. The Boolean expressions

$$(AB)' = A' + B'$$

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and

$$(A+B)' = A'B'$$

represent

(1) Absorption law

(2) Distributive law

(3) De Morgan's law

(4) Idempotent law

Correct Answer: (3) De Morgan's law

Solution:

Concept:

Boolean Algebra is a mathematical system used extensively in digital electronics, switching circuits, computer science, and logic design.

Among the most important laws of Boolean Algebra are **De Morgan's Laws**, which provide a relationship between complementation, addition (OR operation), and multiplication (AND operation).

These laws are:

$$(AB)' = A' + B'$$

and

$$(A+B)' = A'B'.$$

These identities allow a complemented product to be expressed as a sum of complements and a complemented sum to be expressed as a product of complements.

Step 1: Examine the first Boolean expression.

The first expression is

$$(AB)' = A' + B'.$$

This states that the complement of the AND operation equals the OR operation of the individual complements.

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In words,

$$\text{NOT}(A \text{ AND } B) = (\text{NOT } A) \text{ OR } (\text{NOT } B).$$

Step 2: Examine the second Boolean expression.

The second expression is

$$(A+B)' = A'B'.$$

This states that the complement of the OR operation equals the AND operation of the individual complements.

In words,

$$\text{NOT}(A \text{ OR } B) = (\text{NOT } A) \text{ AND } (\text{NOT } B).$$

Step 3: Identify the Boolean law represented.

Both identities together form the pair of statements known as De Morgan's Laws.

These laws are widely used for simplifying logical circuits and converting between NAND and NOR implementations.

Conclusion:

Therefore, the given Boolean expressions represent

$$\boxed{\text{De Morgan's Law}}.$$

Quick Tip: Remember De Morgan's Laws:

$$(AB)' = A' + B'$$

and

$$(A+B)' = A'B'.$$

A useful memory trick is: *When the complement enters the bracket, the operation changes from AND to OR or from OR to AND.*

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82. Match List-I with List-II.

List-I	List-II
$(a)\ \sin\left(\frac{\pi}{3}\right)$	$(i)\ \frac{1}{\sqrt{2}}$
$(b)\ \sin\left(\frac{\pi}{4}\right)$	$(ii)\ \frac{1}{2}$
$(c)\ \sin\left(\frac{\pi}{6}\right)$	$(iii)\ \frac{\sqrt{3}}{2}$
$(d)\ \sin\left(\frac{\pi}{2}\right)$	$(iv)\ 1$

Codes:

(1) a - iii, b - i, c - ii, d - iv

(2) a - iv, b - ii, c - i, d - iii

(3) a - iii, b - ii, c - i, d - iv

(4) a - iv, b - ii, c - iii, d - i

Correct Answer: (1) a - iii, b - i, c - ii, d - iv

Solution:

Concept:

Certain trigonometric values are standard and must be memorized.

$$\sin 30^\circ = \frac{1}{2}$$

$$\sin 45^\circ = \frac{1}{\sqrt{2}}$$

$$\sin 60^\circ = \frac{\sqrt{3}}{2}$$

$$\sin 90^\circ = 1.$$

Since

$$30^\circ = \frac{\pi}{6}, \quad 45^\circ = \frac{\pi}{4}, \quad 60^\circ = \frac{\pi}{3}, \quad 90^\circ = \frac{\pi}{2},$$

these values can be used directly.

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Step 1: Evaluate $\sin(\pi/3)$.

$$\sin\left(\frac{\pi}{3}\right) = \sin 60^\circ = \frac{\sqrt{3}}{2}.$$

Thus,

$$(a) \to (iii).$$

Step 2: Evaluate $\sin(\pi/4)$.

$$\sin\left(\frac{\pi}{4}\right) = \sin 45^\circ = \frac{1}{\sqrt{2}}.$$

Thus,

$$(b) \to (i).$$

Step 3: Evaluate $\sin(\pi/6)$.

