PHYSICS

BOOKS - NTA MOCK TESTS

NTA JEE MOCK TEST 53

Physics

1. A stationary hydrogen atom in the first excited state emits a photon. If the mass of the hydrogen atom is m and its ionization energy is E, then the recoil velocity acquired by the atom is [speed of light = c]

A. $\left[\sqrt{\frac{3E}{2m}+c^2}\right]-c$

B. $\left[\sqrt{\frac{3E}{4m}+c^2}\right]-c$

C. $\frac{3E}{4mc}$

D. $\frac{E}{mc}$

Answer: A

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2. Two identical spheres, each of mass m are suspended by vertical strings such that they are in contact with their centres at the same level. A third identical sphere strikes the other two spheres simultaneously with a velocity U such that the centres of the spheres at the instant of impact form an equilateral triangle in a vertical plane. If the collision is perfectly elastic, then the combined impulse due to the strings is

A. $\frac{12}{7}mu$

B. $\frac{6}{7}mu$

C. $\frac{2\sqrt{3}}{7}mu$

D. $\frac{8}{7}mu$

Answer: A

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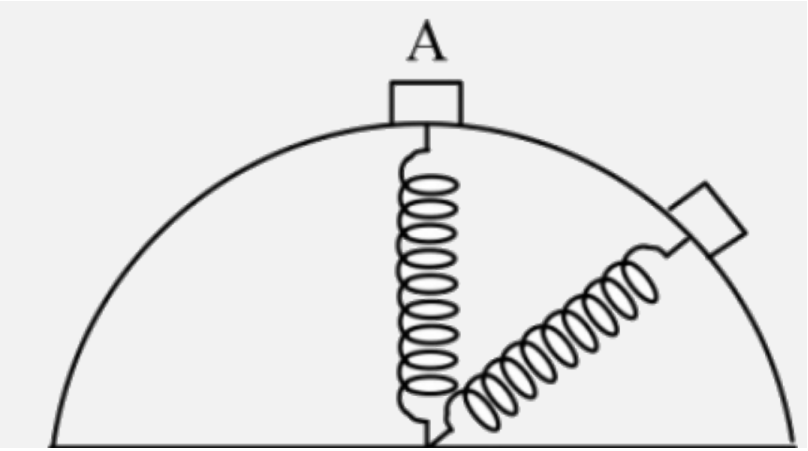
3. A bead of mass m can slide without friction along a vertical ring of radius R. One end of a spring of force constant $k = \frac{3mg}{R}$ is connected to the bead and the other end is fixed at the centre of the ring. Initially, the bead is at the point A and due to a small push it starts sliding down the ring. If the bead momentarily loses contact with the ring at the instant when the spring makes an

angle 60° with the vertical, then the natural length of the spring is



A. $\frac{5R}{9}$

B. $\frac{3R}{4}$

C. $\frac{5R}{6}$

D. $\frac{4R}{7}$

Answer: C

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4. A glass prism of angle $A = 60^\circ$ gives minimum angle of deviation $\theta \approx 30^\circ$ with the maximum error of 1° when a beam of parallel light passed through the prism during an experiment. Find the permissible error in the measurement of refractive index μ of the material of the prism.

A. $\frac{100\pi}{180}\%$

B. $\frac{5\pi}{180}\%$

C. $\frac{50\pi}{180}\%$

D. $\frac{5\pi}{18}\%$

Answer: D

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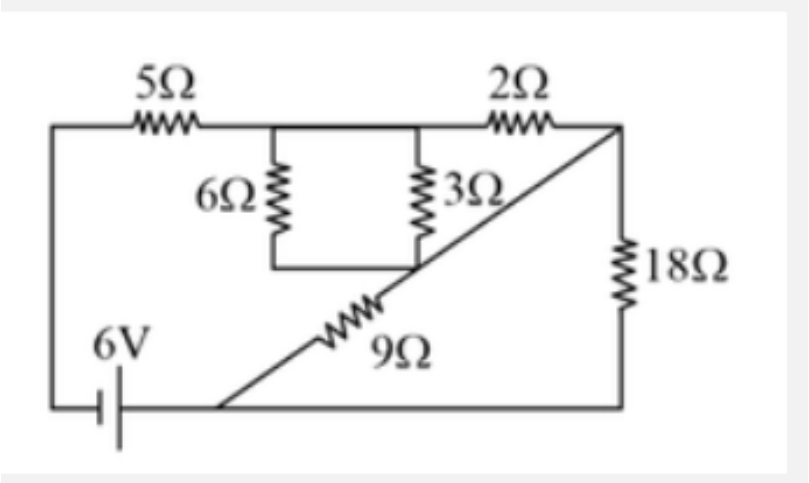
5. Find the resistor in which the dissipated power is the greatest -



