# BITSAT 2026 April 19 (Shift-2)

## Question Paper (Memory-Based) with Solutions

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### 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 390 marks.

(iii) **Structure:** The paper has 4 Sections:

- **Part 1:** 30 Multiple Choice Questions (Physics).
- **Part 2:** 30 Multiple Choice Questions (Chemistry).
- **Part 3:** 10 Multiple Choice Questions (English Proficiency),
  20 Multiple Choice Questions (Logical Reasoning)
- **Part 4:** 40 Multiple Choice Questions (Mathematics/Biology)

(iv) **Compulsory Questions:** All 130 questions are compulsory,and +12 Questions(Optional Extra Questions)

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

(vi) **Correct Answer:** +3 marks.

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

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

## PHYSICS

**1. Young's moduli of the material of wires A and B are in the ratio of 1:4, while its area of cross sections are in the ratio of 1:3. If the same amount of load is applied to both the wires, the amount of elongation produced in the wires A and B will be in the ratio of (Assume length**

**of wires A and B are same)**

(A) 1:12

(B) 12:1

(C) 36:1

(D) 1:36

**Correct Answer:** (B) 12:1

**Solution:**

**Step 1: Understanding the Question:**

The question asks for the ratio of elongation ($\Delta L$) in two wires A and B given the ratios of their Young's moduli, cross-sectional areas, and assuming the same load and length for both.

**Step 2: Key Formula or Approach:**

Young's modulus ($Y$) is defined as:

$$Y = \frac{\text{Stress}}{\text{Strain}} = \frac{F/A}{\Delta L/L} = \frac{FL}{A\Delta L}$$

Rearranging for elongation ($\Delta L$):

$$\Delta L = \frac{FL}{AY}$$

**Step 3: Detailed Explanation:**

Given: - Ratio of Young's moduli: $\frac{Y_A}{Y_B} = \frac{1}{4}$ - Ratio of areas: $\frac{A_A}{A_B} = \frac{1}{3}$ - Same load: $F_A = F_B = F$ - Same length: $L_A = L_B = L$

The ratio of elongations is:

$$\frac{\Delta L_A}{\Delta L_B} = \frac{\frac{FL}{A_A Y_A}}{\frac{FL}{A_B Y_B}} = \frac{A_B Y_B}{A_A Y_A}$$

$$\frac{\Delta L_A}{\Delta L_B} = \left(\frac{A_B}{A_A}\right) \times \left(\frac{Y_B}{Y_A}\right) = \left(\frac{3}{1}\right) \times \left(\frac{4}{1}\right) = \frac{12}{1}$$

**Step 4: Final Answer:**

The ratio of elongation produced in wires A and B is 12:1.

**Quick Tip:** When force and length are constant, elongation is inversely proportional to the product of area and Young's modulus ($\Delta L \propto \frac{1}{AY}$). Just invert the given ratios and multiply them to get the answer quickly.

 

**2. A hollow glass stopper of relative density 2.5 just sinks in water. The ratio of volume of cavity to that of stopper is**

(A) 1:2

(B) 3:5

(C) 1:5

(D) 3:2

**Correct Answer:** (D) 3:2

**Solution:**

**Step 1: Understanding the Question:**

A "just sinking" object has an average density equal to the density of the fluid (water). We need to find the ratio of the cavity volume ($V_c$) to the material volume of the stopper ($V_m$).

**Step 2: Key Formula or Approach:**

For an object to just sink, the total weight must equal the buoyancy force:

$$W = B \Rightarrow \rho_{\text{avg}} V_{\text{total}} g = \rho_w V_{\text{total}} g \Rightarrow \rho_{\text{avg}} = \rho_w$$

**Step 3: Detailed Explanation:**

Let $V_c$ be the volume of the cavity and $V_m$ be the volume of the glass material. The total volume $V_t = V_m + V_c$. The mass of the stopper is purely from the glass material: $m = \rho_g V_m$. Given relative density of glass is 2.5, so $\rho_g = 2.5\rho_w$.

For "just sinking":

$$\text{Weight of stopper} = \text{Buoyancy force}$$

$$\rho_g V_m g = \rho_w V_t g$$

$$(2.5\rho_w)V_m = \rho_w(V_m + V_c)$$

$$2.5V_m = V_m + V_c$$

$$1.5V_m = V_c$$

$$\frac{V_c}{V_m} = \frac{1.5}{1} = \frac{3}{2}$$

 

**Step 4: Final Answer:**

The ratio of the volume of the cavity to the material volume of the stopper is 3:2.

**Quick Tip:** For hollow objects, "just sinks" implies Relative Density of material $\times V_{\text{material}} = V_{\text{total}}$. Here, $2.5V_m = V_m + V_c$, which directly leads to $1.5V_m = V_c$.

