BITSAT 2025 May 28 Shift 2 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**390	**Total questions :**130

General Instructions

Read the following instructions very carefully and strictly follow them:

1. Duration of Exam: 3 Hours

2. Total Number of Questions: 130 Questions

3. Section-wise Distribution of Questions:

   - Physics - 40 Questions

   - Chemistry - 40 Questions

   - Mathematics - 50 Questions

4. Type of Questions: Multiple Choice Questions (Objective)

5. Marking Scheme: Three marks are awarded for each correct response

6. Negative Marking: One mark is deducted for every incorrect answer.

7. Each question has four options; only one is correct.

8. Questions are designed to test analytical thinking and problem-solving skills.

1. The quadratic equation $x^2 - 5x + k = 0$ has equal roots. Find the value of k.

(A) 6

(B) $\frac{25}{4}$

(C) $\frac{9}{4}$

(D) 0

Correct Answer: (B) $\frac{25}{4}$

Solution:

- **Step 1: Condition for equal roots**

  For equal roots, the discriminant $\Delta = b^2 - 4ac = 0$.

- **Step 2: Apply values**

  Here, $a = 1$, $b = -5$, $c = k$.

  $$(-5)^2 - 4 \times 1 \times k = 0 \Rightarrow 25 - 4k = 0$$

- **Step 3: Solve for k**

  $$4k = 25 \Rightarrow k = \frac{25}{4}$$

> Quick Tip
>
> **Tip:** The discriminant condition is crucial for determining the nature of roots in quadratic equations.

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2. If the sum of the first n terms of an arithmetic progression is given by $S_n = 3n^2 + 5n$, find the first term a and common difference d.

(A) $a = 8, d = 6$

(B) $a = 8, d = 3$

(C) $a = 5, d = 6$

(D) $a = 3, d = 5$

Correct Answer: (A) $a = 8, d = 6$

Solution:

- **Step 1: Use formula for** S_n

  Given, $S_n = 3n^2 + 5n$.

- **Step 2: Find first term** a

  First term $a = S_1 = 3(1)^2 + 5(1) = 3 + 5 = 8$.

- **Step 3: Find second term** t_2

$$t_2 = S_2 - S_1 = \left(3(2)^2 + 5(2)\right) - 8 = (12 + 10) - 8 = 14$$

- **Step 4: Calculate common difference** d

$$d = t_2 - a = 14 - 8 = 6$$

> **Quick Tip**
>
> **Tip:** Remember, $t_n = S_n - S_{n-1}$ is useful to find terms from sum expressions.

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3. If $\sin\theta = \frac{3}{5}$ and θ lies in the first quadrant, find $\cos\theta$.

(A) $\frac{4}{5}$

(B) $\frac{3}{4}$

(C) $\frac{5}{3}$

(D) $\frac{5}{4}$

Correct Answer: (A) $\frac{4}{5}$

Solution:

- **Step 1: Use Pythagorean identity**

  Since $\sin^2\theta + \cos^2\theta = 1$,

$$\cos^2\theta = 1 - \sin^2\theta = 1 - \left(\frac{3}{5}\right)^2 = 1 - \frac{9}{25} = \frac{16}{25}$$

- **Step 2: Find $\cos\theta$**

  Since θ is in the first quadrant, $\cos\theta > 0$,

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

4. How many different 4-letter words can be formed from the letters of the word "BINARY" without repetition?

(A) 360

(B) 720

(C) 840

(D) 1260

Correct Answer: (A) 360

Solution:

- **Step 1: Count letters**

  The word "BINARY" has 6 distinct letters.

- **Step 2: Number of 4-letter words without repetition**

  Number of ways $= P(6,4) = \frac{6!}{(6-4)!} = \frac{6!}{2!} = \frac{720}{2} = 360$

  So the correct answer is (A) 360.

