IIT-JEE-Physics-2006

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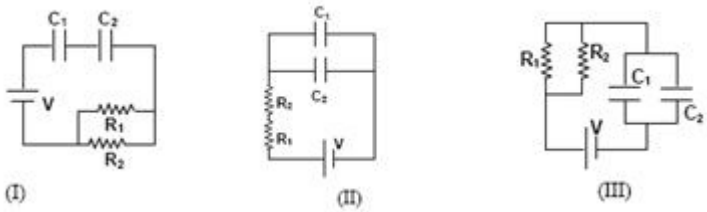
1. Given

$R_1 = 1\Omega$ $C_1 = 2\mu F$

$R_2 = 1\Omega$ $C_2 = 4\mu F$



The times constants (in mS) for the circuits I, II, III are respectively

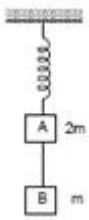
(A) 18, 8/9, 4

(B) 18, 4, 8/9

(C) 4, 8/9, 18

(D) 8/9, 18, 4

2. Two blocks A and B of masses 2m and m, respectively, are connected by a massles and inextensible string. The whole system is suspended by a massless spring as shown in the figure. The magnitudes of acceleration of A and B, immediately after the string is cut, are respectively



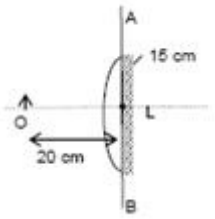
(A) g, g/2

(B) g/2, g

(C) g, g

(D) g/2, g/2

3. A point object is placed at a distance of 20 cm from a thin plani-convex lens of focal length 15 cm, fi the plane surface is silvered. The image will form at



(A) 60 cm left of AB

(B) 30 cm left of AB

(C) 12 cm left of AB

(D) 60 cm right of AB

4. A biconvex lens of focal length f forms a circular image of sun of radius r in focal plane. Then

(A) Πr^2 œ f

(B) Πr^2 œ f^2

(C) if lower half part is covered by black sheet, then area of the image is equal to $\Pi r^2/2$

(D) if f is doubles, intensity will increase

5. Given a sample of Radium-226 having half-life of 4 days. Find the probability, a nucleus distintegrates after 2 half lives.

(A) 1

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(B) ½

(C) 1.5

(D) ¾

6. Graph of position of image vs position of point object from a convex lens is shown. Then, focal length of the lens is

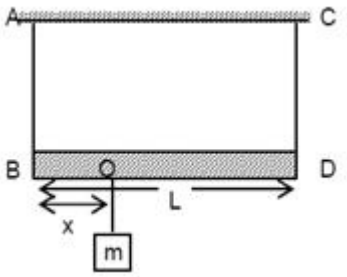
(A) 0.50 + 0.05 cm

(B) 0.50 + 0.10 cm

(C) 5.00 + 0.05 cm

(D) 5.00 + 0.10 cm

7. A massless rod is suspended by two identical strings Ab and CD of equal length. A block of mass m is suspended from point O such that BO is equal to 'x'. Further, it is observed that the frequency of 1st harmonic (fundamental frequency) is AB is equal to 2nd harmonic frequency in CD. Then, length of BO is



(A) L/5

(B) 4L/5

(C) 3L/4

(D) L/4

8. A system of binary stars of masses m_A and m_B are moving in circular orbits of radii r_A and r_B respectively. If T_A and T_B are the time periods of masses m_A and m_B respectively, then

(A) $T_A/T_B = (r_A/r_B)^{3/2}$

(B) $T_A > T_B$ (if $r_A > r_B$)

(C) $T_A > T_B$ (if $m_A > m_B$)

(D) $T_A = T_B$

9. A solid sphere of mass M, radius R and having moment of inertia about an axis passing through the centre of mass as I, is recast into a disc of thickness t, whose moment of inertia about an axis passing through its edge and perpendicular to its plane remains I. Then, radius of the disc will be

(A) 2R/?15

(B) R?(2/15)

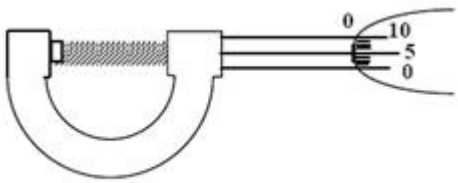
(C) 4R/?15

(D) R/4

10. A student performs an experiment for determination of g (=$(4\pi^2 l)/T^2$),l ? 1m, and he commits an error of Δl . For T he takes the time of n oscillations with the stop watch of least count ΔT and he commits a human error of 0.1 sec. For which of the following data, the measurement of g will be most accurate?