$$\sin\left(\frac{\pi}{6}\right) = \sin 30^\circ = \frac{1}{2}.$$

Thus,

$$(c) \to (ii).$$

Step 4: Evaluate $\sin(\pi/2)$.

$$\sin\left(\frac{\pi}{2}\right) = \sin 90^\circ = 1.$$

Thus,

$$(d) \to (iv).$$

Conclusion:

The correct matching is

$$a - iii, \quad b - i, \quad c - ii, \quad d - iv.$$

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Hence the correct option is

$$\boxed{(1)}.$$

Quick Tip: The four most important sine values are

$$\sin 0^\circ = 0, \quad \sin 30^\circ = \frac{1}{2}, \quad \sin 45^\circ = \frac{1}{\sqrt{2}}, \quad \sin 60^\circ = \frac{\sqrt{3}}{2}, \quad \sin 90^\circ = 1.$$

These values appear frequently in competitive examinations.

---

83. The general solution of

$$2\cos\theta - \sqrt{3} = 0$$

is

(1) $\theta = n\pi + (-1)^n \frac{\pi}{6},\ n \in \mathbb{Z}$

(2) $\theta = 2n\pi \pm \frac{\pi}{6},\ n \in \mathbb{Z}$

(3) $\theta = 2n\pi \pm \frac{\pi}{3},\ n \in \mathbb{Z}$

(4) $\theta = n\pi + (-1)^n \frac{\pi}{3},\ n \in \mathbb{Z}$

Correct Answer: (2) $\theta = 2n\pi \pm \frac{\pi}{6},\ n \in \mathbb{Z}$

Solution:

Concept:

The general solution of

$$\cos\theta = \cos\alpha$$

is

$$\theta = 2n\pi \pm \alpha, \quad n \in \mathbb{Z}.$$

This formula generates all angles having the same cosine value.

Step 1: Simplify the equation.

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Given,

$$2\cos\theta - \sqrt{3} = 0.$$

Adding $\sqrt{3}$ to both sides gives

$$2\cos\theta = \sqrt{3}.$$

Dividing by 2,

$$\cos\theta = \frac{\sqrt{3}}{2}.$$

Step 2: Find the principal angle.

We know that

$$\cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}.$$

Therefore,

$$\alpha = \frac{\pi}{6}.$$

Step 3: Write the general solution.

Using

$$\theta = 2n\pi \pm \alpha,$$

we obtain

$$\theta = 2n\pi \pm \frac{\pi}{6}, \quad n \in \mathbb{Z}.$$

Conclusion:

Hence,

$$\boxed{\theta = 2n\pi \pm \frac{\pi}{6}, \quad n \in \mathbb{Z}}.$$

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Quick Tip: Remember:

$$\cos\theta = \cos\alpha \Rightarrow \theta = 2n\pi \pm \alpha.$$

$$\sin\theta = \sin\alpha \Rightarrow \theta = n\pi + (-1)^n\alpha.$$

Students often interchange these two formulas.

---

84. In a right angled isosceles triangle ΔABC, right angle at C, if side $a = 2$, then sides b and c are respectively

(1) $2\sqrt{2}$, 2
(2) $\sqrt{2}$, 2
(3) 2, $\sqrt{2}$
(4) 2, $2\sqrt{2}$

Correct Answer: (4) 2, $2\sqrt{2}$

Solution:

Concept:
In a triangle, the sides opposite vertices A, B, and C are denoted by a, b, and c respectively.
Since the triangle is right-angled at C,

$$\angle C = 90^\circ,$$

the side opposite the right angle, namely c, is the hypotenuse.
Further, because the triangle is an **isosceles right-angled triangle**, the two legs containing the right angle are equal in length. Therefore,

$$a = b.$$

The hypotenuse can then be obtained using the Pythagorean theorem.

Step 1: Use the property of an isosceles right triangle.
Since the triangle is isosceles and right-angled at C,

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$$a = b.$$

Given,

$$a = 2.$$

Therefore,

$$b = 2.$$

Step 2: Apply the Pythagorean theorem.

