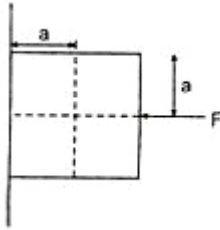


IIT-JEE-Physics–2005

1. A particle moves in a circular path with decreasing speed. Choose the correct statement :



- (a) Angular momentum remains constant
- (b) Acceleration (a) is towards the centre
- (c) Particle moves in a spiral path with decreasing radius
- (d) The direction of angular momentum remains constant

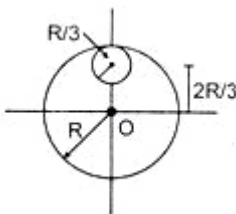
2. A block of mass m is at rest under the action of force F against a wall as shown in figure. Which of the following statement is incorrect?

- (a) $f = mg$ [where f is the frictional force]
- (b) $F = N$ [where N is the normal force]
- (c) F will not produce torque
- (d) N will not produce torque

3. A simple pendulum has time period T_1 . The point of suspension is now moved upward according to the relation $y = Kt^2$, ($K = 1 \text{ m/s}^2$) where y is the vertical displacement. The time period now becomes T_2 . The ratio of $(T_1^2)/(T_2^2)$ is ($g = 10 \text{ m/s}^2$).

- (a) 6/5
- (b) 5/6
- (c) 1
- (d) 4/5

4. From a circular disc of radius R and mass $9M$, a small disc of radius $R/3$ is removed from the disc. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through O is:



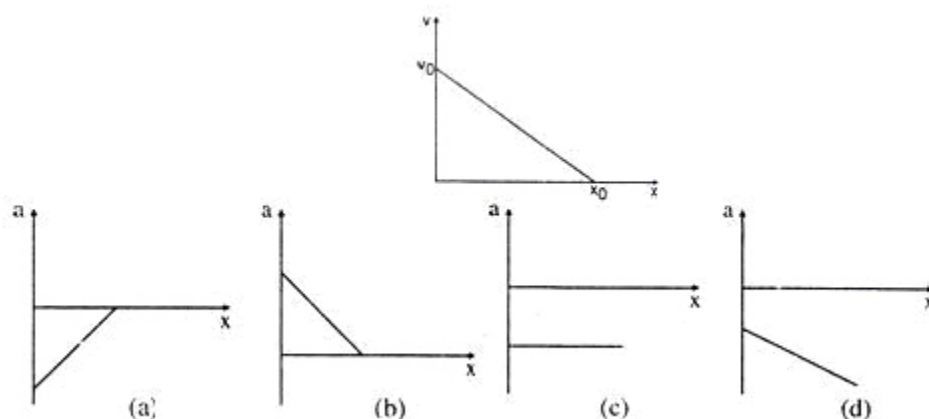
- (a) $4MR^2$
- (b) $40/9 MR^2$
- (c) $10 MR^2$
- (d) $37/9 MR^2$

GRAVITY CLASSES

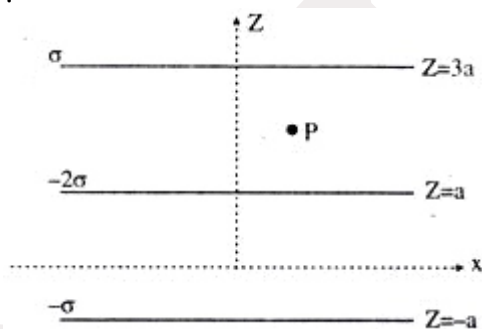
5. Which of the following sets have different dimensions?

- (a) Pressure, Young's modulus, Stress
- (b) Emf, Potential difference, Electric potential
- (c) Heat, Work done, Energy
- (d) Dipole moment, Electric flux, Electric field

6. The given graph shows the variation of velocity with displacement. Which one of the graph given below correctly represents the variation of acceleration displacement?