	Δl	**ΔT**	**n**	**Amplitude oscillation**
(A)	5 mm	0.2 sec	10	5 mm
(B)	5 mm	0.2 sec	20	5 mm
(C)	5 mm	0.1 sec	20	1 mm
(D)	1 mm	0.1 sec	50	1 mm

11. The circular divisions of shown screw gauge are 50. It moves 0.5 mm on main scale in one rotation. The diameter of the ball is



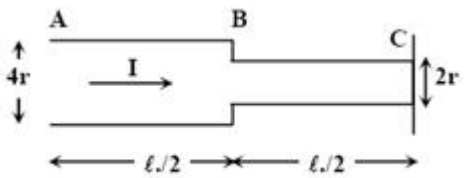
(A) 2.25 mm

(B) 2.20 mm

(C) 1.20 mm

(D) 1.25 mm

12. Consider a cylindrical element as shown in the figure. Current flowing the through element is I and resistivity of material of the cylinder is r.



Choose the correct option out the following.

(A) Power loss in first half is four times the power loss in second half.

(B) Voltage drop in first half is twice of voltage drop in second half.

(C) Current density in both halves are equal.

(D) Electric field in both halves is equal.

More than One Choice may be correct. (+5, -1)

13. In the given diagram, a line of force of a particular force field is shown. Out of the following options, it can never represent

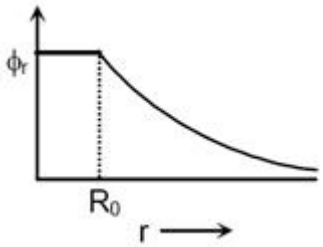
(A) an electrostatic field

(B) a magnetostatic field

(C) a gravitational field of a mass at rest

(D) an induced electric field

14. The electrostatic potential (fr) of a spherical symmetric system, kept at origin, is shown in the adjacent figure, and given as



$\Phi_r = q/(4\pi\ \varepsilon_0\ R_0\ )$ $(r \geq R_0)$

$\Phi_r = q/(4\pi\ \varepsilon_0\ R_0\ )$ $(r \leq R_0)$

Which of the following option(s) is/are correct?

(A) For spherical region $r \leq R_0$, total electrostatic energy stored is zero.

(B) Within $r = 2R_0$, total charge is q.

(C) There will be no charge anywhere except at $r = R_0$.

(D) Electric field is discontinuous at $r = R_0$.

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15. A solid cylinder of mass m and radius r is rolling on a rough inclined plane of inclination θ. The coefficient of friction between the cylinder and incline is m. Then

(A) frictional force is always mmg cos θ

(B) friction is a dissipative force

(C) by decreasing θ, frictional force decreases

(D) friction opposes translation and supports rotation.

16. Function $x = a \sin^2 \omega t + B \cos^2 \omega t + C \sin \omega t \cos \omega t$ represents SHM

(A) for any value of A, B and C (except C = 0)

(B) if A = -B; C = 2B, amplitude = |B?2|

(C) if A = B; C = 0

(D) if A = B; C = 2B, amplitude = |B|

17. In a dark room with ambient temperature T0, a black body is kept at a temperature T. Keeping the temperature of the black body constant (at T), sunrays are allowed to fall on the black body through a hole in the roof to the dark room. Assuming that there is no change in the ambient temperature of the room, which of the following statement(s) is/are correct?

(A) The quantity of radiation absorbed by the black body in unit time will increase.

(B) Since emissivity = absorptivity, hence the quantity of radiation emitted by black body in unit time will increase.

(C) Black body radiates more energy in unit time in the visible spectrum.

(D) The reflected energy in unit time by the black body remains same.

18. The graph between $1/\lambda$ and stopping potential (V) of three metals having work functions Φ_1, Φ_2 and Φ_3 in an experiment of photo-electric effect is plotted as shown in the figure. Which of the following statements(s) is/are correct? [Here λ is the wavelength of the incident ray].

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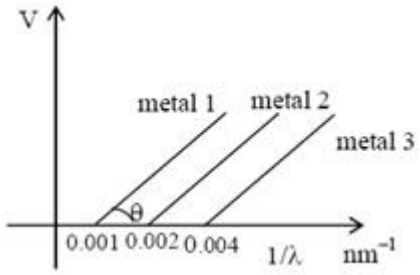


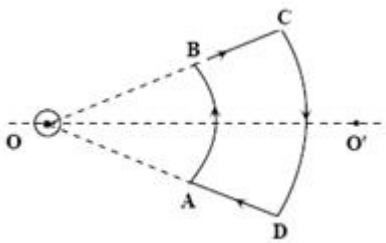
(A) Ratio of work functions $\Phi_1 : \Phi_2 : \Phi_3 = 1 : 2 : 4$

(B) Ratio of work functions $\Phi_1 : \Phi_2 : \Phi_3 = 4 : 2 : 1$

(C) tan q is directly proportional to hc/e, where h is Planck's constant and c is the speed of light.

(D) The violet colour light can eject photoelectrons from metals 2 and 3.