A. 2Ω

B. 9Ω

C. 18Ω

D. 5Ω

Answer: D

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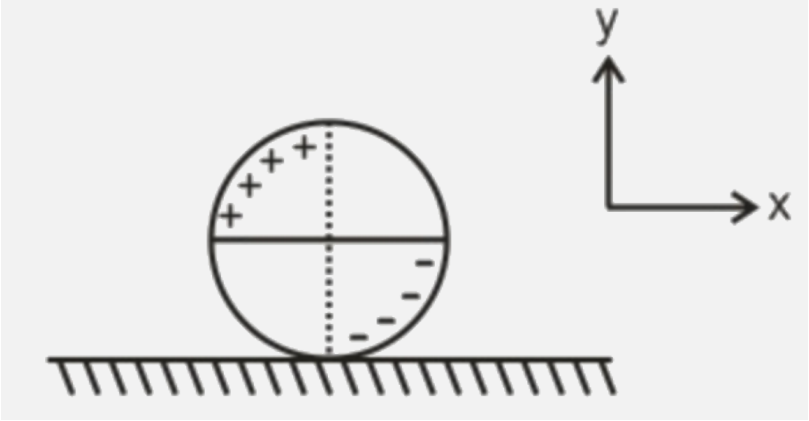
6. A nonconducting ring of mass m and radius R is charged as shown. The charged density i.e. charge per unit length is λ. It is then placed on a rough nonconducting horizontal surface plane. At time t = 0, a uniform electric field $\overrightarrow{E} = E_0\hat{i}$ is switched on and the ring starts rolling without sliding. The friction force (magnitude and direction) acting on the ring, when it starts moving is



A. $\lambda R E_0 i$

B. $3\lambda R E_0 \hat{i}$

C. $\sqrt{2}\lambda R E_0 \hat{i}$

D. $\frac{2}{\lambda R E_0}\hat{i}$

Answer: A

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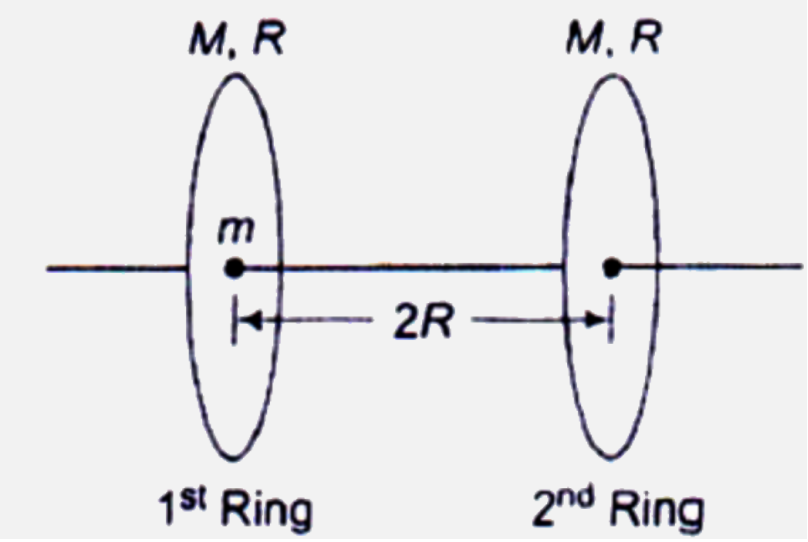
7. Consider two identical rings of mass M and radius R fixed on a horizontal axis in a gravity - free space. A particle of mass m is held at rest at the centre of 1^{st} ring and projected along the axis towards 2^{nd} ring. The minimum speed of projection so that the particle reaches the centre of 2^{nd} ring is



A. $\sqrt{\frac{GM}{R}}$

B. $\sqrt{\frac{2GM}{R}}$

C. $\sqrt{\frac{2GM}{R}\left(1+\frac{1}{\sqrt{5}}-\sqrt{2}\right)}$

D. $\sqrt{\frac{GM}{R}\left(1+\sqrt{5}-\frac{1}{\sqrt{2}}\right)}$

Answer: C

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8. Two metal rods of the same length and area of cross-section are fixed end to end between rigid supports. The materials of the rods have Young moduli Y_1 and Y_2 , and coefficient of linear expansion α_1 and α_2 . The system is now cooled and it is observed that junction between the rods does not shift at all for the condition..

