

## IIT JEE 2009 Test Series 5 PHYSICS PART-II

### SECTION I

#### STRAIGHT OBJECTIVE TYPE

This section contains 6 multiple choice questions. Each question has four choices (a), (b), (c) and (d), out of which ONLY ONE is correct. 3 MARKS will be awarded for correct answer. 1 MARK will be deducted for wrong answer.

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1. If  $A_{i+1}$ ,  $B_{i+1}$ ,  $C_{i+1}$  are feet of perpendicular from  $A_i$ ,  $B_i$ ,  $C_i$  to the sides  $B_iC_i$ ,  $A_iC_i$  and  $A_iB_i$  respectively. If  $R_i$  is the circumference of  $\Delta A_iB_iC_i$  and  $R_1 = 3$ , then the value of  $\sum_{i=1}^{\infty} R_i$  is
  - (a) 5
  - (b) 6
  - (c) 9
  - (d) 12
2. If for all positive integers  $n$ , we are given that  $a_n = n^2 + 20$ ,  $n \in \mathbb{N}$  and  $d_n$  is the highest common factor of  $a_{n+1}$  and  $a_n$ , then the value of  $\left\{ \frac{2n+1}{d_n} \right\}$  is (where  $\{.\}$  denotes fractional part function)
  - (a)  $\frac{1}{2}$
  - (b)  $\frac{1}{4}$
  - (c)  $\frac{1}{6}$
  - (d) 0
3. India decides to destroy one of the militant holdings. In the bombing attack there is 50% chance of a bomb hitting the target, only two direct bomb hits are required to destroy the target completely. Least number of bombs required to give 99% chance or better of completely destroying the target is
  - (a) 9
  - (b) 10
  - (c) 11
  - (d) 12

4. If  $f(x)$  is of period 3 and  $g(x)$  is of period 2, then period of the function

$$F(x) = \left| \begin{matrix} f(x) & f\left(\frac{x}{3}\right) \\ g(x) & g\left(\frac{x}{2}\right) \end{matrix} \right| \text{ is}$$

- (a) 6  
 (b) 12  
 (c) 18  
 (d) 36
5. The first term of an infinite geometric series is 2 and its sum be denoted by  $S$ . If  $|S - 2| < 1/10$ , then the true set of range of common ratio of the series is

- (a)  $\left(\frac{1}{10}, \frac{1}{5}\right)$   
 (b)  $\left(-\frac{1}{2}, \frac{1}{2}\right) - \{0\}$   
 (c)  $\left(-\frac{1}{19}, \frac{1}{20}\right) - \{0\}$   
 (d)  $\left(-\frac{1}{19}, \frac{1}{21}\right) - \{0\}$

6. Let  $\binom{n}{k}$  represent the combination of  $n$  things taken  $k$  at a time. The value of

$$\binom{100}{98} + \binom{99}{97} + \binom{98}{96} + \dots + \binom{2}{0} \text{ equals}$$

- (a) 15050  
 (b) 101000  
 (c) 151500  
 (d) 166650
7. The set of positive values of  $n$  for which  $\left(\sqrt{\frac{1 + \cos 30^\circ}{2}} + i\sqrt{\frac{1 - \cos 30^\circ}{2}}\right)^n$  is real, is
- (a) 4, 8, 12, ...  
 (b) 6, 12, 18, ...  
 (c) 8, 16, 24, ...  
 (d) 12, 24, 36, ...