7. Three infinitely long charge sheets are placed as shown in figure. The electric field at point P is :



- (a) $2\sigma/\epsilon_0 \mathbf{k}$
- (b) $-2\sigma/\epsilon_0 \mathbf{k}$
- (c) $4\sigma/\epsilon_0 \mathbf{k}$
- (d) $-4\sigma/\epsilon_0 \mathbf{k}$

8. A photon collides with a stationary hydrogen atom in ground state inelastically. Energy of the colliding photon is 10.2 eV. After a time interval of the order of micro second another photon collides with same hydrogen atom inelastically with an energy of 15 eV. What will be observed by the detector?

- (a) 2 photon of energy 10.2 eV
- (b) 2 photon of energy of 1.4 eV
- (c) One photon of energy 10.2 eV and an electron of energy 1.4 eV

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(d) One photon of energy 10.2 eV and another photon of energy 1.4 eV

9. A moving coil galvanometer of resistance 100Ω is used as an ammeter using a resistance 0.1Ω . The maximum deflection current in the galvanometer is $100 \mu\text{A}$. Find the minimum current in the circuit so that the ammeter shows maximum deflection :

- (a) 100.1 mA
- (b) 1000.1 mA
- (c) 10.01 mA
- (d) 1.01 mA

10. The pressure of a medium is changed from $1.01 \times 10^5 \text{ Pa}$ to $1.165 \times 10^5 \text{ Pa}$ and change in volume is 0% keeping temperature constant. The Bulk modulus of the medium is :

- (a) $204.8 \times 10^5 \text{ Pa}$
- (b) $102.4 \times 10^5 \text{ Pa}$
- (c) $51.2 \times 10^5 \text{ Pa}$
- (d) $1.55 \times 10^5 \text{ Pa}$

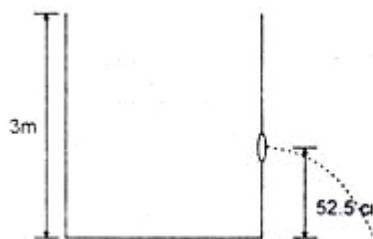
11. An open pipe is in resonance in 2nd harmonic with frequency f_1 . Now one end of the tube is closed and frequency is increased to f_2 such that the resonance again occurs in n th harmonic. Choose the correct option :

- (a) $n = 3, f_2 = 3/4 f_1$
- (b) $n = 3, f_2 = 5/4 f_1$
- (c) $n = 5, f_2 = 5/4 f_1$
- (d) $n = 5, f_2 = 3/4 f_1$

12. Water of volume 2 litre in a container is heated with a coil of 1kW at 27°C . The lid of the container is open and energy dissipates at rate of 160 J/s. In how much time temperature will rise from 27°C to 77°C [Given specific heat of water is 4.2 kJ/kg] :

- (a) 8 min 20 s
- (b) 6 min 2 s
- (c) 7 min
- (d) 14 min

13. Water is filled in a cylindrical container to a height of 3 m. The ratio of the cross sectional area of the orifice and the beaker is 0.1. The square of the speed of the liquid coming out from the orifice is ($g = 10 \text{ m/s}^2$) :



- (a) $50 \text{ m}^2/\text{s}^2$

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- (b) $50.5 \text{ m}^2/\text{s}^2$
- (c) $51 \text{ m}^2/\text{s}^2$
- (d) $52 \text{ m}^2/\text{s}^2$

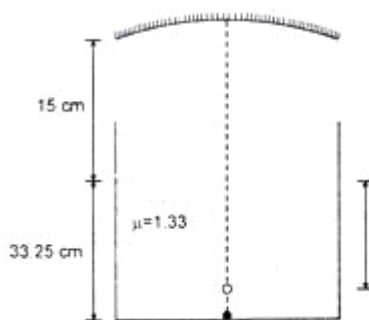
14. In Young's double slit experiment intensity at a point is $(1/4)$ of the maximum intensity. Angular position of this point is :

- (a) $\sin^{-1}(\lambda/d)$
- (b) $\sin^{-1}(\lambda/2d)$
- (c) $\sin^{-1}(\lambda/3d)$
- (d) $\sin^{-1}(\lambda/4d)$

