KEAM 2026 Engineering April 18

Question Paper with Solutions (Memory-Based)

Conducted by CEE Kerala

General Instructions

(i) **Duration:** The total duration of the examination is 3 hours (180 minutes).

(ii) **Total Marks:** The complete paper carries a maximum of 600 marks.

(iii) **Structure:** The paper has 3 Sections:

- **Section A:** 45 Multiple Choice Questions (Physics).
- **Section B:** 30 Multiple Choice Questions (Chemistry).
- **Section B:** 75 Multiple Choice Questions (Mathematics).

(iv) **Compulsory Questions:** All 150 questions are compulsory.

(v) Each question has four options. Only **one** option is correct.

(vi) **Correct Answer:** +4 marks.

(vii) **Incorrect Answer:** −1 (Negative marking).

(viii) **Unanswered/Marked for Review:** 0 marks.

Physics

1. If two planets A and B have their densities in the ratio 2:1 and radii in the ratio 1:2, what will be the ratio of escape velocities from their surfaces?

Solution:

Step 1: Use the formula for escape velocity.

The escape velocity v_e from the surface of a planet is given by the formula:

$$v_e = \sqrt{\frac{2GM}{R}}$$

where:

- G is the universal gravitational constant,

- M is the mass of the planet, and

- R is the radius of the planet.

Step 2: Express mass in terms of density.

The mass of a planet is related to its density ρ and volume. The volume V of a spherical planet is given by:

$$V = \frac{4}{3}\pi R^3$$

Thus, the mass M of the planet is:

$$M = \rho \times V = \rho \times \frac{4}{3}\pi R^3$$

Step 3: Substitute into the formula for escape velocity.

Substitute the expression for mass into the formula for escape velocity:

$$v_e = \sqrt{\frac{2G \times \rho \times \frac{4}{3}\pi R^3}{R}} = \sqrt{\frac{8\pi G\rho R^3}{3R}} = \sqrt{\frac{8\pi G\rho R^2}{3}}$$

Thus, the escape velocity is proportional to:

$$v_e \propto \sqrt{\rho R^2}$$

Step 4: Find the ratio of escape velocities.

Now, let's find the ratio of escape velocities for planets A and B. The ratio of escape velocities is:

$$\frac{v_{eA}}{v_{eB}} = \sqrt{\frac{\rho_A R_A^2}{\rho_B R_B^2}}$$

We are given that: - $\frac{\rho_A}{\rho_B} = \frac{2}{1}$, - $\frac{R_A}{R_B} = \frac{1}{2}$.

Substituting these values:

$$\frac{v_{eA}}{v_{eB}} = \sqrt{\frac{2 \times 1^2}{1 \times 2^2}} = \sqrt{\frac{2}{4}} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$$

Thus, the ratio of escape velocities is:

$$\boxed{\frac{1}{\sqrt{2}}}$$

Quick Tip: The escape velocity depends on the radius of the planet and its density. It is proportional to the square root of the product of density and radius squared.

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2. Three bulbs of power 10 W, 25 W, and 50 W are connected parallel across a voltage source V. What is the effective power of the combination?

Solution:

Step 1: Use the formula for power in terms of voltage and resistance.

The power P of a bulb is related to its resistance R and the voltage V by the formula:

$$P = \frac{V^2}{R}$$

Thus, the resistance of each bulb can be calculated as:

$$R = \frac{V^2}{P}$$

Step 2: Calculate the resistance of each bulb.

Let the voltage across each bulb be V. Then, the resistances of the bulbs are: - For the 10 W bulb:

$$R_1 = \frac{V^2}{10}$$

- For the 25 W bulb:

$$R_2 = \frac{V^2}{25}$$

- For the 50 W bulb:

$$R_3 = \frac{V^2}{50}$$

Step 3: Use the formula for total resistance in a parallel combination.

For parallel resistors, the total resistance R_{total} is given by:

$$\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Substitute the values for R_1, R_2, and R_3:

$$\frac{1}{R_{\text{total}}} = \frac{1}{\frac{V^2}{10}} + \frac{1}{\frac{V^2}{25}} + \frac{1}{\frac{V^2}{50}}$$

Simplify the equation:

$$\frac{1}{R_{\text{total}}} = \frac{10}{V^2} + \frac{25}{V^2} + \frac{50}{V^2} = \frac{85}{V^2}$$

Thus, the total resistance is:

$$R_{\text{total}} = \frac{V^2}{85}$$

Step 4: Calculate the total power.

The total power P_{total} of the combination is given by:

$$P_{\text{total}} = \frac{V^2}{R_{\text{total}}}$$

Substitute $R_{\text{total}} = \frac{V^2}{85}$:

$$P_{\text{total}} = \frac{V^2}{\frac{V^2}{85}} = 85\,\text{W}$$

Thus, the effective power of the combination is:

$$\boxed{85\,\text{W}}$$

Quick Tip: When resistors are connected in parallel, the total power is the sum of the individual powers.

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3. Two lenses, one of focal length 20 cm and another of power 4D are placed together, what is the effective power of the combination?

Solution:

Step 1: Use the formula for the power of a lens.

The power P of a lens is related to its focal length f by the formula:

$$P = \frac{1}{f}$$

where f is the focal length in meters and P is in diopters (D).

Step 2: Convert the focal length to meters.

The focal length of the first lens is given as 20 cm. Convert this to meters:

$$f_1 = 20\,\text{cm} = 0.2\,\text{m}$$

The power of the first lens is:

$$P_1 = \frac{1}{f_1} = \frac{1}{0.2} = 5\,\text{D}$$

Step 3: Calculate the total power of the combination.

The total power of the combination of two lenses in contact is the sum of the individual powers:

$$P_{\text{total}} = P_1 + P_2$$

where $P_2 = 4\,\text{D}$ is the power of the second lens.

Thus, the total power is:

$$P_{\text{total}} = 5\,\text{D} + 4\,\text{D} = 9\,\text{D}$$

Therefore, the effective power of the combination is:

$$\boxed{9\,\text{D}}$$

Quick Tip: When lenses are placed in contact, their total power is the sum of their individual powers.

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4. A constant force acts on a body at rest, resulting it to move with constant acceleration. If power relates to time as $P \propto t^n$, what is the value of n?

Solution:

Step 1: Write the expression for power.

The power P delivered by a force is given by the formula:

$$P = F \cdot v$$

where F is the force and v is the velocity of the body.

Since the force is constant, the acceleration a of the body is constant. The velocity v of the body under constant acceleration is given by:

$$v = u + at$$

where u is the initial velocity (which is 0, as the body starts from rest), a is the acceleration, and t is the time.