19. An infinite current carrying wire passes through point O and in perpendicular to the plane containing a current carrying loop ABCD as shown in the figure. Choose the correct option(s).



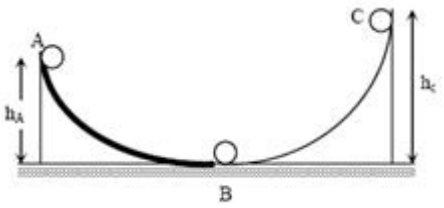
(A) Net force on the loop is zero.

(B) Net torque on the loop is zero.

(C) As seen from O, the loop rotates clockwise.

(D) As seen from O, the loop rotates anticlockwise.

20. A ball moves over a fixed track as shown in the figure. From A to B the ball rolls without slipping. Surface BC is frictionless. KA, KB and KC are kinetic energies of the ball at A, B and C respectively. Then



(A) $h_A > h_C$; $K_B > K_C$

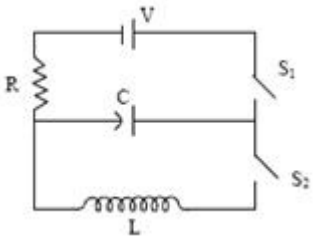
(B) $h_A > h_C$; $K_C > K_A$

(C) $h_A = h_C$; $K_B = K_C$

(D) $h_A < h_C$; $K_B > K_C$

Passage

The capacitor of capacitance C can be charged (with the help of a resistance R) by a voltage source V, by closing switch S_1 while keeping switch S_2 open. The capacitor can be connected in series with an inductor 'L' by closing switch S_2 and opening S_1.



21. Initially, the capacitor was uncharged. Now, switch S_1 is closed and S_2 is kept open. If time constant of this circuit is t, then

(A) after time interval t, charge on the capacitor is CV/2

(B) after time interval 2t, charge on the capacitor is $CV(1-e^{-2})$

(C) the work done by the voltage source will be half of the heat dissipated when the capacitor is fully charged.

(D) after time interval 2t, charge on the capacitor is $CV(1-e^{-1})$

22. After the capacitor gets fully charged, S_1 is opened and S_2 is closed so that the inductor is connected in series with the capacitor. Then

(A) at t = 0, energy stored in the circuit is purely in the form of magnetic energy

(B) at any time t > 0, current in the circuit is in the same direction

(C) at t > 0, there is no exchange of energy between the inductor and capacitor

(D) at any time t > 0, instantaneous current in the circuit may V?(C/L)

23. If the total charge stored in the LC circuit is Q_0, then for $t \geq 0$

(A) the charge on the capacitor is $Q = Q_0 \cos(\pi/2 + t/?(LC))$

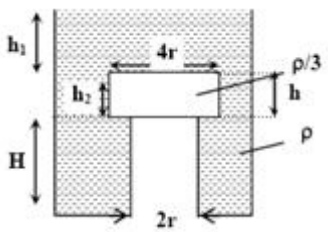
(B) the charge on the capacitor is $Q = Q_0 \cos(\pi/2 - t/?(LC))$

(C) the charge on the capacitor is $Q = -LC\ d^2Q / dt^2$

(D) the charge on the capacitor is $Q = -1/?LC\ d^2Q / dt^2$

Passage

A wooden cylinder of diameter 4r, height h and density r/3 is kept on a hole of diameter 2r of a tank, filled with water of density r as shown in the figure. The height of the base of cylinder form the base of tank is H.



24. If level of liquid starts decreasing slowly when the level of liquid is at a height h_1 above the cylinder, the block just starts moving up. Then, value of h_1 is

(A) 2h/3

(B) 5h/4

(C) 5h/3

(D) 5h/2

25. Let the cylinder is prevented from moving up, by applying a force and water level is further decreased. Then, height of water level (h2 in figure) for which the cylinder remains in original position without application of force is

(A) h/3

(B) 4h/9

(C) 2h/3

(D) h

26. If height h_2 of water level is further decreased, then

(A) cylinder will not move up and remains as its original position.

(B) for $h_2 = h/3$, cylinder again starts moving up

(C) for $h_2 = h/4$, cylinder again starts moving up

(D) for $h_2 = h/5$ cylinder again starts moving up

27. Two waves $y_1 = A \cos (0.5\ px - 100pt)$ and $y_2 = A \cos (0.46\ px - 92\ pt)$ are travelling in a pipe placed along x-axis. Find the number of times intensity is maximum in time interval of 1 sec.

(A) 4

(B) 6

(C) 8

(D) 10

28. Find wave velocity of louder sound

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(A) 100 m/s

(B) 192 m/s

(C) 200 m/s

(D) 96 m/s

29. Find the number of times $y_1 + y_2 = 0$ at $x = 0$ in 1 sec

(A) 100

(B) 46

(C) 192

(D) 96

Paragraph

Modern trains are based on Maglev technology in which trains are magnetically levitated, which runs its EDS Maglev system.