5. Find the equation of the circle which passes through the points $(1,2)$**,** $(4,3)$ **and has its center on the line** $x+y=5$**.**

(A) $(x-2)^2 + (y-3)^2 = 5$

(B) $(x-3)^2 + (y-2)^2 = 2$

(C) $(x-2.5)^2 + (y-2.5)^2 = 2.5)$

(D) $(x-2)^2 + (y-3)^2 = 2$

Correct Answer: (C) $(x-2.5)^2 + (y-2.5)^2 = 2.5)$

Solution:

- **Step 1: Assume center coordinates**

  Let the center be (h, k) lying on the line $x + y = 5$, so

  $$h + k = 5 \quad \Rightarrow \quad k = 5 - h$$

- **Step 2: Use the fact that both points lie on the circle**

  The radius squared $r^2 = (1 - h)^2 + (2 - k)^2 = (4 - h)^2 + (3 - k)^2$.

- **Step 3: Set the distances equal**

  $$(1 - h)^2 + (2 - k)^2 = (4 - h)^2 + (3 - k)^2$$

  Expand:

  $$(1 - h)^2 = (h - 1)^2 = h^2 - 2h + 1$$

  $$(2 - k)^2 = (k - 2)^2 = k^2 - 4k + 4$$

  $$(4 - h)^2 = (h - 4)^2 = h^2 - 8h + 16$$

  $$(3 - k)^2 = (k - 3)^2 = k^2 - 6k + 9$$

  Substitute:

  $$h^2 - 2h + 1 + k^2 - 4k + 4 = h^2 - 8h + 16 + k^2 - 6k + 9$$

- **Step 4: Simplify the equation**

  Cancel h^2 and k^2 on both sides:

  $$-2h + 1 - 4k + 4 = -8h + 16 - 6k + 9$$

  $$(-2h - 4k + 5) = (-8h - 6k + 25)$$

  Rearrange:

  $$-2h - 4k + 5 + 8h + 6k - 25 = 0 \implies 6h + 2k - 20 = 0$$

  Divide by 2:

  $$3h + k = 10$$

- **Step 5: Use the line condition**

  Recall from Step 1:

  $$k = 5 - h$$

  Substitute in $3h + k = 10$:

  $$3h + (5 - h) = 10 \Rightarrow 2h + 5 = 10 \Rightarrow 2h = 5 \Rightarrow h = \frac{5}{2} = 2.5$$

  Then:

  $$k = 5 - 2.5 = 2.5$$

- **Step 6: Calculate radius squared r^2**

  Using point $(1, 2)$:

  $$r^2 = (1 - 2.5)^2 + (2 - 2.5)^2 = (-1.5)^2 + (-0.5)^2 = 2.25 + 0.25 = 2.5$$

- **Step 7: Final equation**

  The circle equation is:

  $$(x - 2.5)^2 + (y - 2.5)^2 = 2.5$$

> **Quick Tip**
>
> **Tip:** Use system of equations and the condition for equal radii distances from the center to points on the circle.

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6. Find the equation of the tangent to the curve $y = x^3 - 3x + 1$ at the point where $x = 2$.

(A) $y = 9x - 19$

(B) $y = 9x - 15$

(C) $y = 13x - 23$

(D) $y = 15x - 25$

Correct Answer: (B) $y = 9x - 15$

Solution:

- **Step 1: Calculate** y **at** $x = 2$

$$y = 2^3 - 3 \times 2 + 1 = 8 - 6 + 1 = 3$$

So the point of tangency is $(2, 3)$.

- **Step 2: Find derivative** $\frac{dy}{dx}$

$$\frac{dy}{dx} = 3x^2 - 3$$

- **Step 3: Find slope at** $x = 2$

$$m = 3(2)^2 - 3 = 3 \times 4 - 3 = 12 - 3 = 9$$

- **Step 4: Write tangent line equation**

Using point-slope form:

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

Substitute:

$$y - 3 = 9(x - 2) \implies y = 9x - 18 + 3 = 9x - 15$$

> **Quick Tip**
>
> **Tip:** Always compute derivative carefully and verify point coordinates before finalizing tangent line.

