

Mathematics

(JEE Advanced 2022)

Paper 1
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SECTION 1 (Maximum Marks:24)

- This section contains **EIGHT(08)** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designed to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 **ONLY** if the correct numerical is entered;
Zero Marks : 0 in all other cases.

QUESTIONS

Q1. A debate club consists of 6 girls and 4 boys. A team of 4 members is to be selected from this club including the selection of a captain (from among these 4 members) for the team. If the team has to include at most one boy, then the number of ways of selecting the team is

- (A) 380 (B) 320 (C) 260 (D) 95

Q2. A solution curve of the differential equation $(x^2 + xy + 4x + 2y + 4)\frac{dy}{dx} - y^2 = 0, x > 0$, passes through the point (1,3). Then the solution curve

- (A) intersects $y = x + 2$ exactly at one point
(B) intersects $y = x + 2$ exactly at two points
(C) intersects $y = (x + 2)^2$
(D) does **NOT** intersect $y = (x + 3)^2$

Q3. Let RS be the diameter of the circle $x^2 + y^2 = 1$, where S is the point (1,0). Let P be a variable point (other than R and S) on the circle at S and P meet at the point Q. The normal to the circle at P intersects a line drawn through Q parallel to RS at point E. Then the locus of E passes through the point(s)

- (A) $\frac{1}{3, 1\sqrt{3}}$ (B) $\frac{1}{4, 12}$ (C) $\frac{1}{3, -1\sqrt{3}}$ (D) $\frac{1}{4, -12}$

Q4. The least value of $\alpha \in \mathbb{R}$ for which $4\alpha x^2 + \frac{1}{x} \geq 1$, for all $x > 0$, is

- (A) $\frac{1}{64}$ (B) $\frac{1}{32}$ (C) $\frac{1}{27}$ (D) $\frac{1}{25}$

Q5. Consider the equation
 $\int \log_e dx \text{ over } x(a - \log_e x) = 1, a \in (-\infty, 0) \cup (1, \infty).$
 Which of the following statements is/are **TRUE** ?
 (A) **No** a satisfies the above equation
 (B) An integer a satisfies the above equation
 (C) An irrational number a satisfies the above equation
 (D) More than one a satisfy the above equation

Q6. Which of the following is (are) NOT the square of a 3×3 matrix with real entries?

$$\begin{array}{ll}
 (A) \quad \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} & (B) \quad \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \\
 (C) \quad \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix} & (D) \quad \begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}
 \end{array}$$

Q7. Let $[x]$ be the greatest integer less than or equal to x . Then, at which of the following point(s) the function $f(x) = x \cos \pi(x + [x])$ is discontinuous?

$$(A) x = -1 \quad (B) x = 0 \quad (C) x = 1 \quad (D) x = 2$$

Q8. If $2x - y + 1 = 0$ is a tangent to the hyperbola $x^2/a^2 - y^2/16 = 1$, then which of the following CANNOT be sides of a right angle triangle?

$$(A) a, 4, 1 \quad (B) a, 4, 2 \quad (C) 2a, 8, 1 \quad (D) 2a, 4, 1$$

Physics

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QUESTIONS

Q1. A particle of mass m is initially at rest at the origin. It is subjected to a force and starts moving along the x -axis. Its kinetic energy K changes with time as $dK/dt = \gamma t$, where γ is a positive constant of appropriate dimensions. Which of the following statements is (are) true?

- (A) The force applied on the particle is constant
- (B) The speed of the particle is proportional to time
- (C) The distance of the particle from the origin increases linearly with time
- (D) The force is conservative

Q2. **STATEMENT-1** The stream of water flowing at high speed from a garden hose pipe tends to spread like a fountain when held vertically up, but tends to narrow down when held vertically down.

and

STATEMENT-2

In any steady flow of an incompressible fluid, the volume flow rate of the fluid remains constant.

- (A) **STATEMENT-1** is True, **STATEMENT-2** is True; **STATEMENT-2** is a correct explanation for **STATEMENT-1**
- (B) **STATEMENT-1** is True, **STATEMENT-2** is True; **STATEMENT-2** is NOT a correct explanation for **STATEMENT-1**
- (C) **STATEMENT-1** is True, **STATEMENT-2** is False
- (D) **STATEMENT-1** is False, **STATEMENT-2** is True

Q3. Six charges are placed around a regular hexagon of side length a as shown in the figure. Five of them have charge q and the remaining one has charge x . The perpendicular from each charge to the nearest hexagon side passes through the center O of the hexagon and is bisected by the side.

Which of the following statement(s) is(are) correct in SI units?

- (A) When $x = q$ the magnitude of the electric field at O is zero.
- (B) When $x = q$ the magnitude of the electric field at O is 2.
- (C) When $x = 2q$ the potential at O is 3
- (D) When $x = 3q$ the potential at O is 1

Q4.STATEMENT-1

If the accelerating potential in an X-ray tube is increased, the wavelengths of the characteristic X-rays do not change.

because

STATEMENT-2

When an electron beam strikes the target in an X-ray tube, part of the kinetic energy is converted into X-ray energy.

- (A) **STATEMENT-1** is True, **STATEMENT-2** is True; **STATEMENT-2** is a correct explanation for **STATEMENT-1**.
- (B) **STATEMENT-1** True, **STATEMENT-2** is True; **STATEMENT-2** is NOT a correct explanation for Statement-1.
- (C) **STATEMENT-1** is True, **STATEMENT-2** is False.
- (D) **STATEMENT-1** is False, **STATEMENT-2** is True.

Q5. In an experiment to measure the speed of sound by a resonating air column, a tuning fork of frequency 500 Hz is used. The length of the air column is varied by changing the level of water in the resonance tube. Two successive resonances are heard at air columns of length 50.7cm and 83.9cm. Which of the following statements is (are) true?

- (A) The speed of sound determined from this experiment is 332 ms^{-1}
- (B) The end correction in this experiment is 0.9cm
- (C) The wavelength of the sound wave is 66.4cm
- (D) The resonance at 50.7cm corresponds to the fundamental harmonic

Q6. A particle of mass m is initially at rest at the origin. It is subjected to a force and starts moving along the x -axis. Its kinetic energy K changes with time as $dK/dt = \gamma t$, where γ is a positive constant of appropriate dimensions. Which of the following statements is (are) true?

- (A) The force applied on the particle is constant
- (B) The speed of the particle is proportional to time
- (C) The distance of the particle from the origin increases linearly with time
- (D) The force is conservative

Q7. A ball is projected from the ground at an angle of 45° with the horizontal surface. It reaches a

maximum height of 120m and returns to the ground. Upon hitting the ground for the first time, it loses half of its kinetic energy. Immediately after the bounce, the velocity of the ball makes an angle of 30° with the horizontal surface. The maximum height it reaches after the bounce, in meters is:

Ans.

Q8.A particle, of mass 10^{-3} kg and charge 1.0 C, is initially at rest. At time $t=0$, the particle comes under the influence of an electric field $\vec{E}(t)=E_0 \sin \omega t \hat{i}$ where $E_0 = 1 \text{ NC}^{-1}$ and $\omega = 10^3 \text{ rad s}^{-1}$. Consider the effect of only the electrical force on the particle. Then the maximum speed, in m s^{-1} , attained by the particle at subsequent times is:

Ans

END OF THE QUESTION PAPER