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8. Solution of the differential equation  $\frac{dy}{dx} + \frac{y}{x} = \frac{1}{1 + \log x + \log y}^2$  is

(a)  $xy^{1 + \ln(xy)^2} = \frac{x^2}{2} + C$

(b)  $xy^{1 + \ln(xy)} = \frac{x^2}{2} + C$

(c)  $xy^{1 + \ln(xy)} = \frac{x}{2} + C$

(d) None

9. The number of solutions of the equation  $\tan^{-1}\left(\frac{x}{1-x^2}\right) + \tan^{-1}\left(\frac{1}{x^3}\right) = \frac{3}{4\pi}$ , belonging to the interval (0, 1) is

(a) 0

(b) 1

(c) 2

(d) infinite

**SECTION II**

**ASSERTION-REASON TYPE**

This question contains 4 reasoning type questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct. 3 MARKS will be awarded for correct answer. 1 MARK will be deducted for wrong answer. NO MARKS WILL BE GIVEN OR DEDUCTED IF A QUESTION IS NOT ANSWERED.

10. STATEMENT-1: If  $f(x) = g(x^3) + x h(x^3)$  is divisible by  $x^2 + x + 1$ , then  $g(1) + f(1) = 0$ .

STATEMENT-2: Any functional relation satisfied by  $\omega$  and  $\omega^2$  is always satisfied by number 1 too where  $\omega$  is cube root of unity.

(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

11. STATEMENT-1: For any natural number  $n$ , 
$$\sum_{r=0}^{2n+1} \frac{-1^r}{{}^{2n+1}C_r} = 0$$

STATEMENT-2: For any natural number  $n$ ,  ${}^nC_x = {}^nC_y \Rightarrow x = y$  or  $x + y = n$  where  $x$  and  $y$  are whole numbers .

- (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
12. STATEMENT-1: The probability for the graph of  $y = 16x^2 + 8(a + 5)x - 7a - 5$  in the interval  $[-20, 0]$  is strictly above the  $x$ -axis is  $9/20$  .
- STATEMENT-2: The graph of  $y = ax^2 + bx + c$  is strictly above the  $x$ -axis if the discriminant is negative and  $a > 0$ .
- (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

13. STATEMENT-1: Let  $f(x) = \begin{cases} \sqrt{\{x\}}, & x \notin I \\ 1, & x \in I \end{cases}$  where  $I$  is the set of all integers and  $g(x) = \{x\}^2$  where

$\{.\}$  represents fractional part function, then area bounded between  $f(x)$  and  $g(x)$  for  $x \in [0, n]$  will be integer if  $n$  is a multiple of 3. .

STATEMENT-2: if  $f(x)$  and  $g(x)$  both are periodic with period  $T$ , then

$$\int_0^{nT} |f(x) - g(x)| dx = n \int_0^T |f(x) - g(x)| dx$$

- (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

### SECTION III

#### LINKED COMPREHENSION TYPE

This section contains 2 paragraphs. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has four choices (a), (b), (c) and (d), out of which ONLY ONE is correct. 4 MARKS will be awarded for correct answer. 1 MARK will be deducted for wrong answer. NO MARKS WILL BE GIVEN OR DEDUCTED IF A QUESTION IS NOT ANSWERED.

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#### Paragraph for Questions numbers 14 to 16

Let  $A(z_1)$ ,  $B(z_2)$ ,  $C(z_3)$  be the vertices of an equilateral triangle ABC such that  $|z_1| = |z_2| = |z_3| = 1$ . A circle is inscribed in the triangle ABC which touches sides AB, BC, CA at points  $P(z_4)$ ,  $Q(z_5)$ ,  $R(z_6)$  respectively.  $S(z)$  is any point on the incircle other than P, Q, R. Then answer the following questions

14. The value of  $\overline{z_1 z_2} + \overline{z_2 z_1} + \overline{z_1 z_3} + \overline{z_3 z_1} + \overline{z_2 z_3} + \overline{z_3 z_2}$  is equal to
- (a) Zero
  - (b) 3
  - (c) -3
  - (d) None

15.  $|z_4 - z_5|^2 + |z_5 - z_6|^2 + |z_6 - z_4|^2$  is equal to
- (a)  $\frac{3\sqrt{3}}{2}$
  - (b)  $\frac{9}{2}$
  - (c)  $\frac{9}{4}$
  - (d)  $\frac{9\sqrt{3}}{4}$

