

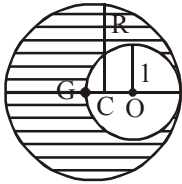
FINAL JEE-MAIN EXAMINATION – JANUARY, 2020

(Held On Wednesday 08th JANUARY, 2020) TIME : 2 : 30 PM to 5 : 30 PM

PHYSICS

TEST PAPER WITH ANSWER

1. As shown in figure, when a spherical cavity (centred at O) of radius 1 is cut out of a uniform sphere of radius R (centred at C), the centre of mass of remaining (shaded) part of sphere is at G, i.e., on the surface of the cavity. R can be determined by the equation :



- (1) $(R^2 - R + 1)(2 - R) = 1$
 (2) $(R^2 + R - 1)(2 - R) = 1$
 (3) $(R^2 + R + 1)(2 - R) = 1$
 (4) $(R^2 - R - 1)(2 - R) = 1$

NTA Ans. (3)

ALLEN Ans. (3)

2. In a double slit experiment, at a certain point on the screen the path difference between the two interfering waves is $\frac{1}{8}$ th of a wavelength. The ratio of the intensity of light at that point to that at the centre of a bright fringe is :
- (1) 0.568 (2) 0.672 (3) 0.760 (4) 0.853

NTA Ans. (4)

ALLEN Ans. (4)

3. A plane electromagnetic wave of frequency 25 GHz is propagating in vacuum along the z-direction. At a particular point in space and time, the magnetic field is given by $\vec{B} = 5 \times 10^{-8} \hat{j} \text{ T}$. The corresponding electric field \vec{E} is (speed of light $c = 3 \times 10^8 \text{ ms}^{-1}$)
- (1) $1.66 \times 10^{-16} \hat{i} \text{ V/m}$
 (2) $15 \hat{i} \text{ V/m}$
 (3) $-1.66 \times 10^{-16} \hat{i} \text{ V/m}$
 (4) $-15 \hat{i} \text{ V/m}$

NTA Ans. (2)

ALLEN Ans. (2)

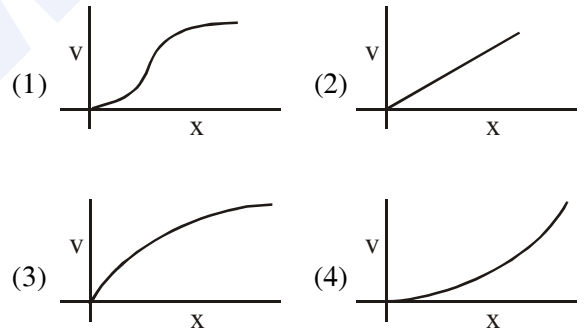
4. A galvanometer having a coil resistance 100Ω gives a full scale deflection when a current of 1 mA is passed through it. What is the value of the resistance which can convert this galvanometer into a voltmeter giving full scale deflection for a potential difference of 10 V?

- (1) 9.9 k Ω (2) 8.9 k Ω
 (3) 7.9 k Ω (4) 10 k Ω

NTA Ans. (1)

ALLEN Ans. (1)

5. A particle of mass m and charge q is released from rest in a uniform electric field. If there is no other force on the particle, the dependence of its speed v on the distance x travelled by it is correctly given by (graphs are schematic and not drawn to scale)



NTA Ans. (3)

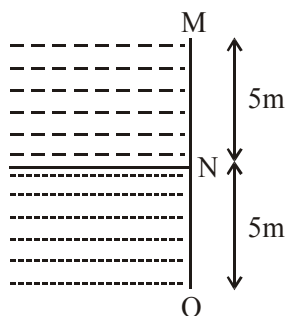
ALLEN Ans. (3)

6. A simple pendulum is being used to determine the value of gravitational acceleration g at a certain place. The length of the pendulum is 25.0 cm and a stop watch with 1s resolution measures the time taken for 40 oscillations to be 50 s. The accuracy in g is :
- (1) 3.40% (2) 5.40%
 (3) 4.40% (4) 2.40%

NTA Ans. (2)

ALLEN Ans. (3)

7. Two liquids of densities ρ_1 and ρ_2 ($\rho_2 = 2\rho_1$) are filled up behind a square wall of side 10 m as shown in figure. Each liquid has a height of 5 m. The ratio of the forces due to these liquids exerted on upper part MN to that at the lower part NO is (Assume that the liquids are not mixing)



- (1) 1/4 (2) 2/3 (3) 1/3 (4) 1/2

NTA Ans. (1)

ALLEN Ans. (1)

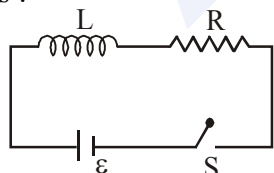
8. A transverse wave travels on a taut steel wire with a velocity of v when tension in it is 2.06×10^4 N. When the tension is changed to T , the velocity changed to $v/2$. The value of T is close to :

