

BITSAT 2026 April 19 (Shift-1)

Question Paper (Memory-Based) with Solutions

Conducted by BITS Pilani



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. In an experiment with Vernier calipers of least count 0.1 mm, when two jaws are joined together the zero of Vernier scale lies right to the zero of the main scale and 6th division of Vernier scale coincides with the main scale division. While measuring the diameter of a spheri-

cal bob, the zero of Vernier scale lies in between 3.2 cm and 3.3 cm marks, and 4th division of Vernier scale coincides with the main scale division. The diameter of bob is measured as

a) 3.26 cm

b) 3.18 cm

c) 3.25 cm

d) 3.22 cm

Correct Answer: b) 3.18 cm

Solution:

Step 1: Understanding the Question:

We need to calculate the actual diameter of a bob using Vernier caliper readings, accounting for a positive zero error.

Step 2: Key Formula or Approach:

1. Least Count (LC) = 0.1 mm = 0.01 cm.
2. Zero Error (ZE) = +(Vernier division \times LC) [since zero is to the right].
3. Observed Reading = Main Scale Reading (MSR) + (Vernier Scale Reading (VSR) \times LC).
4. Actual Reading = Observed Reading - Zero Error.

Step 3: Detailed Explanation:

Part 1: Calculate Zero Error

The zero of Vernier is to the right, so it's a positive zero error.

$$ZE = +6 \times 0.01 = +0.06 \text{ cm.}$$

Part 2: Calculate Observed Reading

MSR = 3.2 cm (since zero lies between 3.2 and 3.3).

$$VSR = 4.$$

$$\text{Observed Reading} = 3.2 + (4 \times 0.01) = 3.24 \text{ cm.}$$

Part 3: Calculate Actual Diameter

$$\text{Actual Diameter} = 3.24 - 0.06 = 3.18 \text{ cm.}$$

Step 4: Final Answer:

The diameter of the bob is 3.18 cm.

Quick Tip: Always remember: "Actual = Observed - (Zero Error)". If zero is to the right, error is positive (subtract). If zero is to the left, error is negative (effectively add).

2. A passenger sitting in a train A moving at 90 km/h observes another train B moving in the opposite direction for 8 s. If the velocity of the train B is 54 km/h, then length of train B is:

a) 120 m

b) 200 m

c) 320 m

d) 80 m

Correct Answer: c) 320 m

Solution:**Step 1: Understanding the Question:**

The passenger in train A sees the entirety of train B pass by. We need to find the length of train B using the relative speed and time of observation.

Step 2: Key Formula or Approach:

1. For opposite directions, Relative Velocity $V_{rel} = V_A + V_B$.
2. Convert km/h to m/s by multiplying with $\frac{5}{18}$.
3. Distance (Length of train B) = $V_{rel} \times \text{time}$.

Step 3: Detailed Explanation:

Velocity of Train A, $V_A = 90 \times \frac{5}{18} = 25 \text{ m/s}$.

Velocity of Train B, $V_B = 54 \times \frac{5}{18} = 15 \text{ m/s}$.

Since they move in opposite directions, relative velocity of B with respect to A:

$$V_{rel} = 25 + 15 = 40 \text{ m/s}$$

The passenger sees train B for 8 seconds. In this time, the entire length of train B passes the passenger.

$$\text{Length of Train B} = 40 \text{ m/s} \times 8 \text{ s} = 320 \text{ m.}$$

Step 4: Final Answer:

The length of train B is 320 m.

Quick Tip: Note that we only use the length of the train that is being "observed" passing a "point passenger". We don't add the length of train A because the passenger is a single point observer.

3. A vector $\sqrt{3}\hat{i} + \hat{j}$ rotates about its tail through an angle 30° in clock wise direction then the new vector is

a) $4\hat{i}$

b) $2\hat{i}$

c) \hat{j}

d) \hat{i}

Correct Answer: b) $2\hat{i}$

Solution:

Step 1: Understanding the Question:

A vector is rotated in a 2D plane. Rotation changes the direction but leaves the magnitude of the vector unchanged.

Step 2: Key Formula or Approach:

1. Magnitude $|\vec{A}| = \sqrt{x^2 + y^2}$.
2. Initial angle $\theta = \tan^{-1}(y/x)$.

Step 3: Detailed Explanation:

Let the initial vector be $\vec{A} = \sqrt{3}\hat{i} + \hat{j}$.

Magnitude: $|\vec{A}| = \sqrt{(\sqrt{3})^2 + 1^2} = \sqrt{3+1} = 2$.

