UPCATET UG 2026 June 17

Question Paper with Solutions (Memory-Based)

Conducted by Banda University of Agriculture and Technology (BUAT)

General Instructions

(i) Each question carries +4 marks for a correct answer. There is a negative marking of 1 for incorrect answers.

(ii) The total number of questions is 200.

(iii) The duration of the exam is 3 hours (180 minutes).

1. Which of the following statements is false about viruses?

(A) Viruses are obligate parasites.
(B) Viruses can multiply only when they are inside the living cells.
(C) Viruses cannot pass bacterial proof filters.
(D) Viruses are made up of protein and DNA or RNA.

Correct Answer: (C)

Solution:

Concept:

Viruses are extremely small, acellular infectious particles that lie at the boundary between living and non-living organisms. They do not possess a cellular organization and cannot perform metabolic activities independently. Therefore, they depend completely on a living host cell for their multiplication.

A virus consists mainly of:

- A nucleic acid core (either DNA or RNA)
- A protein coat called capsid

One important historical characteristic of viruses is that they are **filterable agents**. They can

pass through special filters that retain bacteria. This property led to their discovery.

Step 1: Examine Option (A)

The statement says:

Viruses are obligate parasites

An obligate parasite is an organism that can survive and reproduce only within a living host. Viruses lack:

- Ribosomes
- Cytoplasm
- Independent metabolic machinery
- Energy-generating systems

Therefore, they must utilize the machinery of a host cell for replication.
Hence, this statement is **true**.

Step 2: Examine Option (B)

The statement says:

Viruses can multiply only when they are inside living cells

Outside the host cell, viruses remain metabolically inactive and exist in the form of virions. Replication begins only after:

- Attachment to the host cell
- Entry into the host
- Utilization of host cellular machinery

Therefore, multiplication occurs only inside living cells.
Hence, this statement is also **true**.

Step 3: Examine Option (C)

The statement says:

Viruses cannot pass bacterial proof filters

This statement contradicts one of the most important properties of viruses.
Viruses are much smaller than bacteria and can easily pass through bacterial proof filters such as Chamberland filters, which trap bacteria.
Historically, viruses were discovered because infectious agents could pass through these filters even after bacteria had been removed.
Therefore,

Viruses CAN pass bacterial proof filters.

Hence, this statement is **false**.

Step 4: Examine Option (D)

The statement says:

Viruses are made up of protein and DNA or RNA

A virus contains:

- Protein coat (capsid)
- Genetic material (DNA or RNA)

A virus never contains both DNA and RNA simultaneously as genetic material.
The statement correctly conveys that viruses contain protein and either DNA or RNA.
Hence, this statement is **true**.

Final Conclusion:
Among the given statements, only Option (C) is incorrect because viruses are capable of passing through bacterial proof filters.
Hence,

$$\boxed{\text{Correct Answer} = (C)}$$

Quick Tip: Remember the keyword **"filterable agents"**. Viruses are much smaller than bacteria and can pass through bacterial proof filters. This property played a crucial role in their discovery.

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2. "Gemmae" are multicellular green structures for vegetative propagation. These are found in gemma cups in

(A) Riccia thallus

(B) Marchantia thallus

(C) Funaria protonema

(D) Fern prothallus

Correct Answer: (B)

Solution:

Concept:

Vegetative reproduction is a form of asexual reproduction in which new individuals develop from vegetative structures of the parent plant.

In bryophytes, particularly liverworts, specialized structures called **gemmae** are produced for vegetative propagation.

Gemmae are:

- Small multicellular bodies
- Green in colour
- Haploid in nature
- Produced inside cup-shaped structures called gemma cups

When rainwater splashes the gemmae out of the cup, they disperse and develop into new plants.

Step 1: Analyze Option (A) Riccia thallus

Riccia is a liverwort.

Although Riccia reproduces vegetatively through fragmentation, it does not characteristically possess gemma cups containing gemmae.

Therefore, this option is incorrect.

Step 2: Analyze Option (B) Marchantia thallus

Marchantia is a well-known liverwort.
Its dorsal surface bears cup-shaped structures known as:

Gemma Cups

These gemma cups contain numerous multicellular green gemmae.
When dispersed by rain, each gemma develops into a new Marchantia plant.
Thus, Marchantia is the classic example associated with gemma cups.
Hence, this option is correct.