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7. Two dice are rolled simultaneously. What is the probability that the sum of the numbers on the two dice is at least 10?

(A) $\frac{1}{6}$

(B) $\frac{1}{9}$

(C) $\frac{1}{12}$

(D) $\frac{1}{18}$

Correct Answer: (A) $\frac{1}{6}$

Solution:

- **Step 1: Total possible outcomes**

  Since two dice are rolled, total outcomes $= 6 \times 6 = 36$.

- **Step 2: Outcomes with sum ≥ 10**

  Possible sums are 10, 11, and 12.

  * Sum = 10: (4,6), (5,5), (6,4) $\rightarrow$ 3 outcomes

  * Sum = 11: (5,6), (6,5) $\rightarrow$ 2 outcomes

  * Sum = 12: (6,6) $\rightarrow$ 1 outcome

  Total favorable outcomes $= 3 + 2 + 1 = 6$.

- **Step 3: Calculate probability**

$$P = \frac{\text{favorable outcomes}}{\text{total outcomes}} = \frac{6}{36} = \frac{1}{6}$$

> **Quick Tip**
>
> **Tip:** List all possible outcomes or use systematic counting to avoid missing any cases.

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8. If $\log_2(x - 1) + \log_2(x - 3) = 3$**, find the value(s) of** x**.**

(A) 5

(B) 4

(C) 3 and 5

(D) 4 and 5

Correct Answer: (A) 5

Solution:

- **Step 1: Use logarithm property**

$$\log_2(x - 1) + \log_2(x - 3) = \log_2\left[(x - 1)(x - 3)\right] = 3$$

- **Step 2: Convert logarithmic equation to exponential form**

$$(x - 1)(x - 3) = 2^3 = 8$$

– **Step 3: Expand and form quadratic equation**

$$x^2 - 4x + 3 = 8 \implies x^2 - 4x + 3 - 8 = 0 \implies x^2 - 4x - 5 = 0$$

– **Step 4: Solve quadratic**

$$x = \frac{4 \pm \sqrt{16 + 20}}{2} = \frac{4 \pm \sqrt{36}}{2} = \frac{4 \pm 6}{2}$$

$$\Rightarrow x = \frac{4 + 6}{2} = 5 \quad \text{or} \quad x = \frac{4 - 6}{2} = -1$$

– **Step 5: Check domain restrictions**

Since $\log_2(x - 1)$ and $\log_2(x - 3)$ are defined only if their arguments are positive:

$$x - 1 > 0 \implies x > 1, \quad x - 3 > 0 \implies x > 3$$

So $x > 3$ must hold.

– **Step 6: Valid solution**

$x = 5$ is valid, $x = -1$ is invalid.

> **Quick Tip**
>
> **Tip:** Always check domain restrictions after solving logarithmic equations.

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9. If

$$A = \begin{pmatrix} 2 & 3 \\ 1 & k \end{pmatrix}$$

and $\det(A) = 7$, find the value of k.

(A) 1

(B) 2

(C) 5

(D) 4

Correct Answer: (C) 5

Solution:

- **Step 1: Recall determinant formula**

$$\det(A) = ad - bc$$

For

$$A = \begin{pmatrix} 2 & 3 \\ 1 & k \end{pmatrix},$$

we have $a = 2$, $b = 3$, $c = 1$, and $d = k$.

- **Step 2: Write determinant equation**

$$\det(A) = 2 \times k - 3 \times 1 = 2k - 3$$

- **Step 3: Use given determinant value**

$$2k - 3 = 7 \implies 2k = 10 \implies k = 5$$

> **Quick Tip**
>
> **Tip:** Carefully apply determinant formula and check arithmetic to avoid mistakes.

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10. Find the sum of the infinite geometric series:

$$S = 8 + 4 + 2 + \cdots$$

if it converges.