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**3. A gas undergoes a process in which the pressure and volume are related by $VP^n =$ constant. The bulk modulus of the gas is**

(A) nP

(B) $P^{1/n}$

(C) P/n

(D) $P^n$

**Correct Answer:** (C) P/n

**Solution:**

**Step 1: Understanding the Question:**

We need to find the Bulk Modulus ($B$) for a gas following the polytropic-like process $VP^n = C$.

**Step 2: Key Formula or Approach:**

The Bulk Modulus is defined as:

$$B = -V\frac{dP}{dV}$$

**Step 3: Detailed Explanation:**

Given the relation: $VP^n = k$ Taking the natural logarithm on both sides:

$$\ln V + n \ln P = \ln k$$

Differentiating with respect to volume $V$:

$$\frac{1}{V} + n\left(\frac{1}{P}\right)\frac{dP}{dV} = 0$$

 

Rearranging for $\frac{dP}{dV}$:

$$\frac{n}{P}\frac{dP}{dV} = -\frac{1}{V} \Rightarrow \frac{dP}{dV} = -\frac{P}{nV}$$

Now, substitute this into the expression for Bulk Modulus:

$$B = -V\left(-\frac{P}{nV}\right) = \frac{P}{n}$$

**Step 4: Final Answer:**

The bulk modulus of the gas is P/n.

**Quick Tip:** For a general process $P^x V^y = C$, the bulk modulus is $B = \frac{x}{y}P$. Here the equation is $V^1 P^n = C$, so $B = \frac{1}{n}P$.

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**4. The initial pressure and volume of an ideal gas are $P_0$ and $V_0$. The final pressure of the gas when the gas is suddenly compressed to volume $V_0/4$ will be: (Given $\gamma$ = ratio of specific heats at constant pressure and at constant volume)**

(A) $P_0$

(B) $4P_0$

(C) $P_0(4)^\gamma$

(D) $P_0(4)^{1/\gamma}$

**Correct Answer:** (C) $P_0(4)^\gamma$

**Solution:**

**Step 1: Understanding the Question:**

The term "suddenly compressed" indicates that the process is adiabatic, as there is no time for heat exchange with the surroundings.

**Step 2: Key Formula or Approach:**

For an adiabatic process, the relationship between pressure and volume is:

$$PV^\gamma = \text{constant}$$

**Step 3: Detailed Explanation:**

Initial state: $P_1 = P_0, V_1 = V_0$ Final state: $P_2 = ?, V_2 = V_0/4$

Applying the adiabatic equation:

$$P_1 V_1^\gamma = P_2 V_2^\gamma$$

$$P_0 V_0^\gamma = P_2 \left(\frac{V_0}{4}\right)^\gamma$$

Solving for $P_2$:

$$P_2 = P_0 \left(\frac{V_0}{V_0/4}\right)^\gamma$$

$$P_2 = P_0 (4)^\gamma$$

**Step 4: Final Answer:**

The final pressure of the gas is $P_0(4)^\gamma$.

**Quick Tip:** In thermodynamic problems, words like "sudden" or "rapid" imply an adiabatic process ($PV^\gamma = \text{const}$), while "slow" implies an isothermal process ($PV = \text{const}$).

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## CHEMISTRY

**5. The Bohr orbit radius for the hydrogen atom (n = 1) is approximately 0.530 Å. The radius for the first excited state (n = 2) orbit is (in Å)**

(A) 0.13

(B) 1.06

(C) 4.77

(D) 2.12

**Correct Answer:** (D) 2.12

**Solution:**

**Step 1: Understanding the Question:**

We need to find the radius of the second orbit (n=2, first excited state) given the radius of the ground state (n=1).

**Step 2: Key Formula or Approach:**

According to Bohr's model, the radius of the $n$-th orbit of a hydrogen-like atom is:

$$r_n = r_0 \frac{n^2}{Z}$$

For Hydrogen, $Z = 1$, so $r_n \propto n^2$.

**Step 3: Detailed Explanation:**

Given ground state radius $r_1 = 0.530$ Å. For the first excited state, $n = 2$.

$$r_2 = r_1 \times (2)^2$$

$$r_2 = 0.530 \times 4$$

$$r_2 = 2.12 \text{ Å}$$

**Step 4: Final Answer:**

The radius for the first excited state is 2.12 Å.

**Quick Tip:** Always remember the sequence of squared integers for Bohr radii: 1, 4, 9, 16... Just multiply the base ground state radius by the square of the principal quantum number.