Step 3: Analyze Option (C) Funaria protonema

Funaria is a moss.
Its protonema is a filamentous juvenile stage that can participate in vegetative propagation.
However, gemma cups are absent in Funaria.
Therefore, this option is incorrect.

Step 4: Analyze Option (D) Fern prothallus

The prothallus is the gametophytic stage of ferns.
Although it bears sex organs such as antheridia and archegonia, it does not possess gemma cups.
Therefore, this option is incorrect.

Final Conclusion:
Gemmae are multicellular green structures present inside gemma cups of Marchantia and help in vegetative propagation.
Hence,

$$\boxed{\text{Correct Answer} = (B)\ \text{Marchantia thallus}}$$

Quick Tip: NCERT Fact: **Marchantia + Gemma Cups + Gemmae** is a very frequently asked biology combination. Always associate vegetative reproduction through gemmae with Marchantia.

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3. Natural system of classification was proposed by

(A) Bentham and Hooker

(B) Hutchinson

(C) Whittaker

(D) Engler and Prantl

Correct Answer: (A)

Solution:

Concept:

Plant classification systems have evolved through several stages:

1. Artificial System of Classification
2. Natural System of Classification
3. Phylogenetic System of Classification

A natural classification system considers many plant characteristics simultaneously and reflects overall similarities among organisms.
Such systems are more reliable because they utilize numerous morphological features rather than a few selected traits.

Step 1: Understand the contribution of Bentham and Hooker

George Bentham and Joseph Dalton Hooker proposed a highly influential system of plant classification.
Their work was published in:

Genera Plantarum

This classification:

- Considered a large number of plant characters

- Arranged plants according to natural affinities
- Became one of the most widely accepted natural systems

Therefore, Bentham and Hooker's classification is regarded as a natural system of classification.

Step 2: Examine Hutchinson

John Hutchinson proposed a phylogenetic classification system.
His classification emphasized evolutionary relationships rather than merely natural similarities.
Hence, this option is incorrect.

Step 3: Examine Whittaker

R.H. Whittaker proposed the famous:

Five Kingdom Classification

This system classified living organisms into:

- Monera
- Protista
- Fungi
- Plantae
- Animalia

He did not propose the natural system of plant classification.
Therefore, this option is incorrect.

Step 4: Examine Engler and Prantl

Engler and Prantl proposed a phylogenetic classification system based on evolutionary concepts.
Hence, they are not associated with the natural system.
Therefore, this option is incorrect.

Final Conclusion:
The natural system of plant classification was proposed by Bentham and Hooker.

Hence,

$$\boxed{\text{Correct Answer} = (A)\ \text{Bentham and Hooker}}$$

Quick Tip: Remember:

- Bentham and Hooker → Natural Classification
- Engler and Prantl → Phylogenetic Classification
- Hutchinson → Phylogenetic Classification
- Whittaker → Five Kingdom Classification

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4. According to the mole concept in chemistry, what is the number of carbon atoms in 12 g of Carbon-12?

(A) 6.022×10^{23}
(B) 6.022×10^{-23}
(C) 1.602×10^{19}
(D) 1.602×10^{-19}

Correct Answer: (A) 6.022×10^{23}

Solution:

Concept:
The mole concept is one of the most fundamental concepts in chemistry. A mole is defined as the amount of a substance that contains exactly the same number of elementary entities as there are atoms in 12 g of Carbon-12.
This fixed number is known as **Avogadro's Number** and is represented by:

$$N_A = 6.022 \times 10^{23}$$

The significance of this definition is that 12 g of Carbon-12 contains exactly one mole of carbon atoms.

Step 1: Recall the definition of one mole

By definition,

$$\text{1 mole of Carbon-12}$$

contains

$$6.022 \times 10^{23}$$

carbon atoms.
Also,

$$\text{1 mole of Carbon-12} = 12 \text{ g}$$

Therefore,

$$\text{12 g of Carbon-12}$$

represents exactly one mole.