Thus, the velocity can be written as:

$$v = at$$

Step 2: Express power in terms of time.

Substitute $v = at$ into the expression for power:

$$P = F \cdot (at)$$

Since $F = ma$ (from $F = ma$, where m is the mass), we get:

$$P = ma \cdot (at) = ma^2 t$$

Step 3: Relate power to time.

From the above equation, we see that the power is proportional to t:

$$P \propto t$$

Thus, comparing this with $P \propto t^n$, we find that:

$$n = 1$$

Thus, the value of n is:

$$\boxed{1}$$

Quick Tip: When an object moves with constant acceleration, the velocity increases linearly with time, resulting in power being directly proportional to time.

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5. Which force holds the nucleons together in the nucleus of the atom?

Solution:

The force that holds the nucleons (protons and neutrons) together in the nucleus of the atom is the **strong nuclear force**.

Explanation:

The strong nuclear force is one of the four fundamental forces of nature and is the strongest of them. It acts between the nucleons (protons and neutrons) and binds them together to form the nucleus. The strong nuclear force is attractive at short distances (about 10^{-15} m), and it is much stronger than the electrostatic force that tends to push the positively charged protons apart.

Thus, the answer is:

$$\boxed{\text{Strong Nuclear Force}}$$

Quick Tip: The strong nuclear force is responsible for the stability of the atomic nucleus by overcoming the electrostatic repulsion between positively charged protons.

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6. If the de Broglie wavelength of α-particle and proton are equal, then the momentum P and kinetic energy E are related as:

(A) $P_\alpha = P_p$

(B) $P_\alpha > P_p$

(C) $E_\alpha = E_p$

(D) $E_\alpha > E_p$

Correct Answer: (B) $P_\alpha > P_p$

Solution:

The de Broglie wavelength λ of a particle is related to its momentum p by the equation:

$$\lambda = \frac{h}{p}$$

where:

- h is the Planck's constant,
- p is the momentum of the particle.

For the de Broglie wavelengths of α-particles and protons to be equal, their momenta must also be equal. However, we know that the mass of an α-particle is much greater than the mass of a proton. Since the de Broglie wavelength λ is inversely proportional to the momentum p, the α-particle will have a greater momentum than the proton for the same wavelength.

Step 1: Relationship between momentum and wavelength.

For the same de Broglie wavelength, the momentum of a particle is inversely proportional to its mass. Since the mass of the α-particle is greater, its momentum will be higher than that of a proton.

Step 2: Conclusion.

Therefore, $P_\alpha > P_p$, which corresponds to option (B).

Final Answer: (B) $P_\alpha > P_p$

Quick Tip: The de Broglie wavelength is inversely proportional to the momentum, and since the mass of an α-particle is larger than that of a proton, its momentum will be greater for the same wavelength.

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7. A body starting from rest moves with a constant acceleration of $2\,\text{m/s}^2$. What is the distance covered by the body in the interval between 5 s and 6 s?

Solution:

Step 1: Use the equation for distance under constant acceleration.

The distance s covered by a body under constant acceleration is given by the equation:

$$s = ut + \frac{1}{2}at^2$$

where:

- u is the initial velocity (0 m/s, since the body starts from rest),
- a is the acceleration,
- t is the time.

Since the body starts from rest, the equation simplifies to:

$$s = \frac{1}{2}at^2$$

Step 2: Calculate the distance covered in 6 seconds and 5 seconds.

We are given that the acceleration $a = 2\,\text{m/s}^2$.

The distance covered in 6 seconds is:

$$s_6 = \frac{1}{2} \times 2 \times (6)^2 = \frac{1}{2} \times 2 \times 36 = 36\,\text{m}$$

The distance covered in 5 seconds is:

$$s_5 = \frac{1}{2} \times 2 \times (5)^2 = \frac{1}{2} \times 2 \times 25 = 25\,\text{m}$$

Step 3: Find the distance covered between 5 s and 6 s.

The distance covered between 5 s and 6 s is the difference between s_6 and s_5:

$$\text{Distance between 5s and 6s} = s_6 - s_5 = 36 - 25 = 11\,\text{m}$$

Thus, the distance covered by the body between 5 s and 6 s is:

$$\boxed{11\,\text{m}}$$

Quick Tip: When a body moves with constant acceleration from rest, the distance covered in a given time interval is calculated using the equation $s = \frac{1}{2}at^2$.

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8. If current through a single circular loop of radius 10 cm produces a magnetic field of B Tesla at the centre, what is the current through the loop?

Solution:

The magnetic field at the centre of a circular loop of radius r carrying a current I is given by the formula:

$$B = \frac{\mu_0 I}{2r}$$

where:
- B is the magnetic field at the centre of the loop,
- μ_0 is the permeability of free space ($\mu_0 = 4\pi \times 10^{-7}\,\text{T m/A}$),
- I is the current, and
- r is the radius of the loop.

Step 1: Rearrange the formula to solve for current.

Rearrange the equation to solve for the current I:

$$I = \frac{2rB}{\mu_0}$$

Step 2: Substitute the given values.

We are given:
- $r = 10\,\text{cm} = 0.1\,\text{m}$,
- $B = \mu_0$ Tesla,
- $\mu_0 = 4\pi \times 10^{-7}\,\text{T m/A}$.

Substitute these values into the equation:

$$I = \frac{2 \times 0.1 \times \mu_0}{\mu_0} = 0.2\,\text{A}$$

Thus, the current through the loop is:

$$\boxed{0.2\,\text{A}}$$

Quick Tip: The magnetic field at the centre of a circular loop depends on the radius and the current flowing through the loop. Use the formula $B = \frac{\mu_0 I}{2r}$ to find the current.

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9. What happens to a ferromagnetic material when its temperature is raised above Curie temperature?

Solution:

When a ferromagnetic material is heated above its Curie temperature, it undergoes a phase transition and loses its ferromagnetic properties. The Curie temperature is the critical temperature at which the thermal energy becomes sufficient to overcome the alignment of the magnetic dipoles in the material, causing it to become paramagnetic.

Ferromagnetic State:

Below the Curie temperature, the magnetic moments (spins) of the atoms in the material align in the same direction due to the interaction between neighboring atomic spins. This alignment results in a net magnetization, and the material exhibits strong magnetic properties. These materials can retain their magnetization even after the external magnetic field is removed. The interactions between the spins are stronger than the random thermal motions, allowing the material to stay magnetized.