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**6. In $PO_4^{3-}$, the formal charge on each oxygen atom and the P - O bond order respectively are**

(A) -0.75, 0.6

(B) -0.75, 1.0

(C) -0.75, 1.25

(D) -3, 1.25

**Correct Answer:** (C) -0.75, 1.25

**Solution:**

**Step 1: Understanding the Question:**

The question asks for the formal charge on individual oxygen atoms and the average bond order in the phosphate ion ($PO_4^{3-}$).

**Step 2: Detailed Explanation:**

**Formal Charge Calculation:** The total charge on the $PO_4^{3-}$ ion is -3. Due to resonance, this charge is distributed equally among all 4 oxygen atoms.

$$\text{Formal charge on each O} = \frac{\text{Total charge}}{\text{Number of O atoms}} = \frac{-3}{4} = -0.75$$

**Bond Order Calculation:** In the most stable Lewis structure of phosphate, Phosphorus has 1 double bond and 3 single bonds with Oxygen atoms.

Total number of bonds $= 2 + 1 + 1 + 1 = 5$. These 5 bonds are shared across 4 bond directions (resonance positions).

$$\text{Bond Order} = \frac{\text{Total number of bonds}}{\text{Number of resonance structures}} = \frac{5}{4} = 1.25$$

**Step 3: Final Answer:**

The formal charge is -0.75 and the bond order is 1.25.

**Quick Tip:** For symmetrical polyatomic ions, formal charge is simply (total charge)/(number of atoms). Bond order is (total valency of central atom)/(number of surrounding atoms) if all surrounding atoms are identical.

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**7. The value of x is maximum for**

(A) $MgSO_4 \cdot xH_2O$

(B) $CaSO_4 \cdot xH_2O$

(C) $BaSO_4 \cdot xH_2O$

(D) All have the same value of x.

**Correct Answer:** (A) $MgSO_4 \cdot xH_2O$

**Solution:**

**Step 1: Understanding the Question:**

The question compares the degree of hydration (number of water of crystallization, 'x') in group 2 metal sulfates.

**Step 2: Detailed Explanation:**

The extent of hydration of metal ions depends on their hydration enthalpy, which is inversely proportional to the ionic radius. Small ions have high charge density and attract more water molecules.

- $Mg^{2+}$ is the smallest in the group and forms $MgSO_4 \cdot 7H_2O$ (Epsom salt).
- $Ca^{2+}$ is larger and typically forms $CaSO_4 \cdot 2H_2O$ (Gypsum).
- $Ba^{2+}$ is very large and its sulfate is usually anhydrous ($x = 0$).

**Step 3: Final Answer:**

Since Magnesium is the smallest cation among the choices, it has the highest hydration capacity. The value of x is maximum for $MgSO_4 \cdot 7H_2O$.

**Quick Tip:** Remember the trend: as you go down Group 2, the size of the cation increases, charge density decreases, and thus the degree of hydration decreases.

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## MATHEMATICS

**8. Let P be a point on the parabola, $x^2 = 4y$. If the distance of P from the centre of the circle, $x^2 + y^2 + 6x + 8 = 0$ is minimum, then the equation of the tangent to the parabola at P, is :**

(A) $x + 4y - 2 = 0$

(B) $x + y + 1 = 0$

(C) $x - y + 3 = 0$

(D) $x + 2y = 0$

**Correct Answer:** (B) $x + y + 1 = 0$

**Solution:**

**Step 1: Understanding the Question:**

The shortest distance between a point on a curve and a fixed point (centre of the circle) occurs along the common normal.

**Step 2: Key Formula or Approach:**

Circle: $x^2 + y^2 + 6x + 8 = 0 \Rightarrow (x+3)^2 + y^2 = 1$. Centre is $C(-3,0)$. Parabola: $x^2 = 4y$. A parametric point on this parabola is $P(2t, t^2)$.

**Step 3: Detailed Explanation:**

The slope of the tangent at $P(2t, t^2)$ to $x^2 = 4y$ is: $2x = 4\frac{dy}{dx} \Rightarrow \frac{dy}{dx} = \frac{x}{2} = \frac{2t}{2} = t$. The slope of the normal at P is $m_n = -1/t$. The normal passes through centre $C(-3,0)$. Equation of normal:

$$y - t^2 = -\frac{1}{t}(x - 2t)$$

Substituting $(-3,0)$:

$$0 - t^2 = -\frac{1}{t}(-3 - 2t) \Rightarrow t^3 = -3 - 2t \Rightarrow t^3 + 2t + 3 = 0$$

By inspection, $t = -1$ is a root since $(-1)^3 + 2(-1) + 3 = -1 - 2 + 3 = 0$. So, point $P$ is $(2(-1), (-1)^2) = (-2, 1)$. The equation of the tangent at $(-2, 1)$ is:

$$x(-2) = 2(y+1) \Rightarrow -2x = 2y + 2 \Rightarrow x + y + 1 = 0$$

**Step 4: Final Answer:**

The equation of the tangent is $x + y + 1 = 0$.