Step 2: Determine the number of atoms present

Since 12 g corresponds to one mole,
the number of carbon atoms present will be equal to Avogadro's number.
Hence,

$$\text{Number of atoms} = 6.022 \times 10^{23}$$

Step 3: Verify the options

Option (A):

$$6.022 \times 10^{23}$$

matches Avogadro's number exactly.
Option (B):

$$6.022 \times 10^{-23}$$

has an incorrect negative exponent.

Option (C):

$$1.602 \times 10^{19}$$

represents neither Avogadro's number nor the number of atoms in one mole.

Option (D):

$$1.602 \times 10^{-19}$$

is approximately the magnitude of electronic charge and is unrelated to this question.

Final Conclusion:

The number of carbon atoms present in 12 g of Carbon-12 is

$$\boxed{6.022 \times 10^{23}}$$

Therefore, the correct option is

$$\boxed{(A)}$$

Quick Tip: Always remember:

$$12 \text{ g Carbon-12} = 1 \text{ mole}$$

and

$$1 \text{ mole} = 6.022 \times 10^{23}$$

particles, atoms, molecules, or ions.

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5. For a spontaneous process, the value of Gibbs energy change (ΔG) is always:

(A) Positive

(B) Negative

(C) Zero

(D) Infinity

Correct Answer: (B) Negative

Solution:

Concept:

The spontaneity of a process is determined using Gibbs free energy.

The Gibbs free energy equation is

$$\Delta G = \Delta H - T\Delta S$$

where

- ΔG = Gibbs free energy change
- ΔH = Enthalpy change
- T = Absolute temperature
- ΔS = Entropy change

The sign of ΔG determines whether a process can occur spontaneously under given conditions.

Step 1: Recall the criterion for spontaneity

For a process to occur on its own without continuous external assistance, it must be thermodynamically favorable.

The condition is

$$\Delta G < 0$$

This means the Gibbs free energy of the system decreases during the process.

Such a process is called spontaneous.

Step 2: Understand the significance of different values of ΔG

Case 1:

$$\Delta G < 0$$

The process is spontaneous.

Case 2:

$$\Delta G > 0$$

The process is non-spontaneous and requires external energy.

Case 3:

$$\Delta G = 0$$

The system is at equilibrium.

No net change occurs.

Step 3: Compare with the given options

Option (A): Positive

$$\Delta G > 0$$

Non-spontaneous.

Incorrect.

Option (B): Negative

$$\Delta G < 0$$

Spontaneous.

Correct.

Option (C): Zero

Represents equilibrium.

Incorrect.

Option (D): Infinity

Not a thermodynamic criterion for spontaneity.

Incorrect.

Final Conclusion:

For every spontaneous process,

$$\boxed{\Delta G < 0}$$

Therefore, the correct answer is

$$\boxed{(B)\ \text{Negative}}$$

Quick Tip: Remember the Gibbs free energy rule:

$$\Delta G < 0 \Rightarrow \text{Spontaneous}$$

$$\Delta G = 0 \Rightarrow \text{Equilibrium}$$

$$\Delta G > 0 \Rightarrow \text{Non-spontaneous}$$

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6. Which of the following effects is a permanent effect?

(A) Electromeric effect

(B) Inductive effect

(C) Both

(D) None

Correct Answer: (B) Inductive effect

Solution:

Concept:

Organic molecules exhibit various electronic effects due to the movement or displacement of electrons. These effects influence stability, reactivity, acidity, basicity, and reaction mechanisms. Among the most important electronic effects are:

- Inductive Effect
- Electromeric Effect
- Resonance Effect

- Hyperconjugation

Some of these effects are permanent while others occur only temporarily during a reaction.

Step 1: Understand the Inductive Effect

The inductive effect is the permanent displacement of sigma (σ) electrons along a carbon chain due to differences in electronegativity.
This effect remains present in the molecule even when no attacking reagent is nearby.
Examples:

$$-NO_2,\ -CN,\ -COOH$$

show strong electron-withdrawing ($-I$) effect.

$$-CH_3,\ -C_2H_5$$

show electron-releasing ($+I$) effect.
Since this effect exists permanently within the molecule,

Inductive Effect is a permanent effect

Step 2: Understand the Electromeric Effect

The electromeric effect involves complete transfer of π-electrons in the presence of an attacking reagent.
It appears only during the course of a reaction.
Once the reagent is removed, the effect disappears.
Therefore,

Electromeric Effect is a temporary effect

and not a permanent one.