15. In which of the following process, convection does not take place primarily :

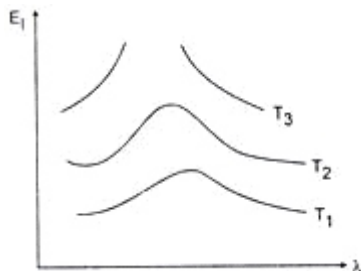
- (a) sea and land breeze
- (b) boiling of water
- (c) warming of glass of bulb due to filament
- (d) heating air around a furnace

16. A container is filled with water ($\mu = 1.33$) upto a height of 33.25 cm. A concave mirror is placed 15 cm above the water level and the image of an object placed at the bottom is formed 25 cm below the water level. The focal length of the mirror is:



- (a) 10 cm
- (b) 15 cm
- (c) 20 cm
- (d) 25 cm

17. Variation of radiant energy emitted by sun, filament of tungsten lamp and welding arc as a function of its wavelength is shown in figure. Which of the following option is the correct match?



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- (a) Sun- T_1 , tungsten filament- T_2 , welding arc- T_3
- (b) Sun- T_2 , tungsten filament- T_1 , welding arc- T_3
- (c) Sun- T_3 , tungsten filament- T_2 , welding arc- T_1
- (d) Sun- T_1 , tungsten filament- T_3 , welding arc- T_2

18. Calorie is defined as the amount of heat required to raise temperature of 1 g of water by 1°C and it is defined under which of the following conditions?

- (a) From 14.5°C to 15.5°C at 760 mm of Hg
- (b) From 98.5°C to 99.5°C at 760 mm of Hg
- (c) From 13.5°C to 14.5°C at 76 mm of Hg
- (d) From 3.5°C to 4.5°C at 76 mm of Hg

19. A convex lens is in contact with concave lens. The magnitude of the ratio of their focal length is $2/3$. Their equivalent focal length is 30 cm. What are their individual focal lengths?

- (a) $-75, 50$
- (b) $-10, 15$
- (c) $75, 50$
- (d) $-15, 10$

20. K_α wavelength emitted by an atom of atomic number $Z = 11$ is λ . Find the atomic number for an atom that emits K_α radiation with wavelength 4λ .

- (a) $Z = 6$
- (b) $Z = 4$
- (c) $Z = 11$
- (d) $Z = 44$

21. A rigid container with thermally insulated walls contains a coil of resistance 100Ω , carrying current 1A. Change in internal energy after 5 minute will be:

- (a) 0 kJ
- (b) 10 kJ
- (c) 20 kJ
- (d) 30 kJ

22. A beam of electron is used in an YDSE experiment. The slit width is d . When the velocity of electron is increased, then :

- (a) no interference is observed
- (b) fringe width increases
- (c) fringe width decreases
- (d) fringe width remains same

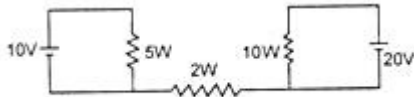
23. A tuning fork of 512 Hz is used to produce resonance in a resonance tube experiment. The level of water at first resonance is 30.7 cm and at second resonance is 63.2 cm. The error in calculating velocity of sound is:

- (a) 204.1 cm/s

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- (b) 110 cm/s
- (c) 58 cm/s
- (d) 80 cm/s

24. Find out the value of current through $2\ \Omega$ resistance for the given circuit.



- (a) 5 A
- (b) 2 A
- (c) zero
- (d) 4 A

25. A $4\ \mu\text{F}$ capacitor, a resistance of $2.5\ \text{M}\Omega$ is in series with 12 V battery. Find the time after which the potential difference across the capacitor is 3 times the potential difference across the resistor. [Given $\ln(2) = 0.693$]

- (a) 13.86 s
- (b) 6.93 s
- (c) 7 s
- (d) 14 s

26. An infinitely long cylinder is kept parallel to an uniform magnetic field B directed along positive z axis. The direction of induced current as seen from the z axis will be :

- (a) clockwise of the +ve z axis
- (b) anticlockwise of the +ve z axis
- (c) zero
- (d) along the magnetic field

27. If a star can convert all the He nuclei completely into oxygen nuclei. The energy released per oxygen nuclei is: [Mass of the nucleus is 4.0026 amu and mass of oxygen nucleus is 15.9994 amu]

- (a) 7.6 MeV
- (b) 56.12 MeV
- (c) 10.24 MeV
- (d) 23.9 MeV

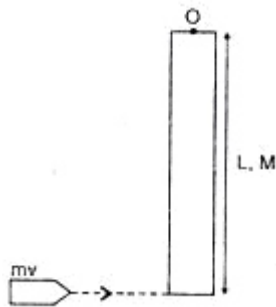
28. A body with area A and temperature T and emissivity $e = 0.6$ is kept inside a spherical black body. What will be the maximum energy radiated?