A. $Y_1\alpha_1 = Y_2\alpha_2$

B. $Y_1\alpha_2 = Y_2\alpha_1$

C. $Y_1\alpha_1^2 = Y_2\alpha_2^2$

D. $Y_1^2\alpha_1 = Y_2^2\alpha_2$

Answer: A

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9. Two cylinders A and B fitted with pistons contain equal amounts of an ideal diatomic gas at 300K. The piston of A is free to move, while that B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 30K, then the rise in temperature of the gas in B is

A. 30 K

B. 18 K

C. 50 K

D. 42 K

Answer: D

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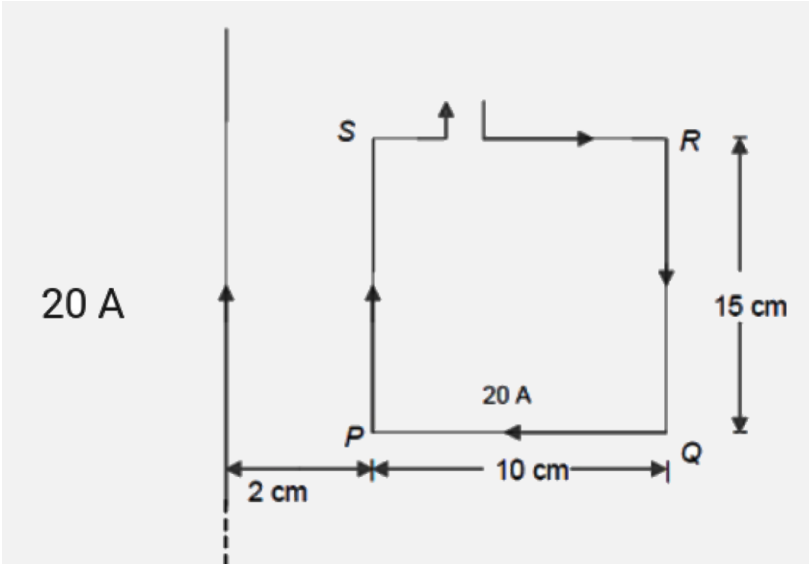
10. The resultant force on the current loop PQRS due to a long current - carrying conductor (current = 20 A) will be



A. $10^{-4}N$

B. $3.6 \times 10^{-4}N$

C. $1.8 \times 10^{-4}N$

D. $5 \times 10^{-4} N$

Answer: D

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11. A particle is projected with velocity $2\sqrt{gh}$ so that it just clears two walls of equal height h which are at a distance 2h from each other. Show that the time of passing between the walls is $2\sqrt{h/g}$.

A. $\frac{2h}{g}$

B. $\sqrt{\frac{2h}{g}}$

C. $\sqrt{\frac{h}{g}}$

D. $2\sqrt{\frac{h}{g}}$

Answer: D

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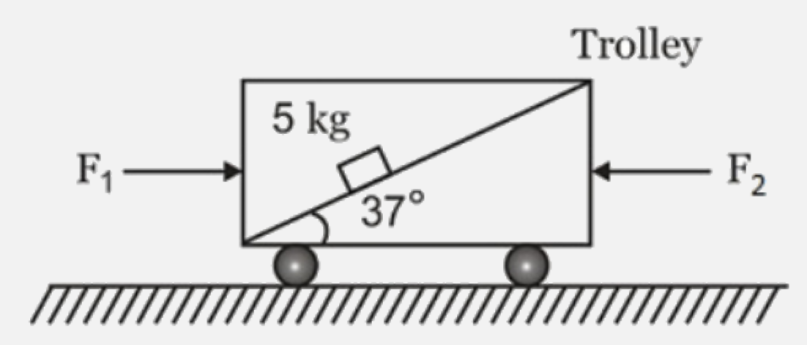
12. There is a trolley in which there is a fixed inclined surface on which a smooth block of mass 5kg is placed. Two horizontal forces of magnitude F_1 and F_2 are applied on the trolley as shown to keep the trolley at rest. The value of $F_1 - F_2$ is :

(Assume there is no friction between the trolley and horizontal ground and $g = 10ms^{-2}$)



A. 0 N

B. 24 N

C. -24N

D. $-30N$

Answer: C

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13. Two radioactive nuclei P and Q, in a given sample decay into a stable nucleus R. At time $t = 0$, number of P species are $4N_0$ and that of Q are N_0. Half-life of P (for conversation to R) is $1\ \text{min}$ whereas that of Q is $2\ \text{min}$. Initially there are no nuclei of R present in the sample. When number of nuclei of P and Q are equal, the number of nuclei of R present in the sample would be :