**Quick Tip:** For minimum distance between a curve and a point, the normal at that point must pass through the given point. Finding 't' by inspection in a cubic equation often saves time.

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**9. If $x = \sqrt{2^{\text{cosec}^{-1} t}}$ and $y = \sqrt{2^{\sec^{-1} t}}$ $(|t| \geq 1)$, then dy/dx is equal to :**

(A) $y/x$

(B) $-y/x$

(C) $-x/y$

(D) $x/y$

**Correct Answer:** (B) $-y/x$

 

**Solution:**

**Step 1: Understanding the Question:**

The question involves parametric equations with inverse trigonometric exponents. We need to find the derivative $\frac{dy}{dx}$.

**Step 2: Key Formula or Approach:**

Recall the identity: $\sec^{-1} t + \text{cosec}^{-1} t = \frac{\pi}{2}$.

**Step 3: Detailed Explanation:**

Square both given equations: $x^2 = 2^{\text{cosec}^{-1} t}$ and $y^2 = 2^{\sec^{-1} t}$. Multiply the two results:

$$x^2 y^2 = 2^{\text{cosec}^{-1} t} \cdot 2^{\sec^{-1} t}$$

$$x^2 y^2 = 2^{\text{cosec}^{-1} t + \sec^{-1} t} = 2^{\pi/2}$$

Since $2^{\pi/2}$ is a constant, differentiate both sides with respect to $x$:

$$\frac{d}{dx}(x^2 y^2) = 0$$

$$2xy^2 + x^2(2y\frac{dy}{dx}) = 0$$

$$2xy(y + x\frac{dy}{dx}) = 0$$

Since $x, y \neq 0$:

$$y + x\frac{dy}{dx} = 0 \Rightarrow \frac{dy}{dx} = -\frac{y}{x}$$

**Step 4: Final Answer:**

The derivative $\frac{dy}{dx}$ is $-y/x$.

**Quick Tip:** Whenever you see inverse trigonometric functions that sum to $\pi/2$ in exponents, try multiplying the functions to eliminate the parameter 't'. This simplifies the differentiation significantly.

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**10. If $f(x) = \int_0^x t(\sin x - \sin t)dt$ then :**

(A) $f'''(x) - f''(x) = \cos x - 2x \sin x$

(B) $f'''(x) + f'(x) = \cos x - 2x \sin x$

(C) $f'''(x) + f''(x) = \sin x$

(D) $f'''(x) + f''(x) - f'(x) = \cos x$

 

**Correct Answer:** (B) $f'''(x)+f'(x)=\cos x-2x\sin x$

**Solution:**

**Step 1: Understanding the Question:**

We need to differentiate the given integral function up to the third order. Note that 'x' is part of the integrand, so we must separate it before differentiating.

**Step 2: Key Formula or Approach:**

Use the Leibniz Rule for differentiation under the integral sign:

$$\frac{d}{dx}\int_0^x g(x,t)dt = g(x,x)+\int_0^x \frac{\partial}{\partial x}g(x,t)dt$$

**Step 3: Detailed Explanation:**

Rewrite $f(x)$:

$$f(x)=\sin x\int_0^x t\,dt-\int_0^x t\sin t\,dt=\frac{x^2}{2}\sin x-\int_0^x t\sin t\,dt$$

Differentiating once:

$$f'(x)=\left[x\sin x+\frac{x^2}{2}\cos x\right]-[x\sin x]=\frac{x^2}{2}\cos x$$

Differentiating a second time:

$$f''(x)=x\cos x-\frac{x^2}{2}\sin x$$

Differentiating a third time:

$$f'''(x)=(\cos x-x\sin x)-(x\sin x+\frac{x^2}{2}\cos x)$$

$$f'''(x)=\cos x-2x\sin x-\frac{x^2}{2}\cos x$$

Observing that $\frac{x^2}{2}\cos x=f'(x)$, we substitute:

$$f'''(x)=\cos x-2x\sin x-f'(x)$$

$$f'''(x) + f'(x) = \cos x - 2x \sin x$$

**Step 4: Final Answer:**

The correct relation is $f'''(x) + f'(x) = \cos x - 2x \sin x$.

**Quick Tip:** Always extract terms containing 'x' outside the integral before differentiating. If you see a term in the derivative that matches an earlier order derivative, substitute it immediately to find the required differential equation.

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