Above Curie Temperature:

When the material is heated beyond the Curie temperature, the thermal energy of the system increases. This increase in thermal energy causes the atomic spins to become randomly oriented due to the random motion of the atoms, disrupting the alignment of the magnetic moments. As a result, the material loses its ferromagnetic properties and behaves like a paramagnet.

In the paramagnetic state, the material will still be weakly magnetized in the presence of an external magnetic field, but this magnetization is not permanent. Once the external field is removed, the material no longer retains its magnetization.

This transition from ferromagnetism to paramagnetism is due to the dominance of thermal energy over the magnetic interaction between atoms at temperatures higher than the Curie point.
Thus, above the Curie temperature, the ferromagnetic material loses its magnetic properties and becomes paramagnetic.

Quick Tip: The Curie temperature marks the transition point where ferromagnetic materials lose their magnetic properties and become paramagnetic due to thermal agitation.

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10. If $\vec{F}$ and $\vec{S}$ represent force and displacement respectively, then which of the following statements is true:

(A) Work is maximum when $\vec{F}$ and $\vec{S}$ are at right angles
(B) Work is positive when $\vec{F}$ and $\vec{S}$ are at obtuse angle
(C) Work is negative when $\vec{F}$ and $\vec{S}$ are at acute angle
(D) Work is zero if $\vec{F}$ and $\vec{S}$ are in opposite direction
(E) Area under $\vec{F}$-$\vec{S}$ graph gives work done

Correct Answer: (E) Area under $\vec{F}$-$\vec{S}$ graph gives work done

Solution:

The work done W by a force $\vec{F}$ when it displaces an object through a displacement $\vec{S}$ is given by:

$$W = \vec{F} \cdot \vec{S} = FS\cos\theta$$

where:
- F is the magnitude of the force,
- S is the magnitude of the displaceent,
- θ is the angle between the force and the displacement vectors.

Step 1: Work and angle between force and displacement.

- When $\theta = 90^\circ$, $\cos 90^\circ = 0$, so work done is zero.
- When $\theta = 0^\circ$, $\cos 0^\circ = 1$, so work is maximum.
- When $\theta = 180^\circ$, $\cos 180^\circ = -1$, so work is negative.

Step 2: Area under $\vec{F}$-$\vec{S}$ graph.

The work done by a force is also represented by the area under the graph of force $\vec{F}$ versus displacement $\vec{S}$. This is the area under the curve on the graph, which gives the work done by the force.

Step 3: Conclusion.

Therefore, the correct statement is that the area under the $\vec{F}$-$\vec{S}$ graph gives the work done, which corresponds to option (E).

Final Answer: (E) Area under $\vec{F}$-$\vec{S}$ graph gives work done

Quick Tip: Work done is the product of force and displacement in the direction of the force. It can also be calculated as the area under the force-displacement graph.

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11. Magnitude and direction of acceleration changes for:

(A) Simple harmonic motion

(B) Body falling under gravity at low altitude

(C) Body falling under gravity at high altitude

(D) Circular motion with constant speed

(E) Body falling in a viscous liquid

Correct Answer: (A) Simple harmonic motion

Solution:

In simple harmonic motion (SHM), the magnitude and direction of acceleration change continuously. The acceleration is proportional to the displacement from the equilibrium position, and it is always directed towards the equilibrium position.

The magnitude of acceleration is given by:

$$a = -\omega^2 x$$

where:
- ω is the angular frequency,
- x is the displacement from the equilibrium position.

Step 1: Understanding acceleration in SHM.
In SHM, acceleration changes its direction as the object moves back and forth. When the object is at the maximum displacement, the acceleration is at its maximum and directed towards the center. When the object is at the equilibrium position, the acceleration is zero.
Step 2: Conclusion.
Therefore, the correct answer is (A), as in simple harmonic motion, both the magnitude and direction of acceleration change continuously.

Final Answer: (A) Simple harmonic motion

Quick Tip: In SHM, the acceleration changes both in magnitude and direction, making it a key feature of this type of motion.

12: A couple can result in which type of motion:

(A) Translational motion
(B) Vibrational motion
(C) Both translation and vibration motion
(D) Rotational motion

Correct Answer: (D) Rotational motion

Solution:

A couple is a pair of equal and opposite forces whose lines of action do not coincide. This produces a rotational effect on the object to which the couple is applied.

Step 1: Understanding a couple's effect.

When a couple acts on a body, it generates a turning or rotational effect around a point or axis. This does not result in any translation of the object, but causes rotation about its center.

Step 2: Conclusion.

Therefore, a couple can only result in rotational motion.

Final Answer: (D) Rotational motion

Quick Tip: A couple produces only rotational motion and does not cause any translational or vibrational motion.

Chemistry

13. First element in 3d series which shows +2, +3, +4, +6 oxidation state

(A) Cr

(B) Mn

(C) Fe

(D) Co

(E) Ni

Correct Answer: (A) Cr

Solution:

In the 3d transition series, different elements exhibit various oxidation states based on the number of electrons they can lose. The first element in the 3d series to exhibit +2, +3, +4, and +6 oxidation states is Chromium (Cr).

Step 1: Oxidation states of elements.

- Chromium (Cr) can exhibit +2, +3, and +6 oxidation states. It is the first in the series to

show these states, and +4 state is possible under some specific conditions.
- Manganese (Mn) shows +2, +3, +4, and +6 oxidation states but starts with +2.
- Iron (Fe) typically shows +2 and +3 oxidation states. - Cobalt (Co) typically shows +2 and +3 oxidation states, but not +4 and +6.
- Nickel (Ni) primarily shows +2 oxidation state.

Step 2: Conclusion.

Chromium is the first element in the 3d series that exhibits +2, +3, +4, and +6 oxidation states, making it the correct answer.

Final Answer: (A) Cr

Quick Tip: Chromium (Cr) is unique in the 3d series for having multiple oxidation states, including +2, +3, +4, and +6, which makes it the correct choice for this question.

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14. Which of the following is used to convert sodium chromate to sodium dichromate in the preparation of potassium dichromate?

(A) Na_2CO_3
(B) NaOH
(C) $KClO_3$
(D) H_2SO_4
(E) H_2O_2

Correct Answer: (D) H_2SO_4

Solution:

Sodium chromate (Na_2CrO_4) is converted to sodium dichromate ($Na_2Cr_2O_7$) in the presence of concentrated sulfuric acid (H_2SO_4).
The chemical reaction is:

$$Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7 + H_2O$$

Step 1: Conversion of sodium chromate to sodium dichromate.

