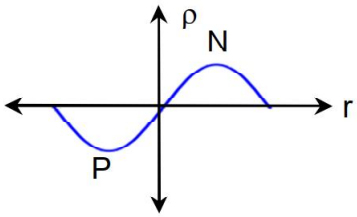
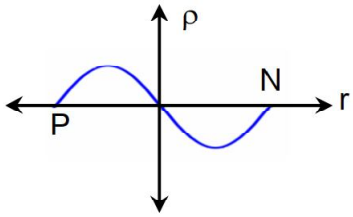
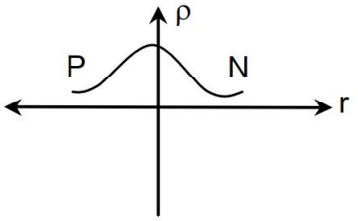
JEE MAIN
SAMPLE PAPER 1 - 2020

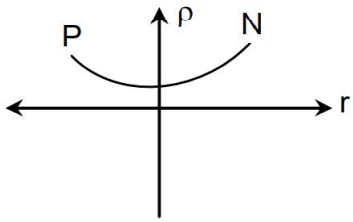
PHYSICS
QUESTION PAPER

1. The curve between charge density ρ and distance r near p – N junction will be

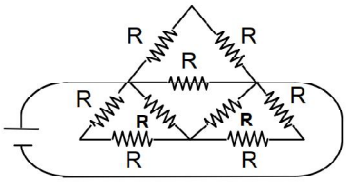
(A) 

(B) 

(C) 

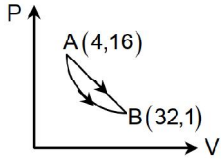
(D) 

2. For maximum power from battery the internal resistance of battery r is



(A) 10 R (B) $\frac{4R}{9}$ (C) $\frac{R}{8}$ (D) $\frac{10R}{9}$

3. An ideal mono atomic gas is taken through the cyclic process shown in fig. Linear expansion from A to B followed by adiabatic compression back to original state



(A) Efficiency of cyclic process is zero.
(B) During process A to B heat is released only
(C) During process A to B heat is absorbed only
(D) During linear process heat enters and leaves the process

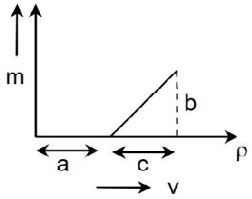
4. If error in the measurement of mass is 0.8 of and in volume it is 0.4% then error in the measurement of density is

(A) 1.2 % (B) 0.4 % (C) 0.8 % (D) 1 %

5. Kundt's tube can be used to

(A) Produce standing wave
(B) Determine viscosity of water
(C) Produce Doppler's effect in sound
(D) Determine velocity of the source of the disturbance

6. The graph shows how the magnification m produced by a convex thin lens varies with image distance v. What was the focal length of the lens used?



(A) b/c (B) b/ca (C) bc/a (D) c/b

7. A particle is moving in x-y plane. At certain instant the components of its velocity and acceleration are as follows $V_x = 3m/s$, $V_y = 4m/s$, $a_x = 2\ m/s^2$ and $a_y = 1m/s^2$. The rate ofchange of speed at this moment is.

(A) $4\ m/s^2$ (B) $2\ m/s^2$ (C) $\sqrt{3}\ m/s^2$ (D) $\sqrt{5}\ m/s^2$

8. In a tug of war, the team that exerts a larger tangential force on the ground wins. Consider the period in which a team is dragging the opposite team by applying a larger tangential force on the ground. Which of the following works are negative?

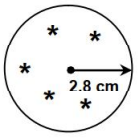
(A) work by the loosing team on the winning team

(B) work by the ground on the winning team

(C) work by the ground on the loosing team

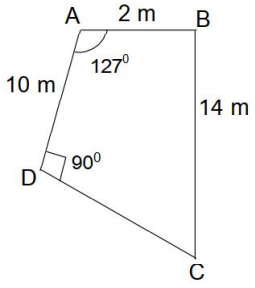
(D) none of these

9. The magnetic field of a cylindrical magnet that has a pole – face radius 2.8 cm can be varied sinusoidally between minimum value 16.8 T and maximum value 17.2 T at a frequency of $\frac{60}{\pi}$ Hz. Cross section of the magnetic field created by the magnet is shown. At a radial distance of 2 cm from the axis find the amplitude of the electric field (in m N/C) induced by the magnetic field variation.