Initial angle with positive x-axis: $\theta = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = 30^\circ$.

The vector is rotated 30° **clockwise**.

New angle with x-axis = $30^\circ - 30^\circ = 0^\circ$.

The new vector has magnitude 2 and is directed along the positive x-axis.

New Vector = $2(\cos 0^\circ \hat{i} + \sin 0^\circ \hat{j}) = 2(1\hat{i} + 0\hat{j}) = 2\hat{i}$.

Step 4: Final Answer:

The new vector is $2\hat{i}$.

Quick Tip: Always check the magnitude first. The magnitude must remain 2. Options (c) and (d) have magnitudes 1 and can be eliminated immediately.

4. If the minimum force required to move a body up an inclined plane of inclination 45° is 3 times the force required to just prevent it sliding down, the coefficient of friction is

- a) 0.5
- b) 0.9
- c) 0.3
- d) 4.1

Correct Answer: a) 0.5

Solution:

Step 1: Understanding the Question:

We need to compare the force required to push an object up an incline versus the force required to keep it from sliding down under the influence of friction.

Step 2: Key Formula or Approach:

1. Force to move up: $F_1 = mg(\sin \theta + \mu \cos \theta)$.
2. Force to prevent sliding down: $F_2 = mg(\sin \theta - \mu \cos \theta)$.

Step 3: Detailed Explanation:

Given: $\theta = 45^\circ$ and $F_1 = 3F_2$.

$$mg(\sin 45^\circ + \mu \cos 45^\circ) = 3mg(\sin 45^\circ - \mu \cos 45^\circ)$$

Since $\sin 45^\circ = \cos 45^\circ = \frac{1}{\sqrt{2}}$, we can cancel these terms:

$$\frac{1}{\sqrt{2}}(1 + \mu) = 3 \cdot \frac{1}{\sqrt{2}}(1 - \mu)$$

$$1 + \mu = 3(1 - \mu)$$

$$1 + \mu = 3 - 3\mu$$

$$4\mu = 2$$

$$\mu = \frac{2}{4} = 0.5$$

Step 4: Final Answer:

The coefficient of friction is 0.5.

Quick Tip: For an incline with angle θ , if the ratio of force up to force down is k , then $\mu = \tan \theta \cdot \frac{k-1}{k+1}$.

Here, $\mu = \tan(45^\circ) \cdot \frac{3-1}{3+1} = 1 \cdot \frac{2}{4} = 0.5$.

CHEMISTRY

5. The screening effect of d-electrons is

- (a) Equal to p-electrons
- (b) Much more than p-electrons
- (c) Same as f-electrons
- (d) Less than p-electrons.

Correct Answer: (d) Less than p-electrons.

Solution:

Step 1: Understanding the Question:

The question compares the shielding (screening) ability of electrons in different subshells within the same principle energy level.

Step 2: Detailed Explanation:

The screening effect depends on the shape and penetration of the orbitals.

- s-orbitals are spherical and penetrate closest to the nucleus, providing the maximum screening.
- p-orbitals have a dumb-bell shape and slightly less penetration.
- d and f orbitals have more diffused shapes and poor penetration, leading to poor screening of nuclear charge.

The order of screening effect for a given shell is: $s > p > d > f$.

Therefore, d-electrons provide less screening than p-electrons.

Step 3: Final Answer:

The screening effect of d-electrons is less than p-electrons.

Quick Tip: Remember the order $s > p > d > f$. Poor shielding by d and f electrons is responsible for phenomena like Lanthanide contraction and the inert pair effect.

6. Chloride ion and potassium ion are isoelectronic. Then

- (a) Their sizes are same
- (b) Cl^- ion is bigger than K^+ ion
- (c) K^+ ion is relatively bigger
- (d) Their sizes depend on other cation and anion

Correct Answer: (b) Cl^- ion is bigger than K^+ ion

Solution:

Step 1: Understanding the Question:

We are comparing the sizes of two isoelectronic species (ions with the same number of electrons).

Step 2: Detailed Explanation:

- Chlorine (Atomic number $Z = 17$) forms Cl^- by gaining 1 electron. Total electrons = 18.
 - Potassium (Atomic number $Z = 19$) forms K^+ by losing 1 electron. Total electrons = 18.
- Both have 18 electrons, but different nuclear charges (number of protons).
- In Cl^- , 17 protons pull 18 electrons.
 - In K^+ , 19 protons pull 18 electrons.

