

**VIDYA DRISHTI**  
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**IIT JEE 2009 Test Series 3**  
**PHYSICS PART-II**

**SECTION I**

**STRAIGHT OBJECTIVE TYPE**

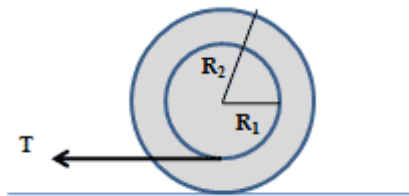
This section contains 6 multiple choice questions. Each question has four choices (a), (b), (c) and (d), out of which ONLY ONE is correct. 3 MARKS will be awarded for correct answer. 1 MARK will be deducted for wrong answer.

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1. A ball is kept at a height  $h$  above the surface of a heavy transparent sphere made of a material of refractive index  $\mu$ . The radius of sphere is  $R$ . At  $t = 0$ , the ball is dropped to fall normally on the sphere. Consider only the image by a single reflection. The speed of the image as a function of time  $t$  for  $t < \sqrt{\frac{2h}{g}}$  is given by
  - (a)  $\frac{\mu R^2 g t}{[(\mu - 1)(h - \frac{1}{2} g t^2) - R]}$
  - (b)  $\frac{\mu R g t}{[(\mu - 1)(h - \frac{1}{2} g t^2)]}$
  - (c) 0
  - (d)  $\frac{\mu R^2 g t}{h - \frac{1}{2} g t^2}$
2. A source emitting sound of frequency 180 Hz is placed in front of a wall of at a distance 2 m from it. A detector is also placed in front of the wall at the same distance from it. Speed of the sound in air is 360 m/s. The minimum distance between the source and the detector for which the detector detects a maximum of sound is
  - (a) 1 m
  - (b) 2 m
  - (c) 3 m
  - (d) Both source and detector should be placed at the same point

3. An inductor coil joined with a 6 V battery draws a steady current of 12 A. This coil is connected to a capacitor and an AC source of RMS voltage 6 V in series. If the current in the circuit is in phase with the emf, the rms current is
- some data is missing (capacitance, frequency etc)
  - 12 A
  - No current
  - None of the above
4. The gravitational field in a region is given by  $\vec{E} = (2\hat{i} + 3\hat{j})$  N/kg. Work done by the gravitational field when a particle is moved on the line  $2x + 3y - 5 = 0$  is
- 10 J
  - 20 J
  - 10 J
  - Zero
5. The kinetic energy of the electron in the hydrogen is half the potential energy. The total energy is found to be - 13.6 eV, for the ground state of the atom. Then,
- The potential and kinetic energy at  $n = 2$  are 6.8 eV and 3.4 eV respectively.
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  - The potential and kinetic energy at  $n = 2$  are 6.8 eV and - 3.4 eV respectively.
6. A particle of mass  $m$  moves on the  $x$ -axis as follows; it starts from rest at  $t = 0$  from the point  $x = 0$ , and comes to rest at  $t = 1$  at the point  $x = 1$ . No other information is available about its motion at intermediate times ( $0 < t < 1$ ). If  $\alpha$  denotes the instantaneous acceleration of the particle, then
- $\alpha$  must be remain positive for half the time
  - $|\alpha|$  cannot exceed 2 at any point in its path
  - $|\alpha|$  must be 4 at some point or points on the path
  - $\alpha$  must change sign during the motion, but no other assertion can be made with the information given.

7. A stepped cylinder (shown in figure) is having a mass of 50 kg and a radius of gyration  $k$  of 0.30 m. The radii  $R_1$  and  $R_2$  are 30 cm and 60 cm respectively. A pull  $T$  equal to 200 N is exerted on the rope attached to the inner cylinder. The coefficients of static and dynamic friction between cylinder and ground are 0.10 and 0.08 respectively. Then the acceleration of the cylinder is
- $3.2 \text{ m/s}^2$
  - $-3.2 \text{ m/s}^2$
  - 0
  - None of these



8. A dielectric slab of thickness  $d$  is inserted in a parallel plate capacitor whose negative plate is at  $x = 0$  and plate is at  $x = 3d$ . The slab is equidistant from the plates. The capacitor is given some charge. As  $x$  goes from 0 to  $3d$
- the magnitude of the electric field remains the same
  - the direction of electric field remains the same
  - the electric potential remains constant
  - the electric potential increase at first, then decrease and again increase.
9. Let  $F_{pp}$ ,  $F_{pn}$  and  $F_{nn}$  denote the magnitudes of the net force by a proton on a proton, by a proton on a neutron and by a neutron on a neutron respectively. Neglect gravitational force. When the separation is 1 fm,
- $F_{pp} > F_{pn} = F_{nn}$
  - $F_{pp} = F_{pn} = F_{nn}$
  - $F_{pp} > F_{pn} > F_{nn}$
  - $F_{pp} < F_{pn} < F_{nn}$

## 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: It is possible to photograph a virtual image.

STATEMENT-2: The rays which appear diverging from a virtual image fall on the camera and a real image is captured.

- (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: When a Coolidge tube is operated for some time it becomes hot.

STATEMENT-2: The electrons emitted by the filament of the Coolidge tube hit the target with a very high speed which then stopped by the target.