The sulfuric acid acts as a dehydrating agent, converting sodium chromate to sodium dichromate. This reaction is essential in the preparation of potassium dichromate.

Step 2: Conclusion.

Therefore, the correct answer is (D) H_2SO_4, as sulfuric acid is used to convert sodium chromate to sodium dichromate.

Final Answer: (D) H_2SO_4

Quick Tip: Sodium chromate is converted to sodium dichromate by heating with concentrated sulfuric acid, a common step in the preparation of potassium dichromate.

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15. Which of the following series in hydrogen spectrum corresponds to UV radiation?

(A) Lyman
(B) Balmer
(C) Pachen
(D) Brackett

Correct Answer: (A) Lyman

Solution:

The Lyman series in the hydrogen spectrum corresponds to ultraviolet (UV) radiation. This series involves transitions of electrons from higher energy levels (n 2) to the n = 1 energy level. These transitions result in the emission of ultraviolet light.

Step 1: Understanding the Lyman series.

The Lyman series includes transitions from n 2 to n = 1 and lies in the UV region of the electromagnetic spectrum.

Step 2: Explanation of other series.

- The Balmer series corresponds to visible light (n 3 to n = 2).
- The Pachen series corresponds to infrared radiation (n 4 to n = 3).
- The Brackett series corresponds to infrared radiation as well (n 5 to n = 4).

Step 3: Conclusion.

Thus, the Lyman series corresponds to ultraviolet radiation, making (A) the correct answer.

Final Answer: (A) Lyman

Quick Tip: The Lyman series emits ultraviolet radiation and corresponds to transitions of electrons to the n = 1 energy level in hydrogen.

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16. When CO is reacted with H_2 at 573 K, methanol is formed. Which is the catalyst used in this process?

(A) Pd-BaSO

(B) Ni-CrO

(C) ZnO - CrO

(D) Pt-BaSO

(E) CuO - CrO

Correct Answer: (C) ZnO - CrO

Solution:

The process of producing methanol from CO and H_2 is known as the catalytic hydrogenation of carbon monoxide. This process typically uses a catalyst consisting of zinc oxide (ZnO) and chromium oxide (CrO).

Step 1: Catalytic reaction.

In this reaction, a mixture of carbon monoxide and hydrogen undergoes a reaction in the presence of a catalyst at high pressure and moderate temperature (573 K). The catalyst helps in the formation of methanol:

$$CO + 2H_2 \rightarrow CH_3OH$$

Step 2: Catalyst used.

ZnO - CrO is the typical catalyst used in this reaction. This combination of catalysts helps facilitate the conversion of CO and H_2 into methanol at the given conditions.

Step 3: Conclusion.

Thus, the correct answer is (C) ZnO - CrO, as this is the catalyst used in the production of methanol from CO and H_2 at 573 K.

Final Answer: (C) ZnO - CrO

Quick Tip: In the industrial synthesis of methanol, ZnO and CrO are commonly used as catalysts in the hydrogenation of carbon monoxide.

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17. Which of these have the least bond length (in pm)?

(A) O_2

(B) Cl_2

(C) Br_2

(D) HF

(E) F_2

Correct Answer: (D) HF

Solution:

The bond length of a molecule is influenced by the atomic size of the atoms involved in the bond. Generally, as the atomic size decreases, the bond length also decreases, provided the atoms are of the same period.

Step 1: Bond length comparison.

- O_2 has a bond length of approximately 121 pm.
- Cl_2 has a bond length of approximately 198 pm.

- Br_2 has a bond length of approximately 228 pm.
- HF has a bond length of approximately 92 pm, which is the shortest among the listed options.
- F_2 has a bond length of approximately 142 pm.

Step 2: Conclusion.

Among the given options, HF (hydrogen fluoride) has the shortest bond length of about 92 pm, making it the correct answer.

Final Answer: (D) HF

Quick Tip: The bond length decreases as the atomic size decreases, and HF has the shortest bond length due to the small size of fluorine and hydrogen.

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18. Two solutions that are isotonic have same ......

(A) Same boiling point
(B) Same freezing point
(C) Same vapour pressure
(D) Same osmotic pressure
(E) Same solubilities

Correct Answer: (D) Same osmotic pressure

Solution:

Isotonic solutions are solutions that have the same osmotic pressure. This means that when two solutions are isotonic, they exert the same pressure on a semipermeable membrane, as they contain the same concentration of solute particles.

Step 1: Definition of isotonic solutions.

Isotonic solutions have equal osmotic pressure, and this is the defining characteristic of isotonicity. Osmotic pressure is related to the concentration of solute particles, and when two solutions are isotonic, they have the same concentration of solute.

Step 2: Explanation of other options.

- Same boiling point and same freezing point: These are related to the colligative properties of the solutions, but isotonicity specifically refers to osmotic pressure, not these properties.
- Same vapor pressure: While vapor pressure is also a colligative property, it is not directly related to isotonicity.

Step 3: Conclusion.

Thus, the correct answer is (D) Same osmotic pressure, as isotonic solutions must have the same osmotic pressure.

Final Answer: (D) Same osmotic pressure

Quick Tip: Isotonic solutions have the same osmotic pressure, which is determined by the concentration of solute particles in the solutions.

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19. 2-methyl propene is obtained as product when sodium methoxide reacts with

(A) 2-chloropropane
(B) Isobutyl bromide
(C) tert-butyl bromide
(D) n-butyl bromide
(E) sec-butyl bromide

Correct Answer: (C) tert-butyl bromide

Solution:

The reaction involves the elimination of a halide ion (Br^-) from a substrate in the presence of sodium methoxide (NaOCH), which results in the formation of an alkene.

Step 1: Mechanism of reaction.

Sodium methoxide is a strong base and will dehydrohalogenate alkyl halides. The base will abstract a hydrogen atom from a carbon adjacent to the carbon bearing the halogen, leading to the formation of a double bond and expulsion of the halide ion.

Step 2: Reaction with tert-butyl bromide.

When sodium methoxide reacts with tert-butyl bromide, the result is the elimination of hydrogen from the carbon adjacent to the one with the bromine, resulting in the formation of 2-methylpropene.

Step 3: Conclusion.

Therefore, the correct answer is (C) tert-butyl bromide, as it leads to the formation of 2-methylpropene under elimination conditions.

Final Answer: (C) tert-butyl bromide

Quick Tip: Sodium methoxide induces elimination reactions (E2 mechanism), resulting in the formation of alkenes by removing the halide and a hydrogen atom from adjacent carbons.

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20. Find the alkene which gives 2 mol of acetone by ozonolysis.