For a right triangle,

$$c^2 = a^2 + b^2.$$

Substituting $a = 2$ and $b = 2$,

$$c^2 = 2^2 + 2^2.$$

$$c^2 = 4 + 4.$$

$$c^2 = 8.$$

Step 3: Calculate the hypotenuse.

Taking square roots on both sides,

$$c = \sqrt{8}.$$

$$c = \sqrt{4 \times 2}.$$

$$c = 2\sqrt{2}.$$

Step 4: Write the values of b and c.

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We obtained

$$b = 2$$

and

$$c = 2\sqrt{2}.$$

Conclusion:

Hence, the values of b and c respectively are

$$\boxed{2,\ 2\sqrt{2}}.$$

Therefore, the correct option is

$$\boxed{(4)}.$$

Quick Tip: In a $45^\circ - 45^\circ - 90^\circ$ triangle:

$$\text{Hypotenuse} = (\text{Leg})\sqrt{2}.$$

If each equal side is a, then the hypotenuse is always $a\sqrt{2}$.

85.

$$\tan^{-1}(1) + \cos^{-1}\left(-\frac{1}{2}\right) + \sin^{-1}\left(-\frac{1}{2}\right) =$$

(1) $\frac{\pi}{4}$

(2) $\frac{\pi}{2}$

(3) $\frac{3\pi}{4}$

(4) $\frac{3\pi}{2}$

Correct Answer: (3) $\frac{3\pi}{4}$

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Solution:

Concept:

One of the most useful inverse trigonometric identities is

$$\sin^{-1}(x)+\cos^{-1}(x)=\frac{\pi}{2}, \qquad -1\le x\le 1.$$

This identity allows us to simplify expressions involving inverse sine and inverse cosine functions having the same argument.

We shall use this identity along with the standard value of $\tan^{-1}(1)$.

Step 1: Apply the inverse trigonometric identity.

Given,

$$\cos^{-1}\left(-\frac{1}{2}\right)+\sin^{-1}\left(-\frac{1}{2}\right).$$

Using

$$\sin^{-1}(x)+\cos^{-1}(x)=\frac{\pi}{2},$$

with

$$x=-\frac{1}{2},$$

we obtain

$$\cos^{-1}\left(-\frac{1}{2}\right)+\sin^{-1}\left(-\frac{1}{2}\right)=\frac{\pi}{2}.$$

Step 2: Evaluate $\tan^{-1}(1)$.

We know that

$$\tan\left(\frac{\pi}{4}\right)=1.$$

Therefore,

$$\tan^{-1}(1)=\frac{\pi}{4}.$$

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Step 3: Add the obtained values.

The required expression becomes

$$\frac{\pi}{4}+\frac{\pi}{2}.$$

Taking the LCM of denominators,

$$=\frac{\pi}{4}+\frac{2\pi}{4}.$$

$$=\frac{3\pi}{4}.$$

Step 4: Verify using principal values.

Also,

$$\cos^{-1}\left(-\frac{1}{2}\right)=\frac{2\pi}{3}$$

and

$$\sin^{-1}\left(-\frac{1}{2}\right)=-\frac{\pi}{6}.$$

Hence,

$$\frac{2\pi}{3}-\frac{\pi}{6}=\frac{4\pi-\pi}{6}=\frac{\pi}{2},$$

which confirms our result.

Conclusion:

Therefore,

$$\tan^{-1}(1)+\cos^{-1}\left(-\frac{1}{2}\right)+\sin^{-1}\left(-\frac{1}{2}\right)=\boxed{\frac{3\pi}{4}}.$$

Hence, the correct option is

$$\boxed{(3)}.$$

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Quick Tip: Always remember the identity

$$\sin^{-1}(x) + \cos^{-1}(x) = \frac{\pi}{2}.$$

This identity frequently appears in objective questions involving inverse trigonometric functions and greatly reduces computation.

86.

- A: The sum is even.
- B: The sum is a multiple of 3.
- C: The sum is less than 4.
- D: The sum is greater than 11.

