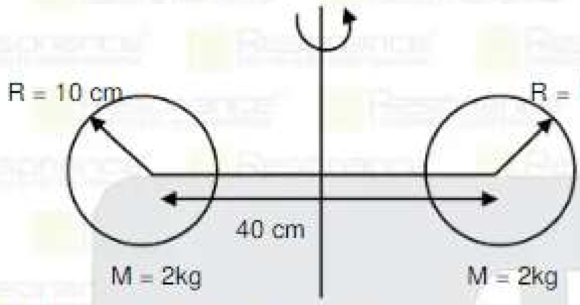
PART : PHYSICS

1.



Moment of inertia of system of two solid spheres connected by light rod about given axis is $n \times 10^{-3}$ kg m^2, then n will be :

(1) 180 (2) 176 (3) 166 (4) 156

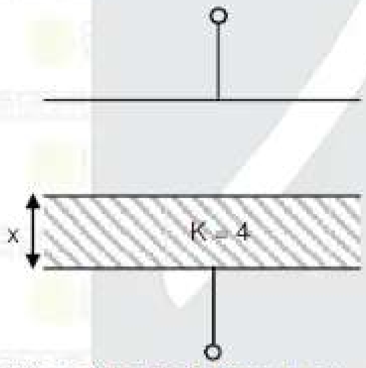
Ans. **(2)**

Sol. $I = 2\left[\frac{2}{5}mR^2 + md^2\right]$

d = 20 cm = 2R

$I = 2\left[\frac{2}{5}mR^2 + 4mR^2\right] = \frac{44}{5}MR^2 = 176 \times 10^{-3}$ kg.m^2

2.



When dielectric is filled upto x = d/3 capacitance is $C_1 = 2\mu F$ and when dielectric is filled up to x = 2d/3 capacitance is C_2 then C_2 will be :

(1) 12 μF (2) 9 μF (3) 6 μF (4) 3 μF

Ans. **(4)**

Sol. $C_1 = \frac{\varepsilon_0 A}{\frac{d}{3k} + \frac{2d}{3}} = \frac{\varepsilon_0 A}{\frac{d}{12} + \frac{2d}{3}} = \frac{\varepsilon_0 A}{\frac{d}{12}(1+8)} = \frac{12\varepsilon_0 A}{9d} = \frac{4\varepsilon_0 A}{3d}$

$C_2 = \frac{\varepsilon_0 A}{\frac{2d}{3k} + \frac{d}{3}} = \frac{\varepsilon_0 A}{\frac{2d}{12} + \frac{d}{3}} = \frac{\varepsilon_0 A}{\frac{d}{6}(1+2)} = \frac{6\varepsilon_0 A}{3d} = \frac{2\varepsilon_0 A}{d}$

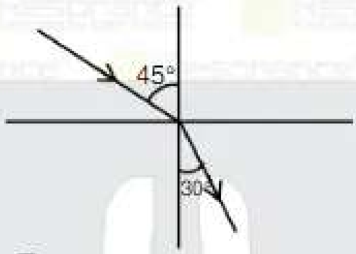
$\frac{C_1}{C_2} = \frac{4/3}{2/1}$; $\frac{C_1}{C_2} = \frac{4}{2\times 3} = \frac{2}{3}$; $C_2 = \frac{3}{2}C_1$

$C_2 = 3\mu F$

3. In an Electromagnetic wave $E = E_0\sin(\omega t - kx)$, $B = B_0\sin(\omega t - kx)$. The ratio of average energy density of electric field and average energy density of magnetic field will be
(1) 2/1 (2) 1/1 (3) 1/2 (4) 4/1

Ans. **(2)**

4. The angle of incidence of a ray in a medium is 45° and angle of refraction in the second medium is 30° let λ_1, f_1 and λ_2, f_2 be the wavelength & frequency in the two media.