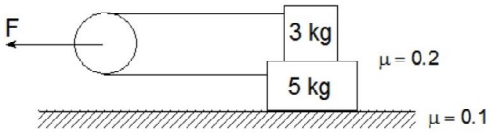
(A) 140 m N/c (B) 245 m N/C (C) 180 m N/C (D) 240 m N/C

10. In the figure shown ABCD is a lamina of mass 12 kg. The moment of inertia of the given body about an axis passing through D, and perpendicular to the plane of the body is



(A) $256\ kg\ m^2$ (B) $512\ kg\ m^2$ (C) $200\ kg\ m^2$ (D) $100\ kg\ m^2$

11. For the arrangement as shown in the figure, the maximum force F, for no relative motion between blocks is

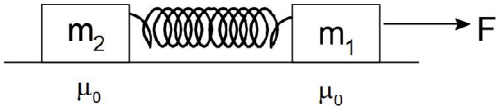


(A) 12 N (B) 8 N (C) 20 N (D) 24 N

12. A particle of mass m moves in a force field such that its potential energy in force field is defined by the equation $U = +A(x-a)^2(x-b)^2$. Where A, a and b are +ve constants then body may oscillate simple harmonically about point.

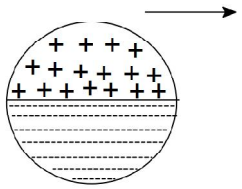
(A) a only (B) a and b both (C) only $\frac{a+b}{2}$ (D) b only

13. Find minimum value of F such that m_2 starts its motion on the ground



(A) $\frac{\mu_0(2m_1+m_2)g}{2}$ (B) $\mu_0(2m_1+m_2)g$ (C) $\mu_0(m_1+m_2)g$ (D) $\frac{\mu_0(m_1+m_2)g}{2}$

14. A disc having uniform surface charge density in upper part +ρ and –ρ in lower half placed on rough horizontal surface as shown in figure. A uniform electric field is set up as shown if mass of disc is M and its radius is R as well sufficient friction is present to prevent slipping. The acceleration of disc is



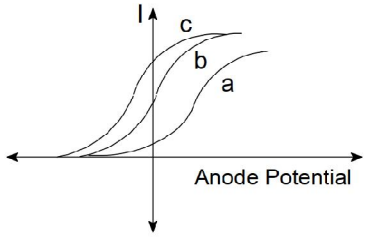
(A) $\frac{8}{9}\frac{\rho R^2 E_0}{M}$ (B) $\frac{9}{8}\frac{\rho R^2 E_0}{M}$ (C) $\frac{4}{3}\frac{\rho R^2 E_0}{M}$ (D) $\frac{3}{4}\frac{\rho R^2 E_0}{M}$

15. Above Curie temp

(A) Paramagnetic materials become ferromagnetic (B) Ferromagnetic materials becomes diamagnetic

(C) Ferromagnetic materials becomes paramagnetic (D) Paramagnetic materials becomes diamagnetic

16. Above figure shows variation of current with anode potential for a photo sensitive surface for there different radiation. Let I_a , I_b and I_c be intensities and f_a f_b and f_c the frequencies for curve a, b and c respectively



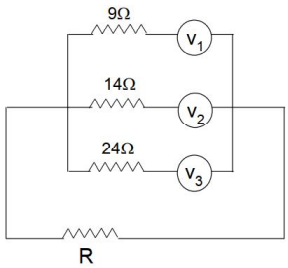
(A) $f_a = f_b$, $I_a \neq I_b$ (B) $f_a = f_c$, $I_a = I_c$ (C) $f_a = f_b$, $I_a = I_b$ (D) $f_b = f_c$, $I_b = I_c$

17. M_x and M_y denote the atomic masses of the parent and daughter nuclei respectively in a radio active decay. The Q value of a β^- decay is Q_1 and for β^+ decay is Q_2. If me denote the masses of electron then which of following statement is correct.