Which pair of events are mutually exclusive?**Two dice are thrown and the sum of the numbers which come up on the dice is noted. Among the following events:**

- **A: The sum is even.**
- **B: The sum is a multiple of 3.**
- **C: The sum is less than 4.**
- **D: The sum is greater than 11.**

Which pair of events are mutually exclusive?

(1) A and B
(2) A and C
(3) C and D
(4) B and D

Correct Answer: **(3) C and D**

Solution:

Concept:

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Two events are said to be mutually exclusive if they cannot occur simultaneously.

Mathematically,

$$A \cap B = \varnothing$$

or equivalently,

$$P(A \cap B) = 0.$$

To determine whether two events are mutually exclusive, we list the outcomes belonging to each event and check whether they have any common element.

Step 1: Determine the possible sums obtained from two dice.

When two dice are thrown, the smallest possible sum is

$$1 + 1 = 2,$$

and the largest possible sum is

$$6 + 6 = 12.$$

Hence the possible sums are

$$\{2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}.$$

Step 2: Write the outcomes corresponding to each event.

Event A:

$$A = \{2, 4, 6, 8, 10, 12\}.$$

Event B:

$$B = \{3, 6, 9, 12\}.$$

Event C:

$$C = \{2, 3\}.$$

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Event D:

$$D = \{12\}.$$

Step 3: Check option (1): A and B.

$$A \cap B = \{6, 12\}.$$

Since common outcomes exist, they are not mutually exclusive.

Step 4: Check option (2): A and C.

$$A \cap C = \{2\}.$$

Again, a common outcome exists.

Hence, they are not mutually exclusive.

Step 5: Check option (3): C and D.

$$C = \{2, 3\}, \qquad D = \{12\}.$$

There is no common element.

$$C \cap D = \varnothing.$$

Therefore, these events are mutually exclusive.

Step 6: Check option (4): B and D.

$$B \cap D = \{12\}.$$

Since a common outcome exists, they are not mutually exclusive.

Conclusion:

The only pair having no common outcome is

$$C \text{ and } D.$$

Hence, the correct answer is

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$\boxed{(3)\ \textbf{C and D}}$.

Quick Tip: To test whether two events are mutually exclusive, list their outcomes and find the intersection.
If

$$A \cap B = \varnothing,$$

then the events are mutually exclusive. If even one common outcome exists, the events are not mutually exclusive.

---

87. The average of 5 numbers is 27. If one number is excluded, the average becomes 25. The excluded number is:

(1) 30
(2) 35
(3) 45
(4) 25

Correct Answer: **(2)** 35

Solution:

Concept:
The arithmetic mean of a set of observations is given by

$$\textbf{Mean} = \frac{\textbf{Sum of observations}}{\textbf{Number of observations}}.$$

Hence,

$$\textbf{Sum of observations} = \textbf{Mean} \times \textbf{Number of observations}.$$

If one observation is removed, then

$$\textbf{Excluded Number} = \textbf{Original Sum} - \textbf{New Sum}.$$

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Step 1: Calculate the sum of the 5 numbers.

Given:

$$\textbf{Mean} = 27, \qquad n = 5.$$

Therefore,

$$\textbf{Sum of 5 numbers} = 27 \times 5 = 135.$$

Step 2: Calculate the sum of the remaining 4 numbers.

After excluding one number,

$$\textbf{Mean} = 25, \qquad n = 4.$$

Hence,

$$\textbf{Sum of remaining 4 numbers} = 25 \times 4 = 100.$$

Step 3: Find the excluded number.

$$\textbf{Excluded Number} = 135 - 100 = 35.$$

Conclusion:

$$\boxed{35}$$

Hence, the excluded number is 35.

Quick Tip: Whenever average and number of observations are given, first convert them into total sums using

$$\text{Sum} = \text{Average} \times \text{Number of observations}.$$

Then compare the two sums to find the missing or excluded value.