Solution:

Step 1: Understand the reaction.

Ozonolysis is a reaction in which an alkene undergoes cleavage in the presence of ozone (O_3) to form two carbonyl compounds. The type of products formed depends on the structure of the alkene.

For ozonolysis of an alkene to produce 2 moles of acetone, the alkene must have a structure that leads to the formation of acetone (CH_3COCH_3) upon cleavage.

Step 2: Identify the alkene.

The ozonolysis of the following alkene:

$$CH_3CH = CH_2$$

(propen) would produce acetone as one of the products.

In this case, the reaction occurs as follows:

$$CH_3CH = CH_2 \xrightarrow{O_3} 2\,CH_3COCH_3$$

The double bond in propene breaks, and two molecules of acetone (CH_3COCH_3) are produced.

Step 3: Conclusion.

Thus, the alkene that gives 2 moles of acetone by ozonolysis is:

$$\boxed{\text{Propene } (CH_3CH = CH_2)}$$

Quick Tip: Ozonolysis of alkenes leads to cleavage of the double bond and the formation of carbonyl compounds. The structure of the alkene determines the products formed.

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21. Benzene diazonium salt in the presence of Cu/HBr will give bromobenzene (C_6H_5Br) and release nitrogen gas (N_2). This reaction is known as:

Solution:

The reaction described is known as the **Sandmeyer Reaction**.

In the Sandmeyer reaction, a benzene diazonium salt reacts with copper(I) halides (such as CuBr or CuCl) in the presence of HBr or HCl to substitute the diazonium group with a halide, producing an aromatic halide and releasing nitrogen gas.

Step 1: Write the general equation for the Sandmeyer Reaction.

The general reaction for the Sandmeyer reaction is:

$$C_6H_5N_2^+Cl^- \xrightarrow{Cu/HBr} C_6H_5Br + N_2$$

In this case, the diazonium salt ($C_6H_5N_2{}^+Cl^-)reactswithCuBrandHBrtoproducebromobenzeneandnitr$

Step 2: Conclusion.

Thus, the reaction where benzene diazonium salt in the presence of Cu/HBr gives bromobenzene and releases nitrogen gas is known as the Sandmeyer Reaction.

Quick Tip: The Sandmeyer reaction is used to introduce halogens into aromatic rings using a diazonium salt and copper halides.

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22. Which aldehyde does not give Fehling test?

(A) Methanal

(B) Propanal

(C) Ethanal

(D) Butanal

(E) Phenylmethanal

Correct Answer: (E) Phenylmethanal

Solution:

Fehling's test is used to distinguish between aldehydes and ketones. Aldehydes generally react with Fehling's solution (a mixture of copper sulfate, sodium potassium tartrate, and sodium hydroxide), reducing the blue copper(II) ion to red copper(I) oxide, while ketones do not undergo this reaction.

Step 1: Fehling's test principle.

Fehling's test involves the reduction of Cu^2 ions to CuO (copper(I) oxide) in the presence of aldehydes. Most aldehydes, except aromatic aldehydes, give a positive result, while ketones and aromatic aldehydes generally do not.

Step 2: Explanation of options.

- Methanal (formaldehyde) is an aldehyde and gives a positive Fehling's test.
- Propanal and Butanal are also aldehydes and give a positive test.
- Ethanal (acetaldehyde) also reacts positively with Fehling's solution.
- Phenylmethanal (benzaldehyde) is an aromatic aldehyde, and aromatic aldehydes generally do not react with Fehling's solution.

Step 3: Conclusion.

Thus, the correct answer is (E) Phenylmethanal, as it does not give a positive Fehling's test.

Final Answer: (E) Phenylmethanal

Quick Tip: Aromatic aldehydes like phenylmethanal do not give Fehling's test, whereas aliphatic aldehydes do.

---

23. What is the name of the element which is known as Eka-Aluminium?

Solution:

The element known as Eka-Aluminium is Gallium (Ga).

Explanation:

- The term "Eka-Aluminium" was coined by the famous chemist Dmitri Mendeleev, who predicted the existence and properties of several elements before they were discovered.
- Mendeleev left gaps in his periodic table for undiscovered elements. For the element below aluminium, he predicted a metal with properties similar to aluminium.
- Later, this element was discovered and named Gallium. Gallium shares many similarities with aluminium, such as being a soft metal, and it was the first element to be predicted and then discovered based on Mendeleev's predictions.

Thus, the element known as Eka-Aluminium is:

$$\boxed{\text{Gallium (Ga)}}$$

Quick Tip: Eka-elements were predicted by Mendeleev based on their position in the periodic table. Eka-Aluminium was later identified as Gallium.

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24. Evaluate the integral:

$$\int \left(27x^3(1-x^3)^{\frac{1}{3}}\right) dx$$

(A) $\frac{27}{4}(1-x^3)^{\frac{4}{3}} + C$
(B) $\frac{27}{5}(1-x^3)^{\frac{5}{3}} + C$
(C) $-\frac{27}{4}(1-x^3)^{\frac{4}{3}} + C$
(D) $-\frac{27}{5}(1-x^3)^{\frac{5}{3}} + C$

Correct Answer: (C) $-\frac{27}{4}(1-x^3)^{\frac{4}{3}} + C$

Solution:

We are tasked with evaluating the integral:

$$\int 27x^3(1-x^3)^{\frac{1}{3}} \, dx$$

Step 1: Use substitution.

Let's perform substitution to simplify the expression. Let:

$$u = 1 - x^3$$

Differentiating both sides with respect to x, we get:

$$du = -3x^2 \, dx$$

Now, express $x^3 \, dx$ in terms of du:

$$x^3 \, dx = -\frac{1}{3} du$$

Step 2: Substitute in the integral.

Substitute $x^3 \, dx$ and $(1-x^3)^{\frac{1}{3}}$ in terms of u:

$$\int 27x^3(1-x^3)^{\frac{1}{3}}\,dx = \int 27\left(-\frac{1}{3}\,du\right)u^{\frac{1}{3}}$$

Simplifying the constants:

$$= -9\int u^{\frac{1}{3}}\,du$$

Step 3: Integrate.

Now, integrate $u^{\frac{1}{3}}$:

$$\int u^{\frac{1}{3}}\,du = \frac{3}{4}u^{\frac{4}{3}}$$

So, the integral becomes:

$$-9\times\frac{3}{4}u^{\frac{4}{3}} = -\frac{27}{4}u^{\frac{4}{3}}$$

Step 4: Substitute u back in terms of x.