Step 3: Evaluate the options

Option (A):

Electromeric effect

Temporary effect.

Incorrect.

Option (B):

Inductive effect

Permanent effect.

Correct.

Option (C):

Both

Incorrect because electromeric effect is not permanent.

Option (D):

None

Incorrect because inductive effect is definitely permanent.

Final Conclusion:

Among the given electronic effects, only the inductive effect is permanent in nature.

Hence,

$$\boxed{\text{Correct Answer} = (B)\ \text{Inductive Effect}}$$

Quick Tip: A simple memory trick:

- **Inductive Effect** → Permanent
- **Electromeric Effect** → Temporary (appears only when reagent attacks)

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7. How many states and union territories are there in India?

(A) 28/8

(B) 28/9

(C) 29/7

(D) 75

Correct Answer: (A) 28/8

Solution:

Concept:

India is a **Union of States** as described in Article 1 of the Constitution of India. The administrative divisions of the country consist of:

- States
- Union Territories (UTs)

States have their own elected governments and enjoy a greater degree of autonomy, whereas Union Territories are administered directly by the Central Government, although some UTs have elected legislatures with limited powers.
The number of states and union territories has changed several times after independence due to reorganization, creation of new states, and changes in administrative status.

Step 1: Recall the present political division of India

At present, India consists of:

28 States

and

8 Union Territories

This became effective after the reorganization of the former state of Jammu and Kashmir in 2019 and the merger of Dadra and Nagar Haveli with Daman and Diu in 2020.

Step 2: Understand why other options are incorrect

Option (B):

28/9

This would imply 28 states and 9 union territories.

This was not the administrative structure after the merger of Dadra and Nagar Haveli with Daman and Diu.
Hence, this option is incorrect.

Option (C):

$$29/7$$

India previously had 29 states before the reorganization involving Jammu and Kashmir.
However, this is no longer the current structure.
Therefore, this option is incorrect.

Option (D):

$$75$$

This number does not represent either the number of states or the combined number of states and union territories.
Hence, this option is incorrect.

Step 3: Verify the total administrative units

The total number of administrative units at the highest level is:

$$28 + 8 = 36$$

Thus, the correct breakup is:

$$\text{28 States and 8 Union Territories}$$

Final Conclusion:
India currently has

$$\boxed{\text{28 States and 8 Union Territories}}$$

Therefore, the correct option is

$$\boxed{(A)}$$

Quick Tip: Current GK Fact:

$$\boxed{\text{India} = 28 \text{ States} + 8 \text{ Union Territories}}$$

A common mistake is choosing 29/7, which was applicable before the reorganization of Jammu and Kashmir and subsequent administrative changes.

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8. Through how many states of India does the Tropic of Cancer pass?

(A) 7

(B) 8

(C) 5

(D) 4

Correct Answer: (2) 8

Solution:

Concept: The Tropic of Cancer is an important imaginary latitude line located at approximately 23.5° north of the Equator. It is one of the five major circles of latitude marked on maps of the Earth. It represents the northernmost point at which the Sun can appear directly overhead at noon during the summer solstice.

In India, this important geographical line passes through several states, and knowledge of these states is a commonly asked geography question.

Step 1: Understanding what the Tropic of Cancer represents.

The Tropic of Cancer is situated at:

$$23.5^\circ N$$

It divides the tropical zone and indicates the farthest northern latitude receiving direct vertical sunlight during a certain period of the year.

This line plays an important role in determining climate patterns and seasons.

Step 2: Identifying the Indian states through which the Tropic of Cancer passes.

The Tropic of Cancer passes through exactly the following eight states of India:

1. *Gujarat*

2. *Rajasthan*

3. *Madhya Pradesh*

4. *Chhattisgarh*

5. *Jharkhand*

6. *West Bengal*

7. *Tripura*

8. *Mizoram*

Step 3: Counting the total number of states crossed by the Tropic of Cancer.

From the above geographical list, the total number of states becomes:

8

Hence, the Tropic of Cancer passes through eight states of India.

$\boxed{8}$

Therefore, the correct answer is option (B).

Quick Tip: Remember the sequence of states crossed by Tropic of Cancer in India: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura, Mizoram. Total = 8 states.