(1) $\lambda_1 = \sqrt{2}\,\lambda_2$, $f_1 = f_2$ (2) $\lambda_2 = \sqrt{2}\,\lambda_1$, $f_1 = f_2$ (3) $\lambda_1 = \lambda_2$, $f_1 = \sqrt{2}\,f_2$ (4) $\lambda_1 = \lambda_2$, $f_2 = \sqrt{2}\,f_1$

Ans. **(1)**

Sol. $n_1\sin45° = n_2\sin30°$

$$\frac{C}{V_1}\times\frac{1}{\sqrt{2}} = \frac{C}{V_2}\times\frac{1}{2} \Rightarrow V_1 = \sqrt{2}V_2,\ \lambda_1 = \sqrt{2}\lambda_2$$

5. If the height of transmitting Antenna on the earth surface is increase by 21%, by what percentage will the range of the signals on the surface increase :
(1) 42% (2) 40% (3) 20% (4) 10%

Ans. **(4)**

Sol. $d = \sqrt{2RH}$

$d' = \sqrt{2R\times1.21H}$

$$\frac{d'-d}{d}\times100 = 10\%$$

6. Find the radius of electrons in 5th orbit of Li^{++}
(1) 3.3Å (2) 7.8Å (3) 4.4Å (4) 5.7Å

Ans. **(2)**

Sol. $r = \frac{n^2}{Z}a_0 = \frac{5^2}{3}\times5.3\times10^{-11}m \approx 4.4Å$

7. A wire is extended by 20% and area of cross-section is reduce by 4%. Find the percentage change in resistance of wire :
(1) 25% (2) 30% (3) 40% (4) 20%

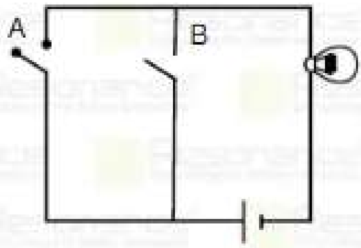
Ans. **(1)**

Sol. Suppose initial length of wire = l
cross area sectional = A
And resistivity of material = ρ
$\therefore$ Initial resistance $R = \rho\times\ell/A$

Now Resistance of change $R' = \frac{\rho\cdot[1+0.20]\ell}{A[1-0.04]}$

$R' = 1.25\frac{\rho\ell}{A} = 1.25R$ $\therefore$ % change $\frac{\Delta R}{R}\times100 = 25\%$

8. Find the type of logic gate



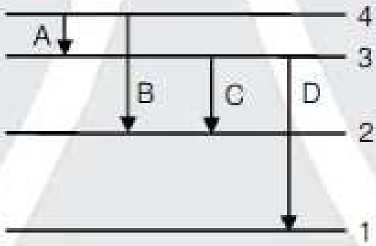
(1) NOR (2) AND (3) NAND (4) OR

Ans. **(4)**

Sol. OR

A	B	Output
1	1	1
1	0	1
0	1	1
0	0	0

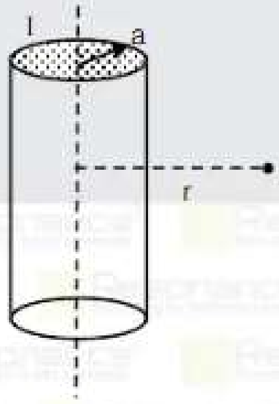
9. Which of the transitions will give maximum wavelength of emitted photon :



(1) A (2) B (3) C (4) D

Ans. **(1)**

10. Solid conductor of radius a carrying uniformly distributed current. Select the correct option about magnetic field B at radial distance r.