Higher nuclear charge results in a stronger pull on the electrons, making the ion smaller. Therefore, K^+ is smaller than Cl^- . Conversely, Cl^- is bigger than K^+ .

Step 3: Final Answer:

Cl^- ion is bigger than K^+ ion.

Quick Tip: For isoelectronic species: $\text{Radius} \propto \frac{1}{\text{Atomic Number (Z)}}$. The species with the highest number of protons will always be the smallest.

7. For the reaction $\text{CO}(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ Which one of the statement is correct at constant T and P?

(a) $\Delta H = \Delta E$

(b) $\Delta H < \Delta E$

(c) $\Delta H > \Delta E$

(d) ΔH is independent of physical state of the reactants

Correct Answer: (b) $\Delta H < \Delta E$

Solution:

Step 1: Understanding the Question:

The question asks for the relationship between enthalpy change (ΔH) and internal energy change (ΔE or ΔU) for a given gaseous reaction.

Step 2: Key Formula or Approach:

The relationship between enthalpy and internal energy for a reaction involving ideal gases is:

$$\Delta H = \Delta E + \Delta n_g RT$$

where Δn_g is the change in the number of moles of gaseous products and reactants.

Step 3: Detailed Explanation:

Calculate Δn_g for the reaction: $\text{CO}(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$

Moles of gaseous products (n_p) = 1

Moles of gaseous reactants (n_r) = 1 + 0.5 = 1.5

$$\Delta n_g = n_p - n_r = 1 - 1.5 = -0.5$$

Since Δn_g is negative:

$$\Delta H = \Delta E - 0.5RT$$

Because R and T are positive, subtracting a positive value from ΔE makes ΔH smaller than

ΔE .

Therefore, $\Delta H < \Delta E$.

Step 4: Final Answer:

The correct relationship is $\Delta H < \Delta E$.

Quick Tip: Just count the moles of gases!

If products have fewer moles of gas ($\Delta n_g < 0$), then $\Delta H < \Delta E$.

If products have more moles of gas ($\Delta n_g > 0$), then $\Delta H > \Delta E$.

MATHEMATICS

8. If $|z_1| = 2$, $|z_2| = 3$, $|z_3| = 4$ and $|2z_1 + 3z_2 + 4z_3| = 4$, then absolute value of $8z_2z_3 + 27z_3z_1 + 64z_1z_2$ equals

(A) 24

(B) 48

(C) 72

(D) 96

Correct Answer: (D) 96

Solution:

Step 1: Understanding the Question:

The question asks for the absolute value (modulus) of a complex expression involving three complex numbers z_1, z_2, z_3 with given moduli and a specific linear combination modulus.

Step 2: Key Formula or Approach:

For any complex number z , we have $z \cdot \bar{z} = |z|^2$.

This implies $\bar{z} = \frac{|z|^2}{z}$ and $z = \frac{|z|^2}{\bar{z}}$.

Also, the modulus of a conjugate is the same as the modulus of the number: $|\bar{w}| = |w|$.

Step 3: Detailed Explanation:

Given $|z_1| = 2 \Rightarrow |z_1|^2 = 4 \Rightarrow z_1 \bar{z}_1 = 4$.

Given $|z_2| = 3 \Rightarrow |z_2|^2 = 9 \Rightarrow z_2 \bar{z}_2 = 9$.

Given $|z_3| = 4 \Rightarrow |z_3|^2 = 16 \Rightarrow z_3 \bar{z}_3 = 16$.

We need to find the modulus of $S = 8z_2z_3 + 27z_3z_1 + 64z_1z_2$.

Let's factor out $z_1z_2z_3$:

$$S = z_1z_2z_3 \left(\frac{8}{z_1} + \frac{27}{z_2} + \frac{64}{z_3} \right)$$

Using the conjugate relations from Step 2:

$$\frac{1}{z_1} = \frac{\bar{z}_1}{4}, \quad \frac{1}{z_2} = \frac{\bar{z}_2}{9}, \quad \frac{1}{z_3} = \frac{\bar{z}_3}{16}.$$

Substitute these into the expression for S :

$$S = z_1z_2z_3 \left(8 \cdot \frac{\bar{z}_1}{4} + 27 \cdot \frac{\bar{z}_2}{9} + 64 \cdot \frac{\bar{z}_3}{16} \right)$$
$$S = z_1z_2z_3 (2\bar{z}_1 + 3\bar{z}_2 + 4\bar{z}_3)$$

Taking the modulus on both sides:

$$|S| = |z_1| \cdot |z_2| \cdot |z_3| \cdot |2\bar{z}_1 + 3\bar{z}_2 + 4\bar{z}_3|$$

We know $|2\bar{z}_1 + 3\bar{z}_2 + 4\bar{z}_3| = \overline{|2z_1 + 3z_2 + 4z_3|} = |2z_1 + 3z_2 + 4z_3|$.