16.  $\frac{z_1}{z_4}$  is equal to

a)  $\frac{1}{2} \left( \frac{1}{2} + \frac{\sqrt{3}}{4} i \right)$

b)  $\frac{1}{2} \left( \frac{1}{2} - \frac{\sqrt{3}}{4} i \right)$

c)  $1 - \sqrt{3}i$

d) none

**Paragraph for Questions numbers 17 to 19 (one or more correct options)**

Let  $f : R \rightarrow R$  be a differentiable function satisfying the condition

$$f\left(\frac{x}{y}\right) = \frac{f(x)}{f(y)}, \text{ where } y \neq 0 \forall x, y \in R \text{ \& } f'(1) = 2, \text{ then}$$

17. Function  $f$  is

- (a) One-one, on to
- (b) Many-one, on to
- (c) One-one, into
- (d) Many-one, into.

18. Value of  $\int_{-1}^2 [f(x)] dx$  is (where  $[.]$  represents greatest integer function)

- a)  $5 - \sqrt{2} - \sqrt{3}$
- b)  $\sqrt{3} - \sqrt{2}$
- c) 1
- d) none

19. Area bounded by the curve  $|2 - f(x)|$  and the lines  $|x| = 2$  is

- a)  $\frac{2\sqrt{2}}{3}$  sq. units  
 b)  $\frac{12 + 2\sqrt{2}}{3}$  sq. units  
 c)  $\frac{2 + 2\sqrt{2}}{3}$  sq. units  
 d) none

## SECTION-IV

### Matrix Match Type

This section contains 3 questions. Each question contains statements given in two columns which have to be matched. Statements in **Column I** are labelled as A, B, C and D whereas statements in **Column II** are labelled as p, q, r and s. The answers to these questions have to be appropriately bubbled as illustrated in the following example.

If the correct matches are A-q, A-r, B-p, B-s, C-r, C-s and D-q, then the correctly bubbled matrix will look like the following :

	p	q	r	s
A	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20. The equation  $ax^2 + b|x| + c = 0$  has exactly K real roots. Match the column I with column II.

Column I	Column II
(a) $K = 1$	(p) $ab < 0$
(b) $K = 2$	(q) $ac > 0$
(c) $K = 3$	(r) $ac < 0$
(d) $K = 4$	(s) $ab > 0$

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21. A uniform magnetic field  $B\hat{k}$  exists in space. A particle of mass  $m$ , charge  $q$  at origin is given velocity  $\vec{v}$  as given in column I. Match the path(s) taken by particle inside the field given in column II.

Column I	Column II
(a) The name of the conic section represented by $\sqrt{px} + \sqrt{qx} = 1$ , where $p, q \in \mathbb{R}$ , $p, q > 0$ is	(p) ellipse
(b) Two parabola $y^2 = 4a(x - \lambda_1)$ and $x^2 = 4a(y - \lambda_2)$ always touch each other. $\lambda_1$ and $\lambda_2$ being variable parameters. There, their point of contact lie on a	(q) circle
(c) If parabola of latus-rectum $l$ , touches a fixed equal parabola, the axes of the two curves, being parallel, then the locus of the vertex of the moving curve is	(r) parabola
(d) From a point $P$ tangents are drawn to the parabola $y^2 = 4ax$ . If chord of contact of these tangents touches the rectangular hyperbola $x^2 - y^2 = a^2$ , then the locus of $P$ is	(s) hyperbola

22. Given: A triangle ABC, if  $a = 2$ ,  $b = 2k$  and  $A = \pi/3$ . Match column I with column II.

Column I	Column II
(a) Two triangles are possible if	(p) $k = 2/\sqrt{3}$
(b) Only one triangle is possible is	(q) $0 < k < 1$
(c) No triangle is possible if	(r) $k > 2\sqrt{3}$
(d) A right angles triangle is possible if	(s) $1 < k < 2/\sqrt{3}$

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