(A) $Q_1 = (M_x - M_y)C^2$ $Q_2 = (M_x - M_y - 2m_e)C^2$ (B) $Q_1 = (M_x - M_y)C^2$ $Q_2 = (M_x - M_y)C^2$

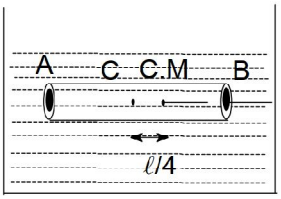
(C) $Q_1 = (M_x - M_y - 2m_e)C^2$ $Q_2 = (M_x - M_y + 2m_e)C^2$ (D) $Q_1 = (M_x - M_y + 2m_e)C^2$ $Q_2 = (M_x - M_y - 2m_e)C^2$

18. The figure shows a portion of a circuit. Resistor are known and indicated on diagram and voltmeter are identical. If voltmeters v_1 and v_2 reads 7.5v and 5v respectively then reading of v_3.



(A) 0v (B) 10v (C) 2.5v (D) 3.0v

19. A non uniform cylinder of mass m, length ℓ and radius r having its C.O.M at a distance $\frac{\ell}{4}$ from centre and lying on axis of cylinder. The cylinder is kept in a liquid of uniform density ρ. The moment of inertia of the rod about C.O.M is I. The angular acceleration of point A relative to point B just after the rod is released from position shown in figure is

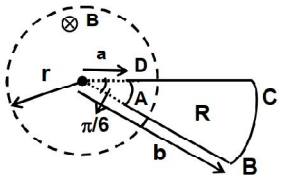


(A) $\frac{\pi\rho g\ell^2 r^2}{2I}$ (B) $\frac{3\pi\rho g\ell^2 r^2}{4I}$ (C) $\frac{\pi\rho g\ell^2 r^2}{I}$ (D) $\frac{\pi\rho g\ell^2 r^2}{4I}$

20. Which of the following forces is non conservative one?

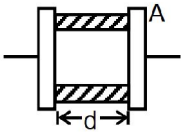
(A) $3\hat{i}+4\hat{j}$ (B) $4x\hat{i}+3y\hat{j}$ (C) $3x^2\hat{i}+4y^2\hat{j}$ (D) $y^2\hat{i}+x^2\hat{j}$

21. Magnetic field B in a cylindrical region of radius r varies according to the law $B = B_0t$ as shown in the figure. A fixed conducting loop ABCDA of resistance R is lying in the region as shown. The current flowing through the loop is



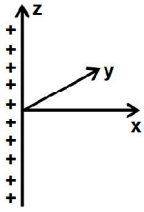
(A) $\frac{\pi a^2 B_0}{12R}$ (B) $\frac{\pi(r^2-a^2)B_0}{12R}$ (C) $\frac{\pi(b^2-a^2)B_0}{12R}$ (D) none of the above

22. A parallel plate capacitor of area A and separation d is provided with thin insulating spacers to keep its plates aligned in an environment of fluctuating temperature. If the coefficient of thermal expansion of material of the plate is α, find the coefficient of thermal expansion (α_s) of the spacers in order that the capacitance does not vary with temperature. (Ignore effect of the spacers on capacitance.)



(A) $\alpha_s = \frac{\alpha}{2}$ (B) $\alpha_s = 3\alpha$ (C) $\alpha_s = 2\alpha$ (D) $\alpha_s = \alpha$

23. An infinite thread of charge density λ lies along z-axis. The potential difference between points A (4, 3, 4) and B (3, 4, 0) is

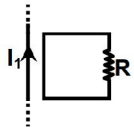


(A) $\frac{\lambda}{2\pi\epsilon_0}\ln\left(\frac{\sqrt{41}}{5}\right)$ (B) $\frac{\lambda}{2\pi\epsilon_0}\ln(5)$ (C) zero (D) $\frac{\lambda}{2\pi\epsilon_0}$

24. The sun having surface temperature T_S radiates like a black body. The radius of sun is R_S and earth is at a distance R from the surface of sun. Earth absorbs radiations falling on its surface from sun only and is at constant temperature T. If radiations falling on earth's surface are almost parallel and earth also radiates like a blackbody, then

(A) $T = T_s\sqrt{\frac{R_s}{2R}}$ (B) $T = T_S$ (C) $T = \frac{T_s}{2}\sqrt{\frac{R_s}{R}}$ (D) $T = T_s\sqrt{\frac{R_s}{R}}$