Substituting the given values:

$$|S| = 2 \cdot 3 \cdot 4 \cdot 4 = 96$$

Step 4: Final Answer:

The absolute value equals 96.

Quick Tip: When you see expressions like $k_1z_2z_3 + k_2z_3z_1 + k_3z_1z_2$, always try to factor out $z_1z_2z_3$ and use the identity $1/z = \bar{z}/|z|^2$. This often simplifies the problem to a known modulus given in the question.

9. If $a > 0$, $b > 0$, $c > 0$ and a, b, c are distinct, then $(a + b)(b + c)(c + a)$ is greater than

(A) $2(a + b + c)$

(B) $3(a + b + c)$

(C) $6abc$

(D) $8abc$

Correct Answer: (D) $8abc$

Solution:

Step 1: Understanding the Question:

The problem asks for an inequality condition for the product of sums of three distinct positive real numbers a, b, c .

Step 2: Key Formula or Approach:

The Arithmetic Mean-Geometric Mean (AM-GM) Inequality states that for positive real numbers, $\frac{x+y}{2} \geq \sqrt{xy}$.

Equality holds if and only if $x = y$. Since a, b, c are distinct, the sum of any two will be strictly greater than twice the square root of their product.

Step 3: Detailed Explanation:

Applying AM-GM to pairs of distinct numbers a, b, c :

1. For a and b : $\frac{a+b}{2} > \sqrt{ab} \Rightarrow a + b > 2\sqrt{ab}$.
2. For b and c : $\frac{b+c}{2} > \sqrt{bc} \Rightarrow b + c > 2\sqrt{bc}$.
3. For c and a : $\frac{c+a}{2} > \sqrt{ca} \Rightarrow c + a > 2\sqrt{ca}$.

Multiply these three inequalities together (valid since all terms are positive):

$$(a + b)(b + c)(c + a) > (2\sqrt{ab})(2\sqrt{bc})(2\sqrt{ca})$$

$$(a + b)(b + c)(c + a) > 8\sqrt{a^2b^2c^2}$$

$$(a + b)(b + c)(c + a) > 8abc$$

Step 4: Final Answer:

The expression is greater than $8abc$.

Quick Tip: In competitive exams, if you see products like $(a + b)(b + c)(c + a)$ with positive numbers, the AM-GM inequality is usually the first tool to use. If the numbers are not specified as distinct, the answer might be $\geq 8abc$.

10. If the minimum force required to move a body up an inclined plane of inclination 45° is 3 times the force required to just prevent it sliding down, the coefficient of friction is

- a) 0.5
- b) 0.9
- c) 0.3
- d) 4.1

Correct Answer: a) 0.5

Solution:

Step 1: Understanding the Question:

We need to compare the force required to push an object up an incline versus the force required to keep it from sliding down under the influence of friction.

Step 2: Key Formula or Approach:

1. Force to move up: $F_1 = mg(\sin \theta + \mu \cos \theta)$.
2. Force to prevent sliding down: $F_2 = mg(\sin \theta - \mu \cos \theta)$.

Step 3: Detailed Explanation:

Given: $\theta = 45^\circ$ and $F_1 = 3F_2$.

$$mg(\sin 45^\circ + \mu \cos 45^\circ) = 3mg(\sin 45^\circ - \mu \cos 45^\circ)$$

Since $\sin 45^\circ = \cos 45^\circ = \frac{1}{\sqrt{2}}$, we can cancel these terms:

$$\frac{1}{\sqrt{2}}(1 + \mu) = 3 \cdot \frac{1}{\sqrt{2}}(1 - \mu)$$

$$1 + \mu = 3(1 - \mu)$$

$$1 + \mu = 3 - 3\mu$$

$$4\mu = 2$$

$$\mu = \frac{2}{4} = 0.5$$

Step 4: Final Answer:

The coefficient of friction is 0.5.

Quick Tip: For an incline with angle θ , if the ratio of force up to force down is k , then $\mu = \tan \theta \cdot \frac{k-1}{k+1}$.

Here, $\mu = \tan(45^\circ) \cdot \frac{3-1}{3+1} = 1 \cdot \frac{2}{4} = 0.5$.