There are coils on both sides of wheels. Due to motion of train, current induces in the coil of track which levitates it. This is in accordance with Lenz's law. If trains lower down then due to Lenz's law a repulsive force increases due to which train gets uplifted and if it goes much high then there is a net downward force disc to gravity. The advantage of Maglev train is that there is no friction between the train and the track, thereby reducing power consumption and enabling the train to attain very high speeds.

Disadvantages of Maglev train is that as it slows down the electromagnetic forces decreases and it becomes difficult to keep it levitated and as it moves forward according to Lenz law there is an electromagnetic drag force.

30. What is the advantage of this system?

(A) No friction hence no power consumption

(B) No electric power is used

(C) Gravitation fore is zero

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(D) Electrostatic force draws the train

31. What is the disadvantage of this system?

(A) Train experiences upward force according to Lenz's law

(B) Friction force create a drag on the train

(C) Retardation

(D) By Lenz's law train experience a drag

32. Which force causes the train to elevate up?

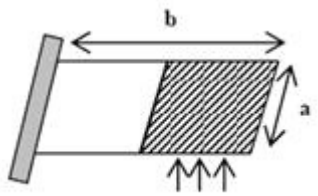
(A) Electrostatic force

(B) Time varying electric field

(C) Magnetic force

(D) Induced electric field

33. There is a rectangular plate of mass M kg of dimensions (a × b). The plate is held in horizontal position by striking n small balls each of mass m per unit area per unit time. These are striking in the shaded half region of the plate. The balls are colliding elastically with velocity v. What is v?



It is given n = 100, M = 3 kg, m = 0.01 kg; b = 2 m; a = 1m; h = 10 m/s2.

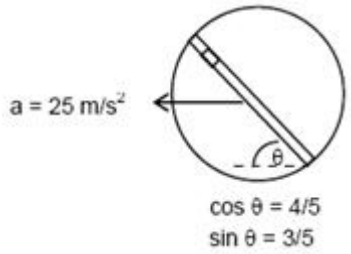
34. In an insulated vessel, 0.05 kg stream at 373 K and 0.45 kg of ice at 253 mixed. Then, find the final temperature of the mixture.

Given, L_{fusion} = 80 cal/g = 336 J/g, $L_{vaporization}$ = 540 cal/g = 2268 J/g,

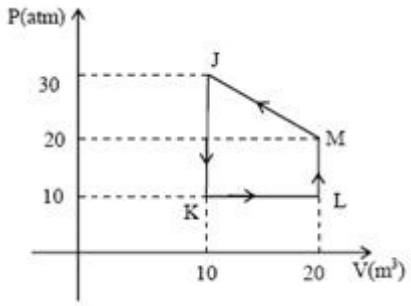
S_{ice} = 2100 J/kg K = 0.5 cal/gK and S_{water} = 4200 J/kg K = 1 cal/gK

35. In hydrogen-like atom (z = 11), nth line of Lyman series has wavelength l equal to the de-Broglie's wavelength of electron in the level from which it originated. What is the value of n?

36. A circular disc with a groove along its diameter is placed horizontally. A block of mass 1 kg is placed as shown. The co-efficient of friction between the block and all surfaces of groove in contact is m = 2/5. The disc has an acceleration of 25 m/s^2. Find the acceleration of the block with respect to disc.



37. Heat given to process is positive, match the following option of column I with the corresponding option of column II.



Column I		Column II	
(A)	KJ	(p)	DW > 0
(B)	KL	(q)	DQ < 0
(C)	LM	(r)	DW < 0
(D)	MJ	(s)	DQ > 0

38. Match the following Columns

Column I		Column II	
(A)	Nuclear fusion	(p)	Converts some matter into energy
(B)	Nuclear fission	(q)	Generally for nuclei with low atomic number
(C)	β-decay	(r)	General possible for nuclei with higher atomic number
(D)	Exothermic nuclear reaction	(s)	$\Delta Q > 0$

39. Match the following Columns

Column I		Column II	
(A)	Dielectric ring uniformly charged	(p)	Time independent electrostatic field out of system
(B)	Dielectric ring uniformly charged rotating with angular velocity w	(q)	Magnetic field
(C)	Constant current in ring i_0	(r)	Induced electric field
(D)	$i = i_0 \cos \omega t$	(s)	$\Delta Q > 0$

40. A simple telescope used to view distant objects has eyepiece and objective lens of focal lengths f_e and f_0, respectively. Then

Column I		Column II	
(A)	Intensity of light received by lens	(p)	Radius of aperture (R)
(B)	Angular magnification	(q)	Dispersion of lens
(C)	Length of telescope	(r)	Focal length f_0, f_e
(D)	Sharpness of image	(s)	Spherical aberration

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