- (a) $0.60\ eAT^4$
- (b) $0.80\ eAT^4$
- (c) $1.00\ eAT^4$
- (d) $0.40\ eAT^4$

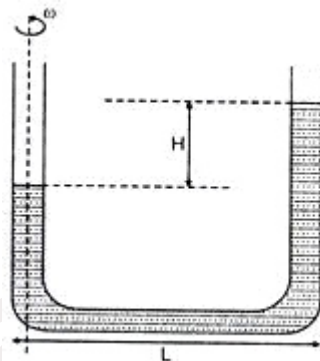
IIT-JEE-Physics-Mains-2005

MAINS

1. A rod of length L and mass M is hinged at point O . A small bullet of mass m hits the rod as shown in the figure. The bullet gets embedded in the rod. Find angular velocity of the system just after impact.



2. An observer standing on a railway crossing receives frequencies of 2.2 kHz and 1.8 kHz when the train approaches and recedes from the observer. Find the velocity of the train. [the speed of the sound in air is 300 m/s].



3. A U-shaped tube contains a liquid of density ρ and it is rotated about the line as shown in the figure. Find the difference in the levels of liquid column.

4. A conducting bubble of radius a , thickness t ($t \ll a$) has potential V . Now the bubble collapses into a droplet. Find the potential of the droplet.

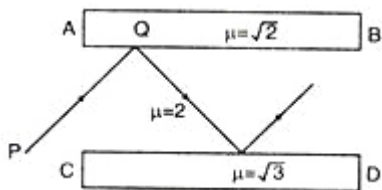
5. The potential energy of a particle varies as

$$U(x) = E_0 \quad 0 < x < 1 \\ = 0 \quad x > 1$$

For $0 < x < 1$, de Broglie wavelength is λ_1 and for $x > 1$ the de Broglie wavelength is λ_2 . Total energy of the particle is $2E_0$. Find λ_1/λ_2 .

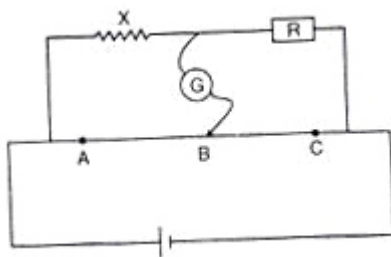
GRAVITY CLASSES

6. AB and CD are two slabs. The medium between the slabs has refractive index 2. Find the minimum angle of incidence at Q so that the ray is totally reflected by both the slabs.



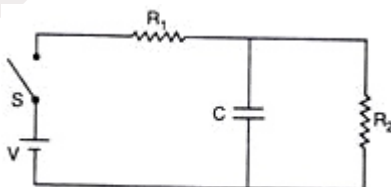
7. The edge of a cube is measured using a vernier caliper. [9 divisions of the main scale are equal to 10 divisions of vernier scale and 1 main scale division is 1 mm]. The main scale division reading is 10 and 1 division of vernier scale was found to be coinciding with the main scale. The mass of the cube is 2.736 g. Calculate the density in g/cm³ upto correct significant figures.

8. R_1, R_2, R_3 are different values of R . A, B, C are the null points obtained corresponding to R_1, R_2 and R_3 respectively. For which resistor, the value of X will be the most accurate and why?



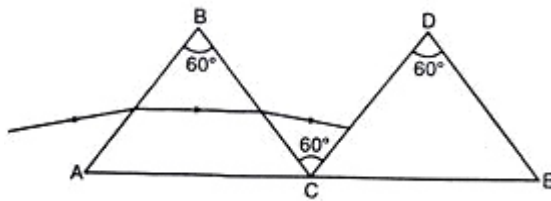
9. A solid cylinder rolls without slipping on an inclined plane inclined at an angle θ . Find the linear acceleration of the cylinder. Mass of the cylinder is M .