(A) 14

(B) 16

(C) 18

(D) 20

Correct Answer: (B) 16

Solution:

- **Step 1: Identify first term and common ratio**

First term $a = 8$. Common ratio $r = \frac{4}{8} = \frac{1}{2}$.

- **Step 2: Check convergence condition**

Since $|r| = \frac{1}{2} < 1$, the series converges.

- **Step 3: Use sum formula for infinite GP**

$$S = \frac{a}{1 - r} = \frac{8}{1 - \frac{1}{2}} = \frac{8}{\frac{1}{2}} = 8 \times 2 = 16$$

> **Quick Tip**
>
> **Tip:** The infinite geometric series sum exists only if $|r| < 1$.

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11. A particle is projected vertically upward with an initial velocity of $20\,m/s$. Calculate the maximum height reached by the particle.

(A) $20\,m$

(B) $15\,m$

(C) $10\,m$

(D) $25\,m$

Correct Answer: (A) $20\,m$

Solution:

- **Step 1: Write down known variables**

Initial velocity, $u = 20\,m/s$

Final velocity at maximum height, $v = 0\,m/s$

Acceleration due to gravity, $g = 9.8\,m/s^2$ (downward)

- **Step 2: Use kinematic equation**

$$v^2 = u^2 - 2gh$$

where h is the maximum height.

- **Step 3: Substitute values and solve for h**

$$0 = (20)^2 - 2 \times 9.8 \times h \implies 400 = 19.6h \implies h = \frac{400}{19.6} \approx 20.41\,m$$

– **Step 4: Final answer**

Rounded to nearest option: $h = 20\,m$.

> **Quick Tip**
>
> **Tip:** At maximum height, velocity becomes zero. Use appropriate kinematic formulas accordingly.

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12. How much heat is required to raise the temperature of $2\,kg$ of water from $20°C$ to $80°C$? (Specific heat capacity of water = $4200\,J/kg°C$)

(A) $504000\,J$

(B) $50400\,J$

(C) $126000\,J$

(D) $168000\,J$

Correct Answer: (A) $504000\,J$

Solution:

– **Step 1: Write known quantities**

Mass, $m = 2\,kg$

Temperature change, $\Delta T = 80 - 20 = 60°C$

Specific heat capacity, $c = 4200\,J/kg°C$

– **Step 2: Use heat formula**

$$Q = mc\Delta T$$

– **Step 3: Substitute values**

$$Q = 2 \times 4200 \times 60 = 504000\,J$$

> **Quick Tip**
>
> **Tip:** Make sure to use consistent units and identify the temperature change correctly.

13. A resistor of resistance $10\,\Omega$ is connected across a $20\,V$ battery. Calculate the current flowing through the resistor.

(A) $1\,A$

(B) $2\,A$

(C) $0.5\,A$

(D) $4\,A$

Correct Answer: (B) $2\,A$

Solution:

– **Step 1: Recall Ohm's Law**

$$V = IR$$

where V is voltage, I is current, and R is resistance.

– **Step 2: Rearrange to find current**

$$I = \frac{V}{R}$$

– **Step 3: Substitute given values**

$$I = \frac{20\,V}{10\,\Omega} = 2\,A$$

Quick Tip

Tip: Always check units and apply Ohm's law correctly.

14. An object is placed $30\,cm$ in front of a convex lens of focal length $20\,cm$. Find the position of the image.

(A) $60\,cm$

(B) $12\,cm$

(C) $15\,cm$

(D) $10\,cm$

Correct Answer: (A) $60\,cm$

Solution:

- **Step 1: Write down known values**

  Object distance, $u = -30\,cm$ (object distances are negative in lens formula convention)

  Focal length, $f = 20\,cm$

- **Step 2: Use lens formula**

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

  where v is image distance.