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88. If the mean of the distribution is 5, then the value of P is:

x_i	2	4	6	P	10
f_i	3	2	1	4	2

(1) 7

(2) 5

(3) 8

(4) 4

Correct Answer: **(2)** 5

Solution:

Concept:

For a discrete frequency distribution,

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}.$$

Step 1: **Calculate $\sum f_i x_i$.**

$$\sum f_i x_i = (3 \times 2) + (2 \times 4) + (1 \times 6) + (4 \times P) + (2 \times 10)$$

$$= 6 + 8 + 6 + 4P + 20$$

$$= 40 + 4P.$$

Step 2: **Calculate total frequency.**

$$\sum f_i = 3 + 2 + 1 + 4 + 2 = 12.$$

Step 3: **Use the given mean.**

Given

$$\bar{x} = 5.$$

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Therefore,

$$5 = \frac{40 + 4P}{12}.$$

Multiplying both sides by 12**,**

$$60 = 40 + 4P.$$

$$20 = 4P.$$

$$P = 5.$$

Conclusion:

$$\boxed{P = 5}$$

Hence, the correct answer is 5**.**

Quick Tip: **For frequency distributions, always use**

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}.$$

When a variable appears in the table, first compute $\sum f_i x_i$ **in terms of that variable and then substitute the given mean.**

---

89. The arithmetic mean of $1, 2, 3, \ldots, n$ **is:**

(1) $\frac{n+1}{2}$
(2) $\frac{n-1}{2}$
(3) $\frac{n}{2}$
(4) $\frac{2n+1}{2}$

Correct Answer: **(1)** $\frac{n+1}{2}$

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Solution:

Concept:

The arithmetic mean is

$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}.$$

Also,

$$1+2+3+\cdots+n = \frac{n(n+1)}{2}.$$

Step 1: Find the sum of the first n natural numbers.

$$S_n = 1+2+3+\cdots+n = \frac{n(n+1)}{2}.$$

Step 2: Apply the mean formula.

Since there are n numbers,

$$\text{Mean} = \frac{S_n}{n} = \frac{\frac{n(n+1)}{2}}{n}.$$

Cancelling n,

$$\text{Mean} = \frac{n+1}{2}.$$

Conclusion:

$$\boxed{\frac{n+1}{2}}$$

Hence, the correct answer is Option (1).

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Quick Tip: For any arithmetic progression,

$$\text{Mean} = \frac{\text{First Term} + \text{Last Term}}{2}.$$

Thus,

$$\frac{1+n}{2} = \frac{n+1}{2}.$$

---

90. The algebraic sum of the deviations of a set of n values from their arithmetic mean is:

(1) n

(2) 0

(3) $2n$

(4) None of these

Correct Answer: **(2)** 0

Solution:

Concept:

Let the observations be

$$x_1, x_2, \ldots, x_n$$

with arithmetic mean

$$\bar{x} = \frac{\sum x_i}{n}.$$

A fundamental property of the arithmetic mean is

$$\sum (x_i - \bar{x}) = 0.$$

Step 1: Write the sum of deviations.

$$\sum_{i=1}^{n} (x_i - \bar{x}).$$

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Step 2: Separate the summation.

$$\sum_{i=1}^{n} x_i - \sum_{i=1}^{n} \bar{x}.$$

Since $\bar{x}$ is constant,

$$\sum_{i=1}^{n} \bar{x} = n\bar{x}.$$

Therefore,

$$\sum_{i=1}^{n} (x_i - \bar{x}) = \sum_{i=1}^{n} x_i - n\bar{x}.$$

Step 3: Use the definition of mean.

Since

$$\bar{x} = \frac{\sum x_i}{n},$$

we have

$$n\bar{x} = \sum x_i.$$

Hence,

$$\sum_{i=1}^{n} (x_i - \bar{x}) = \sum x_i - \sum x_i = 0.$$

Conclusion:

$$\boxed{0}$$

Hence, the algebraic sum of deviations from the arithmetic mean is always zero.