- (1) 10.2×10^2 N (2) 5.15×10^3 N
 (3) 2.50×10^4 N (4) 30.5×10^4 N

NTA Ans. (2)

ALLEN Ans. (2)

9. As shown in the figure, a battery of emf ϵ is connected to an inductor L and resistance R in series. The switch is closed at $t = 0$. The total charge that flows from the battery, between $t = 0$ and $t = t_c$ (t_c is the time constant of the circuit) is :

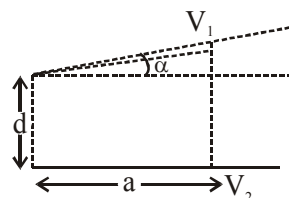


- (1) $\frac{\epsilon L}{R^2} \left(1 - \frac{1}{e}\right)$ (2) $\frac{\epsilon R}{eL^2}$
 (3) $\frac{\epsilon L}{R^2}$ (4) $\frac{\epsilon L}{eR^2}$

NTA Ans. (4)

ALLEN Ans. (4)

10. A capacitor is made of two square plates each of side 'a' making a very small angle α between them, as shown in figure. The capacitance will be close to :

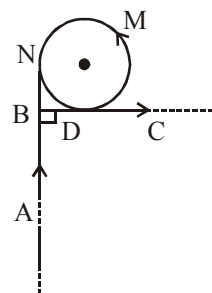


- (1) $\frac{\epsilon_0 a^2}{d} \left(1 - \frac{3\alpha a}{2d}\right)$ (2) $\frac{\epsilon_0 a^2}{d} \left(1 - \frac{\alpha a}{4d}\right)$
 (3) $\frac{\epsilon_0 a^2}{d} \left(1 + \frac{\alpha a}{d}\right)$ (4) $\frac{\epsilon_0 a^2}{d} \left(1 - \frac{\alpha a}{2d}\right)$

NTA Ans. (4)

ALLEN Ans. (4)

11. A very long wire ABDMNDC is shown in figure carrying current I . AB and BC parts are straight, long and at right angle. At D wire forms a circular turn DMND of radius R . AB, BC parts are tangential to circular turn at N and D. Magnetic field at the centre of circle is :



- (1) $\frac{\mu_0 I}{2R}$ (2) $\frac{\mu_0 I}{2\pi R} (\pi + 1)$
 (3) $\frac{\mu_0 I}{2\pi R} \left(\pi + \frac{1}{\sqrt{2}}\right)$ (4) $\frac{\mu_0 I}{2\pi R} \left(\pi - \frac{1}{\sqrt{2}}\right)$

NTA Ans. (3)

ALLEN Ans. (3)

12. A particle of mass m is dropped from a height h above the ground. At the same time another particle of the same mass is thrown vertically upwards from the ground with a speed of $\sqrt{2gh}$. If they collide head-on completely inelastically, the time taken for the combined mass to reach the ground, in units of $\sqrt{\frac{h}{g}}$ is :

- (1) $\frac{1}{2}$ (2) $\sqrt{\frac{1}{2}}$
 (3) $\sqrt{\frac{3}{4}}$ (4) $\sqrt{\frac{3}{2}}$

NTA Ans. (4)

ALLEN Ans. (4)

13. A Carnot engine having an efficiency of $\frac{1}{10}$ is being used as a refrigerator. If the work done on the refrigerator is 10 J, the amount of heat absorbed from the reservoir at lower temperature is :

- (1) 99 J (2) 100 J
 (3) 90 J (4) 1 J

NTA Ans. (3)

ALLEN Ans. (3)

14. Consider a mixture of n moles of helium gas and $2n$ moles of oxygen gas (molecules taken to be rigid) as an ideal gas. Its C_p/C_v value will be :

- (1) 67/45 (2) 19/13
 (3) 23/15 (4) 40/27

NTA Ans. (2)

ALLEN Ans. (2)

15. An electron (mass m) with initial velocity $\vec{v} = v_0\hat{i} + v_0\hat{j}$ is in an electric field $\vec{E} = -E_0\hat{k}$. If λ_0 is initial de-Broglie wavelength of electron, its de-Broglie wave length at time t is given by :

- (1) $\frac{\lambda_0\sqrt{2}}{\sqrt{1 + \frac{e^2E^2t^2}{m^2v_0^2}}}$ (2) $\frac{\lambda_0}{\sqrt{2 + \frac{e^2E^2t^2}{m^2v_0^2}}}$
 (3) $\frac{\lambda_0}{\sqrt{1 + \frac{e^2E^2t^2}{2m^2v_0^2}}}$ (4) $\frac{\lambda_0}{\sqrt{1 + \frac{e^2E_0^2t^2}{m^2v_0^2}}}$

NTA Ans. (3)

ALLEN Ans. (3)

16. A uniform sphere of mass 500 g rolls without slipping on a plane horizontal surface with its centre moving at a speed of 5.00 cm/s. Its kinetic energy is :