(1) if $r < a$, $B \propto r$ if $r > a$, $B \propto 1/r^2$

(2) if $r < a$, $B \propto r$ if $r > a$, $B \propto r^2$

(3) B is uniformly distributed for $r < a$ and for $r > a$, $B \propto 1/r$

(4) if $r < a$ B is proportional to r and for $r > a$, $B \propto 1/r$

Ans. **(4)**

Sol. For $r < a$

$$B = \frac{\mu_0 Ir}{2\pi a^2}$$

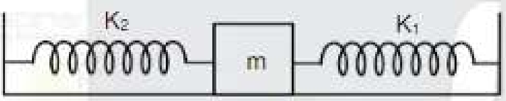
$\therefore B \propto r$

for $r > a$

$$B = \frac{\mu_0 I}{2\pi r}$$

$\therefore B \propto \frac{1}{r}$

11.



$\mu = 0$

Time period of oscillations of this system is

(1) $T = 2\pi\sqrt{\frac{m}{k_1 + k_2}}$ (2) $T = 2\pi\sqrt{\frac{m(k_1 + k_2)}{k_1 k_2}}$ (3) $T = 2\pi\sqrt{\frac{k_1 + k_2}{m}}$ (4) $T = 2\pi\sqrt{\frac{k_1 k_2}{(k_1 + k_2)m}}$

Ans. **(1)**

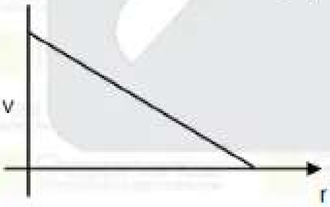
12. Kinetic energy of electron, proton and α–particle is given as 4K, K and 2K respectively. Correct order of de–Broglie wavelength λ_e, λ_p, λ_α for electron, proton and α– particle respectively is:

(1) $\lambda_e > \lambda_\alpha > \lambda_p$ (2) $\lambda_e = \lambda_p > \lambda_\alpha$ (3) $\lambda_e > \lambda_p > \lambda_\alpha$ (4) $\lambda_\alpha > \lambda_p > \lambda_e$

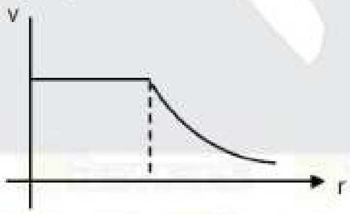
Ans. **(3)**

Sol. $\lambda_e = \frac{h}{\sqrt{2m_e 4K}}$; $\lambda_p = \frac{h}{\sqrt{2m_p K}} < \lambda_e$; $\lambda_\alpha = \frac{h}{\sqrt{2(4m_p)2K}} = \frac{\lambda_p}{2\sqrt{2}}$

13. Potential and radial distance graph for uniformly charged spherical shell will be :



(1)



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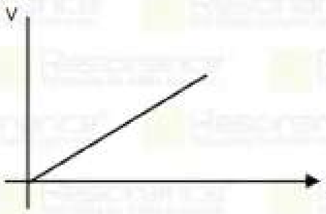

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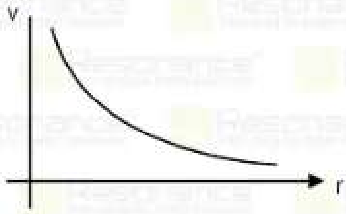


(4)

Ans. **(2)**

14. A block of mass 100 gram attached to spring rotating with angular velocity 5 rad/s in horizontal plane radius of circular path of block is 20mm and spring constant is k = 7.5 N/m then tension in spring will be:

(1) 0.01 N (2) 0.05 N (3) 1 N (4) 2.5 N

Sol. $T = m\omega^2 r$

$= 0.1(5)^2(20 \times 10^{-3})$

$= 50 \times 10^{-3}$

$= 0.05$ N

15. EMF will induced if

(a) Coil moves in uniform magnetic field with constant velocity

(b) Coil moves in non-uniform magnetic field with constant velocity

(c) Coil rotating in uniform magnetic field

(d) Area of coil increase in uniform magnetic field

then which of following is correct :

(1) a & b (2) b & c (3) c & d (4) b & d

Ans. **(4)**

16. **Assertion (A) :** There is atmosphere on the surface of earth and no atmosphere on the surface of moon.
Reason (R) : Escape velocity from the surface of earth is more than escape velocity from the surface of moon. Gases get escape out from moon due to its escape speed load than root mean square velocity at the moon.