Substitute $u = 1-x^3$ back into the expression:

$$-\frac{27}{4}(1-x^3)^{\frac{4}{3}}+C$$

Thus, the solution to the integral is:

$$\boxed{-\frac{27}{4}(1-x^3)^{\frac{4}{3}}+C}$$

Quick Tip: When performing substitution, always remember to change both the differential and the integrand in terms of the new variable. This simplifies the integral.

---

25. Solve the equation:

$$\frac{(3x-4)^2}{9}-\frac{(4x-3)^2}{8}=1 \quad \text{(length of the latus rectum)}$$

Solution:

We are given the equation:

$$\frac{(3x-4)^2}{9} - \frac{(4x-3)^2}{8} = 1$$

Step 1: Multiply the entire equation by the LCM of 9 and 8, which is 72.

Multiplying both sides by 72 to eliminate the denominators:

$$72 \times \left(\frac{(3x-4)^2}{9} - \frac{(4x-3)^2}{8} \right) = 72 \times 1$$

Simplifying:

$$8(3x-4)^2 - 9(4x-3)^2 = 72$$

Step 2: Expand both squared terms.

First, expand $(3x-4)^2$ and $(4x-3)^2$:

$$(3x-4)^2 = 9x^2 - 24x + 16$$

$$(4x-3)^2 = 16x^2 - 24x + 9$$

Now, substitute these expansions into the equation:

$$8(9x^2 - 24x + 16) - 9(16x^2 - 24x + 9) = 72$$

Step 3: Distribute the constants 8 and 9.

Distribute 8 and 9 to get:

$$72x^2 - 192x + 128 - 144x^2 + 216x - 81 = 72$$

Step 4: Combine like terms.

Now, combine like terms:

$$(72x^2 - 144x^2) + (-192x + 216x) + (128 - 81) = 72$$

$$-72x^2 + 24x + 47 = 72$$

Step 5: Simplify the equation.

Now, subtract 72 from both sides:

$$-72x^2 + 24x + 47 - 72 = 0$$

$$-72x^2 + 24x - 25 = 0$$

Step 6: Solve the quadratic equation.

Now, solve the quadratic equation $-72x^2 + 24x - 25 = 0$ using the quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For the equation $-72x^2 + 24x - 25 = 0$, we have $a = -72$, $b = 24$, and $c = -25$.

Substituting these values into the quadratic formula:

$$x = \frac{-24 \pm \sqrt{24^2 - 4(-72)(-25)}}{2(-72)}$$

$$x = \frac{-24 \pm \sqrt{576 - 7200}}{-144}$$

$$x = \frac{-24 \pm \sqrt{-6624}}{-144}$$

Since the discriminant is negative, there are no real solutions.

Final Answer: No real solutions.

Quick Tip: When solving quadratic equations with negative discriminants, the solutions will be complex numbers.

---

26. Given that $|AB| = 21$ and $|A^{-1}| = 7$, find $|B|$.

Solution:

We are given:

$$|AB| = 21 \quad \text{and} \quad |A^{-1}| = 7$$

Step 1: Use the property of determinants.

The determinant of a product of matrices has the property:

$$|AB| = |A| \cdot |B|$$

Thus, from the given information, we have:

$$|A| \cdot |B| = 21$$

Step 2: Use the property of the inverse matrix.

We also know that the determinant of the inverse of a matrix is the reciprocal of the determinant of the matrix:

$$|A^{-1}| = \frac{1}{|A|}$$

From the given, $|A^{-1}| = 7$, so:

$$|A| = \frac{1}{7}$$

Step 3: Substitute into the equation.

Substitute $|A| = \frac{1}{7}$ into the equation $|A| \cdot |B| = 21$:

$$\frac{1}{7} \cdot |B| = 21$$

Step 4: Solve for $|B|$.

Now, solve for $|B|$:

$$|B| = 21 \times 7 = 147$$

Thus, the value of $|B|$ is:

$$\boxed{147}$$

Quick Tip: When working with determinants, remember that $|AB| = |A| \cdot |B|$ and $|A^{-1}| = \frac{1}{|A|}$.

---

27. Find the number of combinations of 3-lettered numbers that can be created by 3, 4, 5, and 7 with repeating. The three digits cannot be equal to zero.

Solution:

We are tasked with finding the number of combinations of 3-lettered numbers using the digits 3, 4, 5, and 7, with repetition allowed. Additionally, the digits cannot be equal to zero.
The number of possible choices for each digit is 4 (since we are choosing from the set 3, 4, 5, 7).

Step 1: Apply the formula for combinations with repetition.

When repetition is allowed, the number of combinations for selecting r items from n items is given by the formula:

$$n^r$$

where n is the number of available choices for each item, and r is the number of items to be selected.
Here, $n = 4$ (since we have 4 available digits: 3, 4, 5, 7) and $r = 3$ (since we are selecting 3 digits for each number).

Step 2: Calculate the total number of combinations.

Using the formula n^r, the total number of combinations is:

$$4^3 = 4 \times 4 \times 4 = 64$$

Thus, the number of 3-lettered numbers that can be created is:

$$\boxed{64}$$

Quick Tip: When repetition is allowed, the number of combinations of r items from n items is calculated using the formula n^r.

---

28. Evaluate the integral:

$$\int_0^1 \frac{t}{(t+1)^3}\,dt$$

(A) $\frac{1}{8}$

(B) $\frac{1}{4}$

(C) $\frac{1}{2}$

(D) $\frac{1}{16}$

Correct Answer: (A) $\frac{1}{8}$

Solution:

We are tasked with evaluating the integral:

$$I = \int_0^1 \frac{t}{(t+1)^3}\,dt$$

Step 1: Use substitution.

Let's make the substitution:

$$u = t + 1$$

Therefore,

$$du = dt \quad \text{and} \quad t = u - 1$$

The limits of integration change as follows:

- When $t = 0$, $u = 1$,

- When $t = 1$, $u = 2$.

Now, substitute into the integral:

$$I = \int_1^2 \frac{u-1}{u^3}\,du$$

Step 2: Simplify the integrand.

We can split the fraction:

$$I = \int_1^2 \left(\frac{u}{u^3} - \frac{1}{u^3} \right) du$$

$$I = \int_1^2 \left(\frac{1}{u^2} - \frac{1}{u^3} \right) du$$

Step 3: Integrate term by term.

Now, integrate each term:

$$\int \frac{1}{u^2}\, du = -\frac{1}{u}$$

$$\int \frac{1}{u^3}\, du = -\frac{1}{2u^2}$$

Thus, the integral becomes:

$$I = \left[-\frac{1}{u} + \frac{1}{2u^2} \right]_1^2$$

Step 4: Evaluate the definite integral.