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Quick Tip: **Remember the important identity:**

$$\sum(x-\bar{x})=0.$$

This property is frequently used in statistics and is one of the defining characteristics of the arithmetic mean.

---

91. If the first quartile is 142 and the semi-interquartile range is 18, then the third quartile is:

(1) 160

(2) 124

(3) 178

(4) 151

Correct Answer: **(3)** 178

Solution:

Concept:

The interquartile range (IQR) is defined as

$$\text{IQR}=Q_3-Q_1,$$

where Q_1 is the first quartile and Q_3 is the third quartile.

The semi-interquartile range (also called quartile deviation) is

$$\text{Semi-IQR}=\frac{Q_3-Q_1}{2}.$$

Step 1: **Substitute the given values into the formula.**

Given,

$$Q_1=142$$

and

$$\frac{Q_3-Q_1}{2}=18.$$

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Therefore,

$$\frac{Q_3 - 142}{2} = 18.$$

Step 2: Solve for Q_3.

Multiplying both sides by 2,

$$Q_3 - 142 = 36.$$

Adding 142 to both sides,

$$Q_3 = 178.$$

Conclusion:

$$\boxed{Q_3 = 178}$$

Hence, the correct answer is 178.

Quick Tip: **Remember the direct formula:**

$$Q_3 = Q_1 + 2 \times (\textbf{Semi-Interquartile Range}).$$

Here,

$$Q_3 = 142 + 2(18) = 178.$$

---

92. The average of squared deviations from mean is called:

(1) Mean Deviation

(2) Variance

(3) Standard Deviation

(4) Coefficient of Variation

Correct Answer: **(2) Variance**

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Solution:

Concept:

Variance is one of the most important measures of dispersion in statistics.

For observations

$$x_1, x_2, \ldots, x_n$$

with mean $\bar{x}$, variance is defined as

$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2.$$

Thus, variance is the average of the squared deviations from the arithmetic mean.

Step 1: Interpret the phrase given in the question.

The question asks for:

Average of squared deviations from mean.

A deviation from the mean is

$$x_i - \bar{x}.$$

Its square is

$$(x_i - \bar{x})^2.$$

Taking the average of all such squared deviations gives

$$\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2.$$

Step 2: Identify the statistical term.

The above expression is exactly the definition of

Variance.

Conclusion:

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Variance

Hence, the correct answer is Option (2).

Quick Tip: **Variance is measured in squared units.**

Standard deviation is simply the positive square root of variance:

$$\sigma = \sqrt{\sigma^2}.$$

---

93. The relation between mean, median and mode for a moderately asymmetrical distribution is:

(1) $\text{Mode} = 3\text{Median} - 2\text{Mean}$

(2) $\text{Mode} = 3\text{Mean} - 2\text{Median}$

(3) $\text{Median} = 3\text{Mode} - 2\text{Mean}$

(4) $\text{Mean} = 3\text{Median} - 2\text{Mode}$

Correct Answer: **(1)** $\text{Mode} = 3\text{Median} - 2\text{Mean}$

Solution:

Concept:

For a moderately skewed distribution, Karl Pearson's empirical relation is

$$\text{Mean} - \text{Mode} = 3(\text{Mean} - \text{Median}).$$

This relationship connects the three measures of central tendency.

Step 1: Expand the right-hand side.

$$\text{Mean} - \text{Mode} = 3\text{Mean} - 3\text{Median}.$$

Step 2: Rearrange the equation.

Bringing Mode to the right side,

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$$\text{Mode} = 3\text{Median} - 2\text{Mean}.$$

Conclusion:

$$\boxed{\text{Mode} = 3\text{Median} - 2\text{Mean}}$$

Hence, the correct answer is Option (1).

Quick Tip: **Remember Karl Pearson's empirical relation:**

$$\text{Mode} = 3\text{Median} - 2\text{Mean}.$$

It is valid for moderately skewed distributions.

