46. The relation between time and distance is $t = \alpha x^2 + \beta x$, where α and β are constants. The retardation is

(a) $2\alpha v^3$ (b) $2\beta v^3$

(c) $2\alpha\beta v^3$ (d) $2\beta^2 v^3$

47. A frog walking in a narrow lane takes 5 leaps forward and 3 leaps backward, then again 5 leaps forward and 3 leaps backward, and so on. Each leap is 1 m long and requires 1 s. Determine how long the frog takes to fall in a pit 13 m away from the starting point.

(a) 35 s (b) 36 s

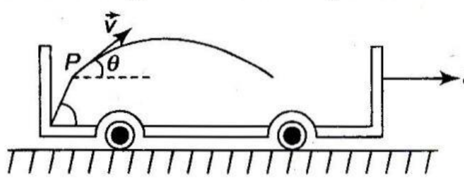
(c) 37 s (d) 38 s

48. If $v = x^2 - 5x + 4$, find the acceleration of the particle when velocity of the particle is zero.

(a) zero (b) 2

(c) 3 (d) none of these

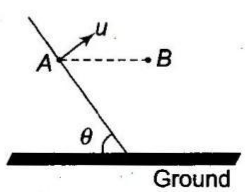
49. A particle is projected from a trolley car with a velocity $\vec{v}$. If the trolley car moves with an acceleration $\vec{a}$ towards right, which of the following remain unchanged relative to both ground and trolley car?



(a) Range (b) Maximum range

(c) Time of flight (d) horizontal velocity

50. A particle is projected at point A from an inclined plane with inclination angle θ as shown in figure. The magnitude of projection velocity is $\vec{u}$ and its direction is perpendicular to the plane. After some time it passes from point B which is in the same horizontal level of A, with velocity $\vec{v}$. Then the angle between $\vec{u}$ and $\vec{v}$ will be



(a) θ (b) 2θ

(c) $\pi - 2\theta$ (d) $90 + \theta$

51. To the captain of a ship A travelling with velocity $\vec{v}_A = (3\hat{i} - 4\hat{j})$ km/h, a second ship B appears to have a velocity $(5\hat{i} + 12\hat{j})$ km/h. What is the true velocity of the ship B?

(a) $2\hat{i} + 16\hat{j}$ km/h (b) $13\hat{i} + 8\hat{j}$ km/h

(c) $-2\hat{i} - 16\hat{j}$ km/h (d) $8(\hat{i} + \hat{j})$ km/h

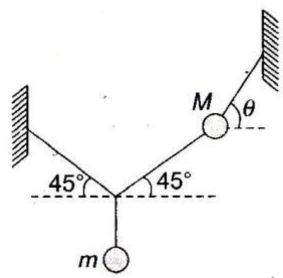
52. Two masses m and M are attached with strings as shown. For the system to be in equilibrium we have

(a) $\tan\theta = 1 + \frac{2M}{m}$

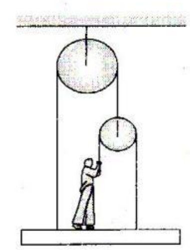
(b) $\tan\theta = 1 + \frac{2m}{M}$

(c) $\tan\theta = 1 + \frac{M}{2m}$

(d) $\tan\theta = 1 + \frac{m}{2M}$



53. In the given diagram, with what force must the man pull the rope to hold the plank in position? Mass of the man is 80 kg. Neglect the weights of plank, rope and pulley. Take $g = 10\ ms^{-2}$.



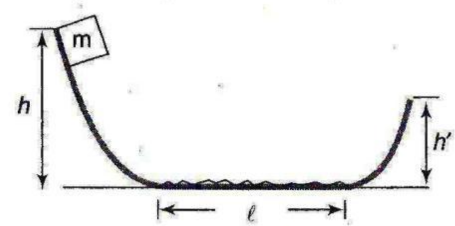
(a) 200 N

(b) 300 N

(c) 600 N

(d) 150 N

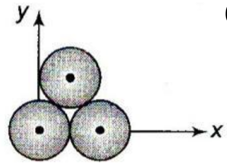
54. A block is released from rest from a height $h = 5$ m. After travelling through the smooth curved surface it moves on the rough horizontal surface through a length $l = 8$ m and climbs onto the other smooth curved surface through a height h'. If $\mu = 0.5$, find h'.