- (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: A capacitor of capacitance  $C$  is charged by connecting it to a battery of emf  $V$ . The capacitor is now disconnected and reconnected to the battery with the polarity reversed. The heat developed in the connecting wires is  $2CV^2$ .

STATEMENT-2: The battery does a work  $2CV^2$  and the energy stored in the capacitor is same in the two cases.

- (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: Temperature of a body depends on the frame from which it is observed.

STATEMENT-2: Temperature depends on kinetic energy.

- (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

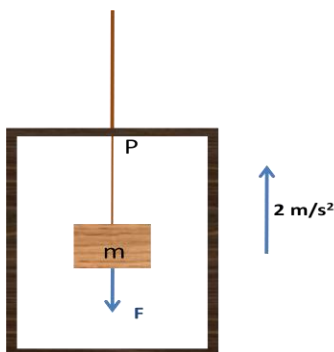
### SECTION III

#### 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.

#### Paragraph for Questions numbers 14 to 16

Mass of a string varies with its length as  $m = 0.1L$  where  $m$  is in kg and  $L$  is in cm. A block of mass 5kg is hanging to its lower end. A force  $F = 12$  N acts on the block in vertically downward direction as shown in the figure. The entire system is kept in an elevator which moves up with an acceleration of  $2 \text{ m/s}^2$ . Length of the string is 10 cm. Height of the elevator is 4m. Assume mass of (string + mass) system to be particle like at the point of interest. Take  $g = 10 \text{ m/s}^2$



14. Tension at a distance 10 cm above the block is
- 60 N
  - 70 N
  - 72 N
  - 84 N
15. Force on the string from the ceiling of the elevator is
- 60 N
  - 70 N
  - 72 N
  - 84 N
16. Suppose the string connecting mass to ceiling of the elevator breaks at the point P (at ceiling; see figure) after some time but the force  $F$  continues to act. The acceleration of the (string + block) system just after the string breaks assuming (string + block) system to be particle is
- $2 \text{ m/s}^2$  upward
  - zero
  - $10 \text{ m/s}^2$  downward
  - $12 \text{ m/s}^2$  downward

**Paragraph for Questions numbers 17 to 19**

A student conducts an experiment using a resonance tube and two tuning forks in order to find the speed of sound in air. The various observations taken by him are as under.

Temperature of air in air column = $30^\circ\text{C}$			
Frequency of tuning fork (Hz)	Resonance	No. of observations	Length of the air column at resonance (cm)
512	First	1	16.2
		2	16.0
	Second	1	50.4
		2	50.2
480	First	1	17.2
		2	17.4
	Second	1	53.8
		2	54.0

17. Speed of sound in air at 30 °C is
- 35100 cm/s
  - 35078 cm/s
  - 35128 cm/s
  - 35228 cm/s
18. Speed of the sound at 0 °C is
- 33296 cm/s
  - 33300 cm/s
  - 33392 cm/s
  - 33402 cm/s
19. If the actual speed of sound at 0 °C is 33200 cm/s, the percentage error at 0 °C is
- 0.6 %
  - 0.9 %
  - 0.3 %
  - 0.01 %

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

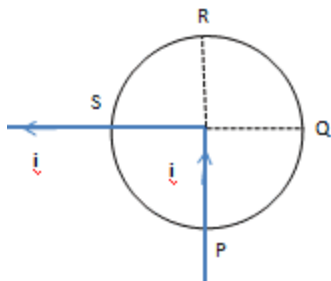
20. A rolling sphere is rolling without slipping on a surface and no force other than force applied by surface and weight is acting on it. Match the column I with column II.

Column I	Column II
(a) Surface is horizontal	(p) Translational kinetic energy is greater than rotational kinetic energy
(b) Surface is inclined and sphere is moving down	(q) Rotational kinetic energy is greater than translational kinetic energy
(c) Surface is inclined and sphere is going up	(r) Gravitation force performs work equal to negative of work done by friction
(d) Sphere is moving in a vertical circle inside a large hollow sphere	(s) Direction of friction force keeps changing

21. A parallel plate capacitor with air gap between its plates is charged using a battery and remains connected to the battery. Match the column I with column II.

Column I	Column II
(a) Electric field intensity between the plates reduces when	(p) separation between the plates is increased
(b) Electric energy stored in the capacitor increase when	(q) separation between the plates is reduced
(c) electric energy density increases when	(r) dielectric of dielectric constant K is filled between the plates
(d) Charge on the capacitor decreases when	(s) the separation between the plates is increased by the $3/2$ times the initial value and the space between the plates is then completely filled with a dielectric of dielectric constant K

22. Figure shows a long wire bent at the middle to form a right angle. Match the column I with column II.



Column I	Column II
(a) Magnitude of magnetic fields is $\frac{\mu_0 i}{4\pi d}$	(p) at point P
(b) Direction of magnetic field is perpendicular to the plane and going into the plane	(q) at point Q
(c) Direction of magnetic field is perpendicular to the plane and going out the plane of the paper	(r) at point R
(d) Magnitude of magnetic field is $\frac{\mu_0 i}{4\pi d}$ and direction is perpendicular to the plane and going into the plane of the paper	(s) at point S

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