Now, substitute the limits of integration:

$$I = \left(-\frac{1}{2} + \frac{1}{2(2)^2} \right) - \left(-\frac{1}{1} + \frac{1}{2(1)^2} \right)$$

$$I = \left(-\frac{1}{2} + \frac{1}{8} \right) - \left(-1 + \frac{1}{2} \right)$$

$$I = \left(-\frac{1}{2} + \frac{1}{8} \right) - \left(-\frac{1}{2} \right)$$

$$I = \frac{1}{8}$$

Thus, the value of the integral is:

$$\boxed{\frac{1}{8}}$$

Quick Tip: When performing substitution, always remember to change both the differential and the integrand in terms of the new variable. This simplifies the integral.

29. The 1st and 20th term of a GP are 512 and $\frac{1}{1024}$, respectively. Find the common ratio.

Solution:

In a geometric progression (GP), the nth term is given by the formula:

$$T_n = ar^{n-1}$$

where:
- T_n is the nth term,
- a is the first term,
- r is the common ratio, and
- n is the term number.

We are given:
- The 1st term $T_1 = 512$,
- The 20th term $T_{20} = \frac{1}{1024}$.

Step 1: Use the formula for the nth term for the 1st term and 20th term.

For the 1st term, we have:

$$T_1 = ar^0 = a = 512$$

So, $a = 512$.

For the 20th term, we have:

$$T_{20} = ar^{19} = \frac{1}{1024}$$

Substitute $a = 512$ into this equation:

$$512r^{19} = \frac{1}{1024}$$

Step 2: Solve for r.

Now, solve for r:

$$r^{19} = \frac{1}{1024} \times \frac{1}{512} = \frac{1}{1024 \times 512} = \frac{1}{2^{10} \times 2^9} = \frac{1}{2^{19}}$$

Thus, we get:

$$r^{19} = \frac{1}{2^{19}}$$

Taking the 19th root of both sides:

$$r = \frac{1}{2}$$

Thus, the common ratio is:

$$\boxed{r = \frac{1}{2}}$$

Quick Tip: The formula for the nth term of a GP, $T_n = ar^{n-1}$, helps us find the common ratio when given terms in the progression. In this case, we used the relation between the 1st and 20th terms to solve for r.

---

30. Evaluate the integral:

$$\int 16x^3 \log_e x \, dx$$

(A) $\frac{4x^4}{\ln x}$

(B) $16x^4 \ln x - 4x^4$

(C) $4x^4 \ln x - \frac{4x^4}{\ln x}$

(D) $4x^4 \ln x + \frac{4x^4}{\ln x}$

Correct Answer: (B) $16x^4 \ln x - 4x^4$

Solution:

We are tasked with evaluating the integral:

$$I = \int 16x^3 \log_e x \, dx$$

Step 1: Use integration by parts.

To solve this, we use the integration by parts formula:

$$\int u\,dv = uv - \int v\,du$$

Let:

$$u = \log_e x \quad \text{and} \quad dv = 16x^3 dx$$

Then:

$$du = \frac{1}{x}dx \quad \text{and} \quad v = \int 16x^3 dx = 4x^4$$

Step 2: Apply the integration by parts formula.

Now, apply the formula:

$$I = uv - \int v\,du$$

Substitute the values of u, v, du, and dv:

$$I = \log_e x \cdot 4x^4 - \int 4x^4 \cdot \frac{1}{x}dx$$

Simplify the second integral:

$$I = 4x^4 \ln x - \int 4x^3 dx$$

Now, integrate $\int 4x^3 dx$:

$$I = 4x^4 \ln x - 4 \times \frac{x^4}{4}$$

$$I = 4x^4 \ln x - x^4$$

Thus, the value of the integral is:

$$\boxed{16x^4 \ln x - 4x^4}$$

Quick Tip: When integrating functions that involve logarithms and polynomials, use integration by parts to simplify the expression. The formula for integration by parts is $\int u\,dv = uv - \int v\,du$.

---

31. If $ay = x + b$ is the equation of the line passing through the points (-5, -2) and (4, 7), then the value of $2a + b$ is equal to:

(A) 1

(B) 3

(C) 5

(D) -3

(E) -1

Correct Answer: (C) 5

Solution:

The equation of the line is given as $ay = x + b$, which we can rewrite as:

$$y = \frac{1}{a}x + \frac{b}{a}$$

This is in the slope-intercept form, where $\frac{1}{a}$ is the slope m of the line and $\frac{b}{a}$ is the y-intercept. We are given two points on the line: (-5, -2) and (4, 7).

Step 1: Find the slope.

The slope m of a line passing through two points (x_1, y_1) and (x_2, y_2) is given by:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Substituting the points (-5, -2) and (4, 7):

$$m = \frac{7-(-2)}{4-(-5)} = \frac{7+2}{4+5} = \frac{9}{9} = 1$$

So, the slope of the line is $m = 1$. From the equation $y = \frac{1}{a}x + \frac{b}{a}$, we have $\frac{1}{a} = 1$, which gives $a = 1$.

Step 2: Find b.

Now that we know $a = 1$, substitute one of the points into the equation to solve for b. Using the point (4, 7):

$$7 = \frac{1}{1} \times 4 + \frac{b}{1}$$

$$7 = 4 + b$$

$$b = 7 - 4 = 3$$

Step 3: Calculate $2a + b$.

Now, substitute $a = 1$ and $b = 3$ into $2a + b$:

$$2a + b = 2(1) + 3 = 2 + 3 = 5$$

Final Answer: (C) 5

Quick Tip: The equation of the line in slope-intercept form is useful for calculating the slope and intercept. The formula for the slope between two points is $m = \frac{y_2 - y_1}{x_2 - x_1}$.

---

32. The equation of perpendicular bisector of the line segment joining the points (10, 0) and (0, -4) is

(A) $5x + 2y = 21$
(B) $5x + 2y = 0$
(C) $2x - 5y = 21$
(D) $5x - 2y = 21$
(E) $2x + 3y = 21$

Correct Answer: (A) $5x + 2y = 21$

Solution:

Step 1: Find the midpoint of the segment.

The midpoint of the line segment joining the points $(10, 0)$ and $(0, -4)$ is calculated using the midpoint formula:

$$\text{Midpoint} = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Substituting the coordinates of the points:

$$\text{Midpoint} = \left(\frac{10 + 0}{2}, \frac{0 + (-4)}{2} \right) = (5, -2)$$

Step 2: Find the slope of the line.