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9. Where is Kuchipudi a classical dance from?

(A) Assam

(B) Tamil Nadu

(C) Kerala

(D) Andhra Pradesh

Correct Answer: (4) Andhra Pradesh

Solution:

Concept: India is famous for its rich cultural heritage and has several recognized classical dance forms. Each dance form originated in a particular state and reflects the traditions, history, and cultural identity of that region.

Kuchipudi is one of the eight major classical dance forms of India and is known for combining graceful movements with dramatic storytelling.

Step 1: Understanding what Kuchipudi dance is.

Kuchipudi is a traditional Indian classical dance form involving:

- Rhythmic footwork
- Expressive facial expressions
- Storytelling through dance-drama
- Musical accompaniment

It is one of India's oldest dance traditions.

Step 2: Finding the place of origin of this dance form.

Kuchipudi originated in the village named Kuchipudi located in the Indian state:

$$Andhra\ Pradesh$$

The dance developed as a performance tradition associated with devotional storytelling.

Step 3: Comparing with other options.

The other options are incorrect because:

$$Assam \rightarrow Bihu\ dance$$

$$Tamil\ Nadu \rightarrow Bharatanatyam$$

$$Kerala \rightarrow Kathakali,\ Mohiniyattam$$

Only Andhra Pradesh is associated with Kuchipudi.

Hence,

$$\boxed{Andhra\ Pradesh}$$

Therefore, option (D) is correct.

Quick Tip: Associate classical dances with states: Bharatanatyam – Tamil Nadu, Kathakali – Kerala, Kuchipudi – Andhra Pradesh, Odissi – Odisha.

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10. When was NABARD established?

(A) 1929

(B) 1982

(C) 1905

(D) 1965

Correct Answer: (2) 1982

Solution:

Concept: NABARD stands for National Bank for Agriculture and Rural Development. It is an apex development financial institution in India responsible for promoting sustainable agriculture and rural economic development.

It plays an important role in providing financial support for agriculture, cottage industries, village industries, and rural infrastructure.

Step 1: Understanding the full form of NABARD.

NABARD means:

$$National\ Bank\ for\ Agriculture\ and\ Rural\ Development$$

It functions as the primary financial institution dealing with agricultural credit policies.

Step 2: Identifying the year of establishment.

NABARD was officially established on:

$$12\ July,\ 1982$$

It was created on the recommendations of the B. Sivaraman Committee.

Step 3: Checking the given options.

Comparing the available options:

$$1929 \rightarrow Incorrect$$

$$1982 \rightarrow Correct$$

$$1905 \rightarrow Incorrect$$

$$1965 \rightarrow Incorrect$$

Thus, the correct year is:

$$\boxed{1982}$$

Hence option (B) is correct.

Quick Tip: NABARD was established on 12 July 1982 and is India's apex development bank responsible for agricultural and rural financing.

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11. What is the value of i^{4k+2} where k is an integer?

(A) 1

(B) -1

(C) i

(D) $-i$

Correct Answer: (2) -1

Solution:

Concept: The imaginary unit i is defined by the property:

$$i = \sqrt{-1}$$

The powers of i follow a repeating cyclic pattern after every four powers. Understanding this cycle helps in simplifying higher powers of complex numbers.

The cycle is:

$$i^1 = i$$

$$i^2 = -1$$

$$i^3 = -i$$

$$i^4 = 1$$

Then the pattern repeats again.

Step 1: Breaking the exponent into separate powers.

The given expression is:

$$i^{4k+2}$$

Using exponent rule:

$$a^{m+n} = a^m \times a^n$$

we write:

$$i^{4k+2} = i^{4k} \times i^2$$

Step 2: Simplifying the term involving multiples of four.

Since powers of i repeat after every four powers:

$$i^4 = 1$$

Therefore:

$$i^{4k} = (i^4)^k$$

Substituting:

$$i^{4k} = 1^k$$

Since any power of 1 remains 1:

$$i^{4k} = 1$$

Step 3: Substituting the remaining value.

Now substitute in the original expression:

$$i^{4k+2} = 1 \times i^2$$

We know:

$$i^2 = -1$$

Therefore:

$$i^{4k+2} = -1$$

Hence the final value becomes:

$$\boxed{-1}$$

Therefore option (B) is the correct answer.