10. At $t = 0$, switch S is closed. The charge on the capacitor is varying with time as $Q = Q_0(1 - e^{-\alpha t})$. Obtain the value of Q_0 and α in the given circuit parameters.



11. A ray of light is incident on a prism ABC of refractive index $\sqrt{3}$ as shown in figure.

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(a) Find the angle of incidence for which the deviation of light ray by the prism ABC is minimum.

(b) By what angle the second prism must be rotated, so that the final ray suffer net minimum deviation.

12. A harmonically moving transverse wave on a string has a maximum particle velocity and acceleration of 3 m/s and 90 m/s² respectively. Velocity of the wave is 20 m/s. Find the waveform.

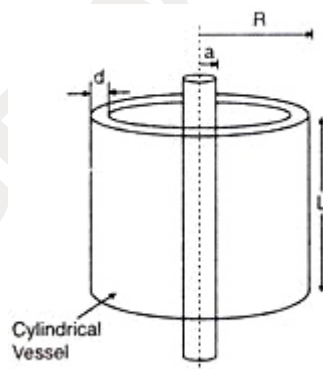
13. X-rays are incident on a target metal atom having 30 neutrons. The ratio of atomic radius of the target atom and ${}^4_2\text{He}$ is $(14)^{1/3}$.

(a) Find the atomic number of target atom.

(b) Find the frequency of K_{α} line emitted by this metal.

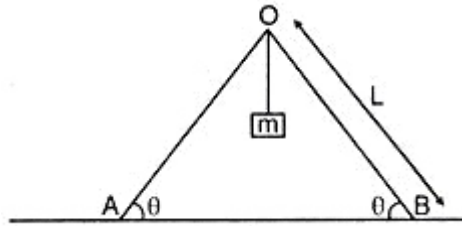
$$R = 1.1 \times 10^7 \text{ m}^{-1}, c = 3 \times 10^8 \text{ m/s}$$

14. A long solenoid has n turns per unit length and radius a . A current $I = I_0 \sin \omega t$ flows through it. A cylindrical vessel of radius R , length L , thickness d ($d \ll R$) and resistivity ρ is kept coaxially as shown in the figure. Find the induced current in the outer cylindrical vessel.

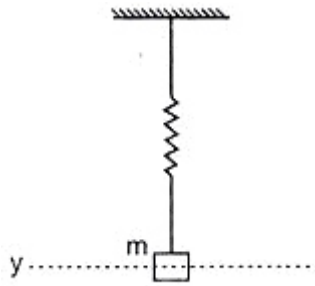


15. Two identical ladders are arranged as shown in the figure. Mass of each ladder is M and length L . The system is in equilibrium. Find direction and magnitude of frictional force acting at A or B.

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16. A mass m is undergoing SHM in the vertical direction about the mean position y_0 with amplitude A and angular frequency ω . At a distance y from the mean position, the mass detaches from the spring. Assume that the spring contracts and does not obstruct y (measured from the mean position) such that the height h attained by the block is maximum. ($A\omega^2 > g$).



17. A metal of mass 1 kg at constant atmospheric pressure and at initial temperature 20°C is given a heat of 20,000 J. Find the following :

- Change in temperature
- Work done
- Change in internal energy

(**Given** : Specific heat $400 \text{ J/kg/}^\circ\text{C}$,
coefficient of cubical expansion, $\gamma = 9 \times 10^{-5}/^\circ\text{C}$, density $\rho = 9000 \text{ kg/m}^3$, atmospheric pressure = 10^5 N/m^2)

18. A moving coil galvanometer experiences torque = ki where i is current. If N coils of area A each and moment of inertia I is kept in magnetic field B .

- find k in terms of given parameters
- if for current i deflection is $\pi/2$, find out torsional constant of spring,
- if a charge Q is passed suddenly through the galvanometer find out maximum angle of deflection.