(1) Both A and R are correct but R is not the correct explanation of A

(2) A is correct but R is not correct

(3) A is not correct but R is correct

(4) Both A and R are correct and R is the correct explanation of A

Ans. **(1)**

17. A planet has mass twice of that of earth but same density as that of earth. Weight of an object placed on earth is 'W' then what will be the weight of the same object on this planet

(1) $W \times 2$ (2) $W \times 2^{4/3}$ (3) $W \times 2^{1/3}$ (4) $W \times 2^{5/3}$

Ans. **(3)**

Sol. Weight $W_e = mg = \frac{mGM}{R^2}$

$$\frac{M}{\frac{4\pi}{3}R_e^3} = \frac{2M}{\frac{4\pi}{3}R_p^3}$$

$$R_p = R_e\, 2^{\frac{1}{3}}$$

Ratio of weight $\Rightarrow \frac{We}{Wp} = \frac{Me}{Mp} \times \left(\frac{R_p}{R_e}\right)^2$

$$\frac{W}{W_p} = \frac{M}{2M} \times (2^{1/3})^2 \Rightarrow \frac{W}{W_p} = 2^{\frac{2}{3}-1} \Rightarrow W_p = W \times 2^{\frac{1}{3}}$$

18. In a process Rate at which work done by gas is 10J/s and rate of heat supply to gas is 30J/s. Determine the rate at which internal energy of gas is increasing (in J/s)

(1) 20 (2) 30 (3) 40 (4) 60

Ans. (1)

Sol. First law of thermodynamic

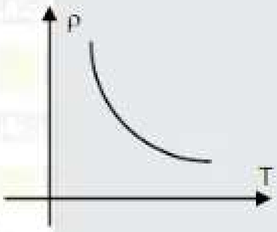
$Q = \Delta u + w$

$\dot{Q} = \frac{du}{dt} + \dot{W}$

$30 = \frac{du}{dt} + 10$

$\frac{du}{dt} = 20$ J/s

19. Select the correct graph which give variation of resistivity of semiconductor with increase in temperature.



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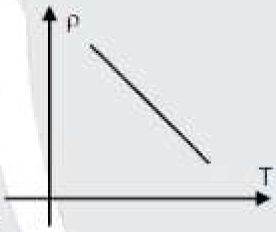

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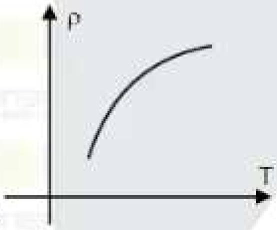

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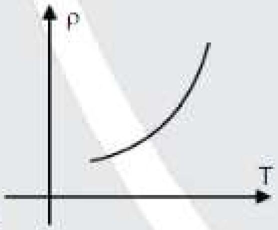

(4)

Ans. **(1)**

20. Two resistance $R_1 = [15 \pm 0.5]\Omega$ and $R_2 = (10 \pm 0.5)\Omega$ are connected in parallel. The equivalent resistance will be :

(1) $[6 \pm 0.26]\ \Omega$ (2) $[6 \pm 0.52]\Omega$ (3) $[6 \pm 0.14]\Omega$ (4) $[6 \pm 0.75]\Omega$

Ans. **(1)**

Sol. $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R} = \frac{1}{15} + \frac{1}{10}$

$R = 6\Omega$

$\frac{\Delta R}{R^2} = \left[\frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}\right]$

$\Delta R = R^2\left[\frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}\right] = 6^2\left[\frac{0.5}{15^2} + \frac{0.5}{10^2}\right] = 36\ [0.0022 + 0.005]$

$= 36\ [0.0072] = 0.2592 \approx 0.26\ \Omega$

Resistance is $R \pm \Delta R = 6 \pm 0.26$