A. $2N_0$

B. $3N_0$

C. $\frac{9N_0}{2}$

D. $\frac{5N_0}{2}$

Answer: C

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14. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to massless spring of spring constant K. A mass M hangs freely from the free end of the spring. The area of cross-section and Young's modulus of the wire are A and Y respectively. If the mass is slightly pulled down and released, it will oscillate with a time period T equal to

A. $2\pi\left(\frac{m}{k}\right)^{1/2}$

B. $2\pi\sqrt{\frac{m(YA+kL)}{YAk}}$

C. $2\pi\left[\left(\frac{mYA}{kL}\right)^{1/2}\right]$

D. $2\pi\left[\left(\frac{mL}{YA}\right)^{1/2}\right]$

Answer: B

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15. An electric bulb of power $30\pi W$ has an efficiency of $10\ \%$ and it can be assumed to behave like a point source of light. At a distance of 3 m from the bulb, the peak value of the electric field in the light produced by the bulb is $\left[\text{Take } \varepsilon_0 \approx 9 \times 10^{-12} C^2 N^{-1} m^{-2}\right]$

A. $\frac{100}{9}\ \text{V m}^{-1}$

B. $\frac{10}{9}\text{V m}^{-1}$

C. $\frac{10}{9\sqrt{2}}\text{V m}^{-1}$

D. $\frac{100}{9\sqrt{2}}\text{V m}^{-1}$

Answer: D

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16. A rigid bar of mass 15 kg is supported symmetrically by three wires, each of length 2 m. The wires at the endpoints are made of

copper and the middle one is made of steel. If the tension in each wire is the same, then the diameter of copper wire to the diameter of steel wire is

$\left[\text{Given, } Y_{\text{copper}} = 1.1 \times 10^{11}\text{N m}^{-2} \text{ and } Y_{\text{steel}} = 1.9 \times 10^{11}\text{N m}^{-2}\right]$

A. $\sqrt{\frac{19}{11}}$

B. $\sqrt{\frac{11}{19}}$

C. $\frac{11}{19}$

D. $\frac{19}{11}$

Answer: A

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17. Zener diodes have higher dopant densities as compared to ordinary p - n junction diodes. This

A. decreases the width of depletion layer as well as electric field

B. decreases the width of depletion layer as well as electric field

C. decreases with width of depletion layer but increases the electric field

D. increases the width of depletion layer but decreases the electric field

Answer: C

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18. A metal sphere of radius r and specific heat s is rotated about an axis passing through its centre at a speed of n rotation/s. It is suddenly stopped and $50\,\%$ of its energy is used in increasing its temperature. Then, the rise in temperature of the sphere is

A. $\frac{2\pi^2 n^2 r^2}{5S}$

B. $\frac{\pi^2 n^2}{10r^2 S}$

C. $\frac{7}{8}\pi r^2 n^2 S$

D. $\frac{5(\pi r n)^2}{14S}$

Answer: A

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19. Dimensional formula of magentic flux is

A. $[ML^2T^{-1}A^2]$

B. $[M^0L^{-2}T^2A^{-2}]$

C. $[ML^3T^{-2}A^{-1}]$

D. $[ML^2T^{-2}A^{-1}]$

Answer: D

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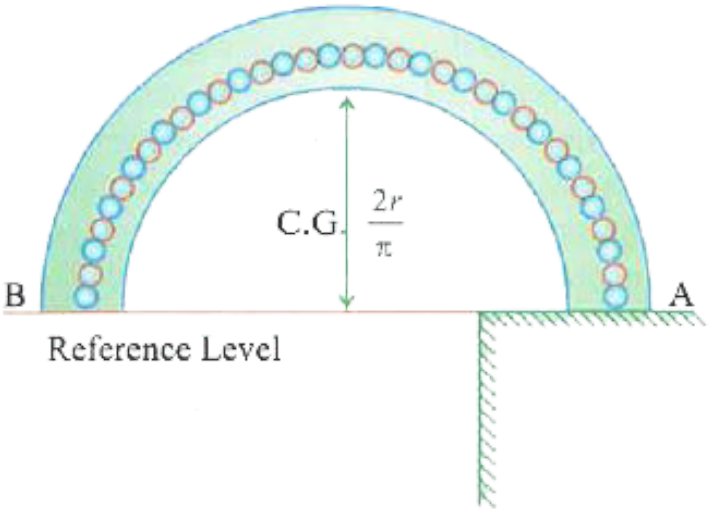
20. A heavy flexible uniform chain of length πr and mass $\lambda \pi r$ lies in a smooth semicircular tube AB of radius 'r'. Assuming a slight disturbane to start the chain in motion, find the velocity v with which it will emerge from the end of the tube?