- (1) 8.75×10^{-4} J (2) 8.75×10^{-3} J
 (3) 6.25×10^{-4} J (4) 1.13×10^{-3} J

NTA Ans. (1)

ALLEN Ans. (1)

17. Consider two charged metallic spheres S_1 and S_2 of radii R_1 and R_2 , respectively. The electric fields E_1 (on S_1) and E_2 (on S_2) on their surfaces are such that $E_1/E_2 = R_1/R_2$. Then the ratio V_1 (on S_1) / V_2 (on S_2) of the electrostatic potentials on each sphere is :

- (1) (R_2/R_1) (2) $\left(\frac{R_1}{R_2}\right)^3$
 (3) R_1/R_2 (4) $(R_1/R_2)^2$

NTA Ans. (4)

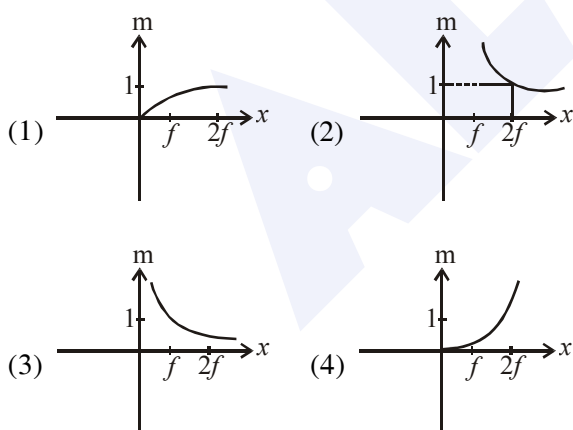
ALLEN Ans. (4)

18. A particle moves such that its position vector $\vec{r}(t) = \cos \omega t \hat{i} + \sin \omega t \hat{j}$ where ω is a constant and t is time. Then which of the following statements is true for the velocity $\vec{v}(t)$ and acceleration $\vec{a}(t)$ of the particle :
- (1) \vec{v} is perpendicular to \vec{r} and \vec{a} is directed towards the origin
 - (2) \vec{v} and \vec{a} both are parallel to \vec{r}
 - (3) \vec{v} and \vec{a} both are perpendicular to \vec{r}
 - (4) \vec{v} is perpendicular to \vec{r} and \vec{a} is directed away from the origin

NTA Ans. (1)

ALLEN Ans. (1)

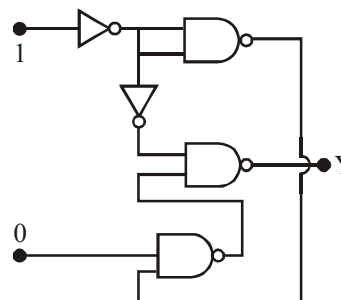
19. An object is gradually moving away from the focal point of a concave mirror along the axis of the mirror. The graphical representation of the magnitude of linear magnification (m) versus distance of the object from the mirror (x) is correctly given by :
- (Graphs are drawn schematically and are not to scale)



NTA Ans. (2)

ALLEN Ans. (2)

20. In the given circuit, value of Y is :



- (1) will not execute
- (2) 0
- (3) toggles between 0 and 1
- (4) 1

NTA Ans. (2)

ALLEN Ans. (2)

21. Three containers C_1 , C_2 and C_3 have water at different temperatures. The table below shows the final temperature T when different amounts of water (given in litres) are taken from each containers and mixed (assume no loss of heat during the process)

C_1	C_2	C_3	T
1l	2l	-	60°C
-	1l	2l	30°C
2l	-	1l	60°C
1l	1l	1l	θ

The value of θ (in °C to the nearest integer) is

NTA Ans. (50)

ALLEN Ans. (50)

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22. A ball is dropped from the top of a 100 m high tower on a planet. In the last $\frac{1}{2}$ s before hitting the ground, it covers a distance of 19 m. Acceleration due to gravity (in ms^{-2}) near the surface on that planet is _____

NTA Ans. (8 or 2888)

ALLEN Ans. (8)

23. The first member of the Balmer series of hydrogen atom has a wavelength of 6561 Å. The wavelength of the second member of the Balmer series (in nm) is:

NTA Ans. (486)

ALLEN Ans. (486)

24. An asteroid is moving directly towards the centre of the earth. When at a distance of $10R$ (R is the radius of the earth) from the earth's centre, it has a speed of 12 km/s. Neglecting the effect of earth's atmosphere, what will be the speed of the asteroid when it hits the surface of the earth (escape velocity from the earth is 11.2 km/s)? Give your answer to the nearest integer in kilometer/s _____.

NTA Ans. (16)


ALLEN Ans. (16)

25. The series combination of two batteries, both of the same emf 10 V, but different internal resistance of 20Ω and 5Ω , is connected to the parallel combination of two resistors 30Ω and $R\Omega$. The voltage difference across the battery of internal resistance 20Ω is zero, the value of R (in Ω) is : _____

NTA Ans. (30)

ALLEN Ans. (30)

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