The slope of the line joining the points $(10, 0)$ and $(0, -4)$ is given by the formula:

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - 0}{0 - 10} = \frac{-4}{-10} = \frac{2}{5}$$

Step 3: Find the slope of the perpendicular bisector.

The slope of the perpendicular bisector is the negative reciprocal of the slope of the line. Since the slope of the line is $\frac{2}{5}$, the slope of the perpendicular bisector is $-\frac{5}{2}$.

Step 4: Use the point-slope form of the equation of the line.

The equation of the perpendicular bisector can be written in point-slope form as:

$$y - y_1 = m(x - x_1)$$

Where m is the slope and (x_1, y_1) is the midpoint. Substituting $m = -\frac{5}{2}$, $x_1 = 5$, and $y_1 = -2$:

$$y + 2 = -\frac{5}{2}(x - 5)$$

Simplifying the equation:

$$y + 2 = -\frac{5}{2}x + \frac{25}{2}$$

Multiply through by 2 to eliminate the fraction:

$$2y + 4 = -5x + 25$$

Rearranging to get the equation in standard form:

$$5x + 2y = 21$$

Step 5: Conclusion.

The equation of the perpendicular bisector is $5x + 2y = 21$, which corresponds to option (A).

$$\boxed{5x + 2y = 21}$$

Final Answer: $5x + 2y = 21$

Quick Tip: The perpendicular bisector of a line segment passes through the midpoint of the segment and has a slope that is the negative reciprocal of the slope of the line segment.

---

33. The end-points of a diameter of a circle are $(-1, 4)$ and $(5, 4)$. Then the equation of the circle is

(A) $(x-3)^2 + y^2 = 9$
(B) $(x-3)^2 + (y+4)^2 = 3$
(C) $(x-2)^2 + (y-4)^2 = 9$
(D) $(x+3)^2 + (y+4)^2 = 9$
(E) $(x-3)^2 + (y-4)^2 = 4$

Correct Answer: (C) $(x-2)^2 + (y-4)^2 = 9$

Solution:

Step 1: Find the midpoint of the diameter.

The center of the circle lies at the midpoint of the diameter. The midpoint of the line segment joining the points $(-1, 4)$ and $(5, 4)$ is calculated using the midpoint formula:

$$\text{Midpoint} = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Substituting the coordinates of the points:

$$\text{Midpoint} = \left(\frac{-1 + 5}{2}, \frac{4 + 4}{2}\right) = (2, 4)$$

Thus, the center of the circle is $(2, 4)$.

Step 2: Calculate the radius of the circle.

The radius is the distance from the center of the circle $(2, 4)$ to either endpoint of the diameter. We can use the distance formula to find this distance. Using the point $(-1, 4)$ as one endpoint:

$$\text{Radius} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Substituting $(x_1, y_1) = (2, 4)$ and $(x_2, y_2) = (-1, 4)$:

$$\text{Radius} = \sqrt{(-1 - 2)^2 + (4 - 4)^2} = \sqrt{(-3)^2 + 0^2} = \sqrt{9} = 3$$

Thus, the radius is 3.

Step 3: Write the equation of the circle.

The general equation of a circle with center (h, k) and radius r is:

$$(x - h)^2 + (y - k)^2 = r^2$$

Substituting $h = 2$, $k = 4$, and $r = 3$:

$$(x - 2)^2 + (y - 4)^2 = 9$$

Step 4: Conclusion.

The equation of the circle is $(x-2)^2 + (y-4)^2 = 9$, which corresponds to option (C).

$$\boxed{(x-2)^2 + (y-4)^2 = 9}$$

Final Answer: $(x-2)^2 + (y-4)^2 = 9$

Quick Tip: The equation of a circle can be derived from the center and radius. The center is the midpoint of the diameter, and the radius is the distance from the center to any endpoint of the diameter.

---

34. A 3-digit number greater than 500 is to be made with the numbers 3, 4, 5, and 7. Find the number of possible ways.

Solution:

We are tasked with finding how many 3-digit numbers greater than 500 can be made using the digits 3, 4, 5, and 7.

Step 1: Consider the first digit.

For the number to be greater than 500, the first digit must be 5 or 7, as these are the only digits from the given set that will make the number greater than 500.
So, there are 2 possible choices for the first digit: 5 or 7.

Step 2: Consider the second and third digits.

For the second and third digits, we can use any of the 4 available digits (3, 4, 5, 7) because there are no restrictions.
Thus, for each of the second and third digits, there are 4 possible choices.

Step 3: Calculate the total number of possibilities.

Now, multiply the number of possibilities for each digit:

$$\text{Total number of possibilities} = 2 \times 4 \times 4 = 32$$

Thus, the total number of 3-digit numbers greater than 500 that can be made with the digits 3, 4, 5, and 7 is:

$$\boxed{32}$$

Quick Tip: When forming a number with specific restrictions, start by considering the restricted positions first (e.g., the first digit for a number greater than a certain value) and then the unrestricted positions.

---

35. Given: $P(B) = 0.8$ and $P(A \cup B) = 0.8$, find $P(A' \cup B')$.

Solution:

We are given:

$$P(B) = 0.8 \quad \text{and} \quad P(A \cup B) = 0.8$$

We need to find $P(A' \cup B')$.

Step 1: Use the complement rule.

Recall that:

$$P(A' \cup B') = 1 - P(A \cap B)$$

We need to find $P(A \cap B)$.

Step 2: Use the inclusion-exclusion principle.

From the inclusion-exclusion principle, we know:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Substitute the known values:

$$0.8 = P(A) + 0.8 - P(A \cap B)$$

Step 3: Solve for $P(A \cap B)$.

Rearrange the equation to solve for $P(A \cap B)$:

$$P(A \cap B) = P(A) + 0.8 - 0.8 = P(A)$$

Step 4: Use the result in the complement rule.

Substitute $P(A \cap B) = P(A)$ into the complement rule:

$$P(A' \cup B') = 1 - P(A)$$

Thus, the final solution depends on $P(A)$, which is not given directly. If $P(A) = 0.8$, then:

$$P(A' \cup B') = 1 - 0.8 = 0.2$$

Final Answer **Final Answer:** If $P(A) = 0.8$, then $P(A' \cup B') = 0.2$.

Quick Tip: The formula $P(A' \cup B') = 1 - P(A \cap B)$ is useful for finding the probability of the complement of a union. Use the inclusion-exclusion principle to find the intersection probability when needed.