Quick Tip: Memorize the power cycle of i: $i, -1, -i, 1$. The pattern repeats every 4 powers, making higher powers easy to simplify.

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12. What is the value of ${}^{n}C_{n-1}$?

(A) 1

(B) $n!$

(C) n

(D) 0

Correct Answer: (3) n

Solution:

Concept: In mathematics, combinations are used to determine the number of ways of selecting objects from a group when the order of selection does not matter. The general formula for combinations is:

$$ {}^{n}C_{r} = \frac{n!}{r!(n-r)!} $$

where:

$$ n! = n \times (n-1) \times (n-2) \times \cdots \times 1 $$

One important property of combinations is symmetry, given by:

$$ {}^{n}C_{r} = {}^{n}C_{n-r} $$

This property helps simplify expressions involving combinations.

Step 1: Writing the standard formula for the given combination expression.

The expression given in the question is:

$$ {}^{n}C_{n-1} $$

Using the combination formula:

$$ {}^{n}C_{r} = \frac{n!}{r!(n-r)!} $$

Substituting:

$$^{n}C_{n-1} = \frac{n!}{(n-1)!(n-(n-1))!}$$

Step 2: Simplifying the factorial expression carefully.

Now simplify the denominator.

First:

$$n-(n-1) = 1$$

So the expression becomes:

$$^{n}C_{n-1} = \frac{n!}{(n-1)!1!}$$

Since:

$$1! = 1$$

we obtain:

$$^{n}C_{n-1} = \frac{n!}{(n-1)!}$$

Step 3: Expanding factorial terms to obtain the final result.

Expand the factorial:

$$n! = n \times (n-1)!$$

Substituting this gives:

$$^{n}C_{n-1} = \frac{n \times (n-1)!}{(n-1)!}$$

Cancelling common terms:

$$^{n}C_{n-1} = n$$

Hence the required value becomes:

$$\boxed{n}$$

Therefore option (C) is the correct answer.

Quick Tip: Remember the symmetry property of combinations: ${}^nC_r = {}^nC_{n-r}$. Thus ${}^nC_{n-1} = {}^nC_1 = n$.

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13. What is the total number of terms in the expansion of $(x+y)^{15}$?

(A) 15

(B) 16

(C) 14

(D) 30

Correct Answer: (2) 16

Solution:

Concept: The expansion of an expression of the form:

$$(a+b)^n$$

is determined by the Binomial Theorem.

According to the Binomial Theorem:

$$(a+b)^n = \sum_{r=0}^{n} {}^nC_r a^{n-r} b^r$$

An important result from this theorem is that the total number of distinct terms in the expansion is always:

$$n+1$$

where n is the exponent.

Step 1: Understanding the formula for total number of terms in binomial expansion.

For any binomial expression:

$$(a+b)^n$$

the number of terms generated in complete expansion is:

$$n+1$$

This happens because the powers of the second term start from zero and continue up to n.

Thus there are exactly $n+1$ separate terms.

Step 2: Applying the formula to the given expression.

The given expression is:

$$(x+y)^{15}$$

Here the exponent is:

$$n=15$$

Using formula:

$$\text{Number of terms} = n+1$$

Substituting:

$$\text{Number of terms} = 15+1$$

$$=16$$

Step 3: Writing the final conclusion.

Therefore, the expansion of

$$(x+y)^{15}$$

contains exactly:

$$16$$

distinct terms.

Hence,

$$\boxed{16}$$

So option (B) is correct.

Quick Tip: For binomial expansion $(a+b)^n$, always remember: Total number of terms $= n+1$.

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14. When a forward bias voltage is applied to a p-n junction diode, it:

(A) Increases the potential barrier

(B) Decreases the potential barrier

(C) Increases the width of the depletion layer

(D) Converts it into an insulator

Correct Answer: (2) Decreases the potential barrier

Solution:

Concept: A p-n junction diode is formed when p-type semiconductor and n-type semiconductor materials are joined together. At the junction, electrons and holes combine and create a region called the depletion layer.

This depletion region creates an electric field and a potential barrier that normally prevents free flow of current.

The behavior of this barrier changes depending upon whether forward bias or reverse bias is applied.