- **Step 3: Substitute and solve for v**

$$\frac{1}{20} = \frac{1}{v} - \frac{1}{-30} = \frac{1}{v} + \frac{1}{30}$$
$$\frac{1}{v} = \frac{1}{20} - \frac{1}{30} = \frac{3-2}{60} = \frac{1}{60}$$
$$v = 60\,cm$$

> **Quick Tip**
>
> **Tip:** Remember the sign conventions for lenses carefully when applying the lens formula.

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15. The rate constant k of a reaction doubles when the temperature is raised from 300 K to 310 K. Calculate the activation energy E_a of the reaction. (Use $R = 8.314\,J/mol \cdot K$**)**

(A) $52\,kJ/mol$

(B) $55\,kJ/mol$

(C) $53\,kJ/mol$

(D) $60\,kJ/mol$

Correct Answer: (C) $53\,kJ/mol$

Solution:

- **Step 1: Use Arrhenius equation ratio form**

$$\frac{k_2}{k_1} = e^{\frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

Given $\frac{k_2}{k_1} = 2$, $T_1 = 300\,K$, $T_2 = 310\,K$.

- **Step 2: Take natural logarithm**

$$\ln 2 = \frac{E_a}{R}\left(\frac{1}{300} - \frac{1}{310}\right)$$

- **Step 3: Calculate difference in reciprocals**

$$\frac{1}{300} - \frac{1}{310} = \frac{310 - 300}{300 \times 310} = \frac{10}{93000} \approx 1.075 \times 10^{-4}$$

- **Step 4: Calculate E_a**

$$\ln 2 \approx 0.693$$

$$0.693 = \frac{E_a}{8.314} \times 1.075 \times 10^{-4} \implies E_a = \frac{0.693}{1.075 \times 10^{-4}} \times 8.314 \approx 53642\,J/mol = 53.6\,kJ/mol$$

> **Quick Tip**
>
> **Tip:** Use the logarithmic form of the Arrhenius equation and careful unit conversions.

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16. Calculate the de Broglie wavelength of an electron moving with velocity $6 \times 10^6\,m/s$**. (Mass of electron** $m = 9.11 \times 10^{-31}\,kg$**, Planck's constant** $h = 6.626 \times 10^{-34}\,Js$**)**

(A) $1.2 \times 10^{-10}\,m$

(B) $1.1 \times 10^{-10}\,m$

(C) $1.0 \times 10^{-10}\,m$

(D) $0.9 \times 10^{-10}\,m$

Correct Answer: (A) $1.2 \times 10^{-10}\, m$

Solution:

– **Step 1: Write de Broglie wavelength formula**

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

– **Step 2: Substitute values**

$$\lambda = \frac{6.626 \times 10^{-34}}{9.11 \times 10^{-31} \times 6 \times 10^6} = \frac{6.626 \times 10^{-34}}{5.466 \times 10^{-24}} \approx 1.21 \times 10^{-10}\, m$$

> **Quick Tip**
>
> **Tip:** Carefully handle powers of ten in calculations involving quantum scales.

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17. Which of the following molecules has a trigonal planar shape?

(A) CH_4

(B) BF_3

(C) NH_3

(D) H_2O

Correct Answer: (B) BF_3

Solution:

– **Step 1: Understand molecular geometry**

  - CH_4: tetrahedral shape (4 bonds, no lone pairs)

  - BF_3: 3 bonds, no lone pairs, trigonal planar

  - NH_3: trigonal pyramidal (3 bonds + 1 lone pair)

  - H_2O: bent or angular (2 bonds + 2 lone pairs)

– **Step 2: Conclusion**

  Only BF_3 has trigonal planar geometry.

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18. Choose the word which is closest in meaning to "Eloquent".

(A) Silent

(B) Fluent

(C) Awkward

(D) Hesitant

Correct Answer: (B) Fluent

Solution:

- **Step 1: Understand the word "Eloquent"**

  "Eloquent" means fluent or persuasive in speaking or writing.