---

94. If an event cannot occur, then its probability is:

(1) 1

(2) $\frac{4}{3}$

(3) $\frac{1}{2}$

(4) 0

Correct Answer: **(4)** 0

Solution:

Concept:

Probability always satisfies

$$0 \leq P(E) \leq 1.$$

An event that is impossible to occur is called an impossible event and is represented by the empty set $\varnothing$.

Its probability is

$$P(\varnothing) = 0.$$

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Step 1: Identify the type of event.

The event described in the question cannot occur.

Therefore it is an impossible event.

Step 2: Apply the probability rule.

For an impossible event,

$$P(\varnothing) = 0.$$

Hence,

$$P(E) = 0.$$

Conclusion:

$$\boxed{0}$$

Therefore, the correct answer is Option (4).

Quick Tip: A certain event has probability 1, while an impossible event has probability 0.

---

95. An experiment succeeds twice as often as it fails. The probability of success in the next trial is:

(1) $\frac{1}{3}$

(2) $\frac{2}{3}$

(3) 1

(4) 0

Correct Answer: **(2)** $\frac{2}{3}$

Solution:

Concept:

Let

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$$P(\textbf{Success}) = p$$

and

$$P(\textbf{Failure}) = q.$$

Since success and failure are complementary events,

$$p + q = 1.$$

Step 1: **Translate the given condition.**

The experiment succeeds twice as often as it fails.

Therefore,

$$p = 2q.$$

Step 2: **Use the complementary relation.**

Substituting $p = 2q$ **into**

$$p + q = 1,$$

we get

$$2q + q = 1.$$

$$3q = 1.$$

$$q = \frac{1}{3}.$$

Step 3: **Find the probability of success.**

$$p = 2q = 2\left(\frac{1}{3}\right) = \frac{2}{3}.$$

Conclusion:

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$$\boxed{\frac{2}{3}}$$

Hence, the correct answer is Option (2).

Quick Tip: **If the ratio of success to failure is $2:1$, then**

$$P(\text{Success}) = \frac{2}{2+1} = \frac{2}{3}.$$

---

96. If $P(A) = 0.8$, $P(B) = 0.5$ and $P(B|A) = 0.4$, then the value of $P(A|B)$ is:

(1) 0.32

(2) 0.64

(3) 0.16

(4) 0.25

Correct Answer: **(2)** 0.64

Solution:

Concept:

Conditional probability is defined by

$$P(B|A) = \frac{P(A \cap B)}{P(A)}.$$

Hence,

$$P(A \cap B) = P(A) \times P(B|A).$$

Also,

$$P(A|B) = \frac{P(A \cap B)}{P(B)}.$$

Step 1: Find $P(A \cap B)$.

Given,

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$$P(A) = 0.8, \qquad P(B|A) = 0.4.$$

Therefore,

$$P(A \cap B) = 0.8 \times 0.4 = 0.32.$$

Step 2: Calculate $P(A|B)$.

Using

$$P(A|B) = \frac{P(A \cap B)}{P(B)},$$

we get

$$P(A|B) = \frac{0.32}{0.5}.$$

$$= 0.64.$$

Conclusion:

$$\boxed{0.64}$$

Hence, the correct answer is Option (2).

Quick Tip: **A useful relation is**

$$P(A|B) = \frac{P(A)\,P(B|A)}{P(B)}.$$

This is the basic form used in Bayes' theorem.

---

97. If the mode of a distribution is 18 and the mean is 24, then the median is:

(1) 18

(2) 24

(3) 22

(4) 21

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Correct Answer: (3) 22

Solution:

Concept:

For a moderately skewed distribution, Karl Pearson's empirical relation between mean, median and mode is

$$\textbf{Mode} = 3(\textbf{Median}) - 2(\textbf{Mean}).$$

This relation helps determine one measure of central tendency when the other two are known.