Step 1: Understanding forward bias connection in a diode.

A diode is said to be forward biased when:

$$Positive\ terminal\ of\ battery \rightarrow p\text{-}side$$

$$Negative\ terminal\ of\ battery \rightarrow n\text{-}side$$

This external voltage pushes charge carriers toward the junction.

Electrons from n-side and holes from p-side move closer together.

Step 2: Studying the effect on depletion layer and potential barrier.

The applied forward voltage opposes the internal electric field already present at the junction.

As a result:

$$Barrier\ Potential\ decreases$$

At the same time:

$$Depletion\ Layer\ Width\ decreases$$

This allows majority charge carriers to cross the junction more easily.

Step 3: Determining the correct option by comparing all statements.

Checking all options:

Option A:

$$Increases\ potential\ barrier$$

Incorrect because forward bias reduces barrier.

Option B:

$$Decreases\ potential\ barrier$$

Correct because current flow becomes easier.

Option C:

$$Increases\ depletion\ width$$

Incorrect because depletion width decreases.

Option D:

$$Converts\ into\ insulator$$

Incorrect because forward bias makes conduction easier.

Therefore the correct effect is:

$$\boxed{\textit{Decreases the potential barrier}}$$

Hence option (B) is correct.

Quick Tip: Forward bias decreases both the depletion layer width and barrier potential, allowing current to flow easily through the diode.

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15. Photons of energy 4 eV are incident on a metal surface whose work function is 2 eV. If the intensity of this incident light is doubled, the maximum kinetic energy of the emitted photoelectrons will:

(A) Double to 4 eV

(B) Quadruple to 8 eV

(C) Remain 2 eV

(D) Become zero

Correct Answer: (c) Remain 2 eV

Solution:

Concept:

This question is based on Einstein's Photoelectric Equation and the effect of intensity on the photoelectric effect.

According to Einstein's photoelectric theory, when light of sufficiently high frequency falls on a metal surface, electrons are emitted from the surface. The maximum kinetic energy of the emitted photoelectrons depends only on the frequency (or energy) of the incident photons and not on the intensity of the light.

The photoelectric equation is:

where:

- K_{max} = maximum kinetic energy of photoelectrons
- $h\nu$ = energy of the incident photon
- ϕ = work function of the metal

The work function is the minimum energy required to remove an electron from the metal surface.

Step 1: Identify the given quantities.

From the question,

$$h\nu = 4\,\text{eV}$$

and

$$\phi = 2\,\text{eV}$$

Step 2: Apply Einstein's photoelectric equation.

Substituting the given values,

$$K_{\text{max}} = 4 - 2$$

$$K_{\text{max}} = 2\,\text{eV}$$

Thus, the maximum kinetic energy of the emitted photoelectrons is $2\,\text{eV}$.

Step 3: Analyze the effect of doubling the intensity.

Intensity of light represents the number of photons incident per unit area per unit time.

When the intensity is doubled:

- The number of photons striking the surface per second increases.
- Therefore, the number of emitted photoelectrons increases.
- However, the energy of each individual photon remains unchanged at $4\,\text{eV}$.

Since the photon energy remains unchanged, the maximum kinetic energy given by Einstein's equation also remains unchanged.

Step 4: Examine each option.

- **Option (a): Double to $4\,\text{eV}$**
  Incorrect. Kinetic energy does not depend on intensity.
- **Option (b): Quadruple to $8\,\text{eV}$**
  Incorrect. Increasing intensity cannot increase the energy of individual photons.

- **Option (c): Remain 2 eV**
  Correct. Photon energy remains 4 eV, so maximum kinetic energy remains 2 eV.

- **Option (d): Become zero**
  Incorrect. The incident photon energy is greater than the work function, so photoelectrons continue to be emitted.

Final Conclusion:

Doubling the intensity increases only the number of emitted photoelectrons and does not affect their maximum kinetic energy. Therefore,

$$K_{max} = 2\,\text{eV}$$

even after doubling the intensity.

Hence, the correct answer is

(c) Remain 2 eV

Quick Tip: In the photoelectric effect, **intensity controls the number of photoelectrons**, while **frequency (or photon energy) controls the maximum kinetic energy**. Never confuse these two effects.