A. $\sqrt{4gr\left(\frac{3}{\pi}+\frac{\pi}{2}\right)}$

B. $\sqrt{3gr\left(\frac{2}{n}+\frac{\pi}{5}\right)}$

C. $\sqrt{2gr\left(\frac{2}{\pi}+\frac{\pi}{2}\right)}$

D. $\sqrt{5gr\left(\frac{4}{\pi}+\frac{\pi}{3}\right)}$

Answer: C

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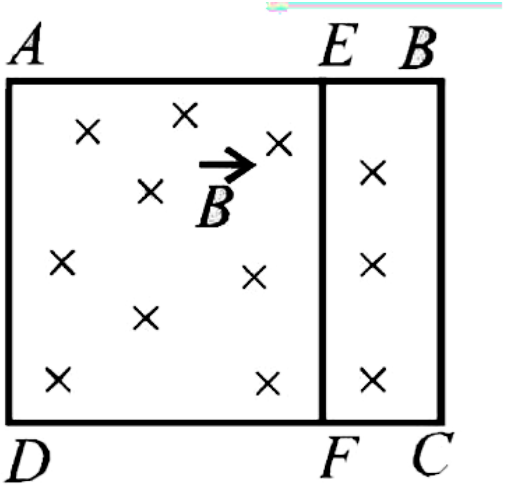
21. A rectangular frame ABCD, made of a uniform metal wire, has a straight connection between E and F made of the same wire, as shown in fig. AEFD is a square of side 1m, and EB=FC=0.5m. The entire circuit is placed in steadily increasing, uniform magnetic field directed into the plane of the paper and normal to it. The rate of change of the magnetic field is $1T/s$. The resistance per unit length of the wire is $1\omega/m$. Find the magnitude and directions of

the currents in the segments AE, BE and EF.



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22. A rectangular tank filled with some liquid is accelerated along a horizontal surface at $\frac{40}{3} ms^{-2}$. Inside the liquid, a laser pointer is fixed a the centre of the tank which shoots a thin laser beam in the vertically upward direction. If after refraction from the liquid surface, the laser beam moves along the surface of the liquid, then what is the refractive index of the liquid ?

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23. A uniform ball of radius r is placed on the top of a sphere of radius R = 10 r. It is given a slight push due to which it starts rolling down the sphere without slipping. The spin angular velocity of the ball when it breaks off from the sphere is $\omega = \sqrt{\frac{p}{q}\left(\frac{g}{r}\right)}$, where g is the acceleration due to gravity and p and q are the smallest integers. What is the value of $p + q$?

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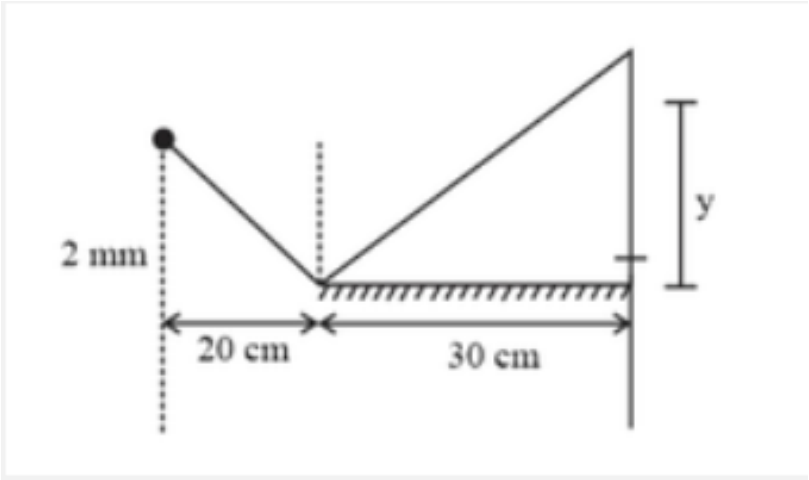
24. A plane mirror of length 30 cm is placed horizontally along with a vertical screen. A monochromatic point source of light is placed 20 cm to the left off the left edge of the mirror, at a height of 2 mm above the plane of the mirror. If the wavelength of light used is

6400Å, then find the number of complete bright fringes formed.



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25. A string of length 1.5 m with its two ends clamped is vibrating in fundamental mode. Amplitude at the centre of the string is 4 mm. Minimum distance between the two points having amplitude 2 mm is:

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