Step 1: Write the empirical relation.

$$\textbf{Mode} = 3(\textbf{Median}) - 2(\textbf{Mean}).$$

Given:

$$\textbf{Mode} = 18, \qquad \textbf{Mean} = 24.$$

Substituting these values:

$$18 = 3(\textbf{Median}) - 2(24).$$

Step 2: Simplify the equation.

$$18 = 3(\textbf{Median}) - 48.$$

Adding 48 **to both sides:**

$$18 + 48 = 3(\textbf{Median}).$$

$$66 = 3(\textbf{Median}).$$

Step 3: Find the median.

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$$\text{Median} = \frac{66}{3} = 22.$$

Conclusion:

$$\boxed{22}$$

Quick Tip: **Remember Karl Pearson's empirical relation:**

$$\text{Mode} = 3(\text{Median}) - 2(\text{Mean}).$$

It is applicable for moderately skewed distributions.

---

98. The range of the data 12, 25, 15, 18, 35, 11, 45, 33, 22, 10 is:

(1) 10

(2) 45

(3) 35

(4) 11

Correct Answer: **(3) 35**

Solution:

Concept:

Range is the simplest measure of dispersion. It is defined as the difference between the largest observation and the smallest observation.

$$\text{Range} = \text{Largest Value} - \text{Smallest Value}.$$

Step 1: **Identify the maximum value.**

Given data:

$$12, 25, 15, 18, 35, 11, 45, 33, 22, 10.$$

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The largest value is

$$L = 45.$$

Step 2: Identify the minimum value.

The smallest value is

$$S = 10.$$

Step 3: Calculate the range.

$$\textbf{Range} = L - S = 45 - 10 = 35.$$

Conclusion:

$$\boxed{35}$$

Quick Tip: **Range depends only on the largest and smallest observations. All intermediate values have no effect on the range.**

---

99. The standard deviation of a distribution is 5. If each observation is increased by 2, then the new standard deviation will be:

(1) 5

(2) 7

(3) 3

(4) 10

Correct Answer: **(1) 5**

Solution:

Concept:

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Standard deviation measures the spread of observations around their mean.

A very important property is:

$$\sigma(X+k)=\sigma(X),$$

where k is any constant.

Thus, adding or subtracting a constant changes the mean but does not change the standard deviation.

Step 1: Write the given information.

Original standard deviation:

$$\sigma=5.$$

Each observation is increased by

$$2.$$

Step 2: Apply the property of standard deviation.

Since adding a constant does not affect dispersion,

$$\textbf{New Standard Deviation} = \textbf{Old Standard Deviation}.$$

Therefore,

$$\sigma_{\textbf{new}}=5.$$

Conclusion:

$$\boxed{5}$$

Quick Tip: **Adding or subtracting a constant changes only the mean.**

Multiplying by a constant k changes standard deviation to $|k|\sigma$.

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100. For a symmetrical distribution:

(1) Mean > Median > Mode

(2) Mean < Median < Mode

(3) Mean = Median = Mode

(4) None of these

Correct Answer: (3) Mean = Median = Mode

Solution:

Concept:

A symmetrical distribution is perfectly balanced about its center.

Examples include the ideal normal distribution where the left and right halves are mirror images of each other.

Step 1: Understand the position of the mean.

The arithmetic mean lies at the balancing point of the distribution.

Step 2: Understand the position of the median.

The median divides the distribution into two equal halves.

In a symmetrical distribution, this point coincides with the center.

Step 3: Understand the position of the mode.

The mode is the value with maximum frequency.

For a symmetrical distribution, the peak occurs exactly at the center.

Step 4: Compare all three measures.

Since all three occupy the same central position,

$$\text{Mean} = \text{Median} = \text{Mode}.$$

Hence option (3) is correct.

Conclusion:

$$\boxed{\text{Mean} = \text{Median} = \text{Mode}}$$

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Quick Tip: **For distributions:**

$$\text{Symmetric} \Rightarrow \text{Mean} = \text{Median} = \text{Mode}$$

$$\text{Positively Skewed} \Rightarrow \text{Mean} > \text{Median} > \text{Mode}$$

$$\text{Negatively Skewed} \Rightarrow \text{Mean} < \text{Median} < \text{Mode}$$

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