25. In the adjacent figure, the mutual inductance of the infinite straight wire and the coil is M, while the self inductance of the coil is L. The current in infinite wire is varying according to the relation $I_1 = \alpha t$, where α is a constant and t is the time. The time dependence of current in the coil is

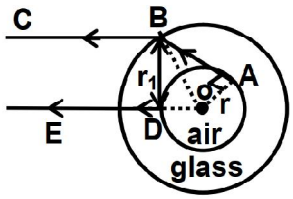


(A) $\frac{M\alpha}{R}$ (B) $\frac{M\alpha L}{R}e^{-Rt/L}$ (C) $\frac{\alpha}{R}(1-e^{-Rt/L})$ (D) none of the above

26. A cubical box of side 1 m contains an ideal gas at pressure 100 N/m^2. If $\sum V_x^2 = \sum V_y^2 = \sum V_z^2 = 10^{28}\,m^2/s^2$, where v_x, v_y and v_z are the x, y and z components, respectively, of the gas molecule, then the mass of each gas molecule is

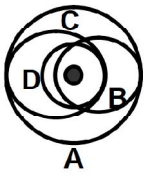
(A) 10^{-20} g (B) 10^{-23} g (C) 10^{-18}g (D) 10^{-26} g

27. The adjacent figure shows cross section of a hollow glass tube of internal radius r, external radius R and index of refraction n. For two rays DE and ABC (in which DE lies on ODE and DE and BC are parallel), the separation r_1 will be



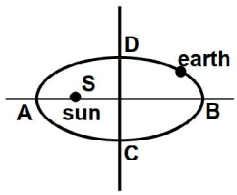
(A) $r_1 = (n-1)R$ (B) $r_1 = n^2R$ (C) $r_1 = nr$ (D) $r_1 = n^2r$

28. The given figure shows several possible elliptical orbits of a satellite. On which orbit will the satellite acquire the largest speed?



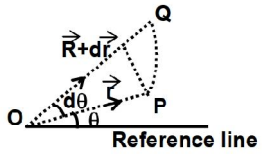
(A) A (B) B (C) C (D) D

29. The earth is moving on an elliptical path, whose one focus sun is situated as shown in figure. If AS = r_{min} and SB = r_{max}, the sun and earth system obey the Kepler's law, the square of time-period is directly proportional to



(A) $(r_{min})^3$ (B) $(r_{max})^3$ (C) $\left(\frac{r_{min}+r_{max}}{2}\right)^3$ (D) $\left(\frac{r_{min}r_{max}}{r_{min}+r_{max}}\right)^3$

30. A body is moving under the action of central force $\vec{F}(r)\hat{e}_r$ such that its position vector is $\vec{r} = r\hat{e}_r$. Then, choose the correct statement (symbols are having usual meaning and $\hat{e}_r, \hat{e}_\theta$ denote unit vectors along the radial and tangential direction, respectively) from the following.



(A) $\vec{v} = \frac{dr}{dt}\hat{e}_r + r\frac{d\theta}{dt}\hat{e}_\theta, \vec{a} = \left[\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2\right]\hat{e}_r, 2\frac{dr}{dt}\frac{d\theta}{dt} + r\frac{d^2\theta}{dt^2} = 0$

(B) $\vec{v} = \frac{dr}{dt}\hat{e}_r + r\frac{d\theta}{dt}\hat{e}_\theta, \vec{a} = \left[\frac{d^2r}{dt^2} + r\left(\frac{d\theta}{dt}\right)^2\right]\hat{e}_r, 2\frac{dr}{dt}\frac{d\theta}{dt} - r\frac{d^2\theta}{dt^2} = 0$

(C) $\vec{v} = \frac{dr}{dt}\hat{e}_r - r\frac{d\theta}{dt}\hat{e}_\theta, \vec{a} = \left[\frac{d^2r}{dt^2} + r\left(\frac{d\theta}{dt}\right)^2\right]\hat{e}_r, 2\frac{dr}{dt}\frac{d\theta}{dt} + r\frac{d^2\theta}{dt^2} = 0$

(D) $\vec{v} = \frac{dr}{dt}\hat{e}_r - r\frac{d\theta}{dt}\hat{e}_\theta, \vec{a} = \left[\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2\right]\hat{e}_r, 2\frac{dr}{dt}\frac{d\theta}{dt} + r\frac{d^2\theta}{dt^2} = 0$