- **Step 2: Analyze options**

  - Silent: not speaking

  - Fluent: able to express oneself easily and articulately

  - Awkward: lacking grace or skill

  - Hesitant: unsure or slow in acting

- **Step 3: Choose closest synonym**

  "Fluent" is the closest synonym to "Eloquent".

> **Quick Tip**
>
> **Tip:** Always understand the meaning and usage of the word before choosing synonyms.

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19. Identify the part of the sentence that contains an error:

"Neither the manager nor the employees ___ willing to accept the new policy."

(A) Neither the manager

(B) nor the employees

(C) willing

(D) to accept the new policy

Correct Answer: (C) willing

Solution:

- **Step 1: Subject-verb agreement with "Neither...nor..."**
  When subjects are connected by "neither...nor...", the verb agrees with the nearer subject.

- **Step 2: Identify subject nearest to the verb**
  "employees" is plural, so the verb should be plural.

- **Step 3: Correct the verb**
  "willing" should be replaced with "are willing" to maintain agreement.

- **Step 4: Hence error is in part (C).**

> **Quick Tip**
>
> **Tip:** In "neither...nor..." constructions, verb agrees with the closer subject.

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20. Read the passage and answer the question:

"Climate change is one of the biggest challenges facing humanity. It affects the environment, economy, and health. Immediate action is required to reduce greenhouse gas emissions."

Question: What is the main idea of the passage?

(A) The economy is not affected by climate change.

(B) Climate change is a minor issue.

(C) Immediate action is needed to combat climate change.

(D) Health is unrelated to climate change.

Correct Answer: (C) Immediate action is needed to combat climate change.

Solution:

– **Step 1: Identify key points**

Climate change impacts environment, economy, and health.

– **Step 2: Note concluding statement**

Immediate action is required to reduce emissions.

– **Step 3: Main idea**

The passage emphasizes urgent measures against climate change.

> **Quick Tip**
>
> **Tip:** Focus on main message or purpose when answering comprehension questions.

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21. Choose the word which is most opposite in meaning to "Benevolent".

(A) Kind

(B) Cruel

(C) Generous

(D) Compassionate

Correct Answer: (B) Cruel

Solution:

– **Step 1: Understand the word "Benevolent"**

"Benevolent" means showing kindness and goodwill.

– **Step 2: Analyze options**

- Kind, Generous, Compassionate all imply positive qualities

- Cruel means causing pain or suffering; opposite of kind

– **Step 3: Select antonym**

"Cruel" is the correct antonym.

> **Quick Tip**
>
> **Tip:** Identify the core meaning before picking antonyms.

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22. Choose the best alternative to improve the underlined part:

"She gave a beautiful speech, which everyone enjoyed it."

(A) which everyone enjoyed

(B) that everyone enjoyed

(C) whom everyone enjoyed

(D) who everyone enjoyed

Correct Answer: (B) that everyone enjoyed

Solution:

– **Step 1: Identify error**

The clause "which everyone enjoyed it" is incorrect because "which" and "it" are redundant.

– **Step 2: Use correct relative pronoun**

"That" is preferred for restrictive clauses.

– **Step 3: Remove redundant pronoun**

Correct phrase: "that everyone enjoyed"

> Quick Tip
>
> **Tip:** Avoid redundant pronouns in relative clauses.

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23. Identify the part of the sentence which contains a grammatical error:

"Each of the students have submitted their assignments on time."

(A) Each of the students

(B) have submitted

(C) their assignments

(D) on time

Correct Answer: (B) have submitted

Solution:

– **Step 1: Subject-verb agreement**

"Each" is singular, so the verb should be singular: "has submitted".

– Step 2: Analyze pronoun

Though "their" is plural, it is often used for singular indefinite pronouns in modern English for gender neutrality.

– Step 3: Error is in verb "have submitted"

It should be "has submitted".

> **Quick Tip**
>
> **Tip:** Check verb form agreement with singular indefinite pronouns like "each".