(a) 2 m (b) 3 m

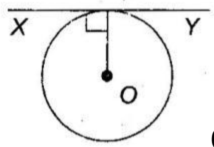
(c) 1 m (d) zero

55. Three identical spheres each of radius R are placed touching each other on a horizontal table as shown in figure. The co-ordinates of centre of mass are:



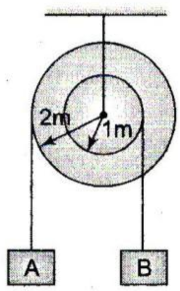
(a) (R, R)
(b) $(0, 0)$
(c) $\left(\frac{R}{2}, \frac{R}{2}\right)$
(d) $\left(R, \frac{R}{\sqrt{3}}\right)$

56. A thin wire of length L and uniform linear mass density ρ is bent into a circular loop with centre at O as shown. The moment of inertia of the loop about an axis XY is



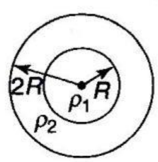
(a) $\frac{\rho L^3}{8\pi^2}$
(b) $\frac{\rho L^3}{16\pi^2}$
(c) $\frac{5\rho L^3}{8\pi^2}$
(d) $\frac{3\rho L^3}{8\pi^2}$

57. In the pulley system shown, if radii of the bigger and smaller pulley are 2 m and 1 m respectively and the acceleration of block A is 5 m/s^2 in the downward direction, then the acceleration of block B will be:



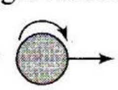
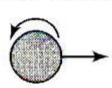
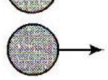
(a) 0 m/s^2
(b) 5 m/s^2
(c) 10 m/s^2
(d) 5/2 m/s^2

58. The density of core of a planet is ρ_1 and that of outer shell is ρ_2. The radius of core is R and that of planet is $2R$. Gravitational field at outer surface of planet is same as at the surface of core. What is the ratio ρ_1/ρ_2.

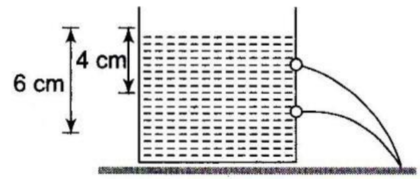


(a) 3/4
(b) 5/3
(c) 7/3
(d) 3/5

59. To get the maximum flight a ball must be thrown as:

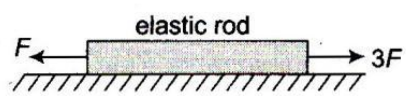
(a) 
(b) 
(c) 
(d) any of (a), (b) and (c)

60. Figure shows two holes in a wide tank containing a liquid common. The water streams coming out of these holes strike the ground at the same point. The height of liquid column in the tank is



(a) 10 cm
(b) 8 cm
(c) 9.8 cm
(d) 980 cm

61. A uniform elastic rod of cross-section area A, natural length L and Young's modulus Y is placed on a smooth horizontal surface. Now two horizontal forces (of magnitude F and $3F$) directed along the length of rod and in opposite direction act at two of its ends as shown. After the rod has acquired steady state, the extension of the rod will be

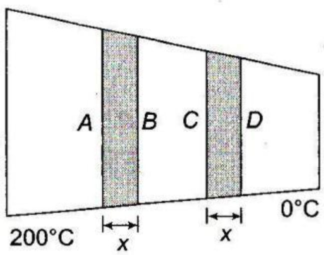


(a) $\frac{2F}{YA}L$
(b) $\frac{4F}{YA}L$
(c) $\frac{F}{YA}L$
(d) $\frac{3F}{2YA}L$

62. The pressure applied from all directions on a cube is P. How much its temperature should be raised to maintain the original volume? The volume elasticity of the cube is β and the coefficient of volume expansion is α.

(a) $\frac{P}{\alpha\beta}$
(b) $\frac{P\alpha}{\beta}$
(c) $\frac{P\beta}{\alpha}$
(d) $\frac{\alpha\beta}{P}$

63. Two ends of a conducting rod of varying cross-section are maintained at 200°C and 0°C respectively. In steady state:

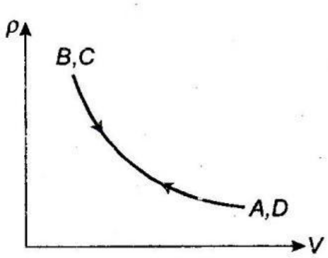


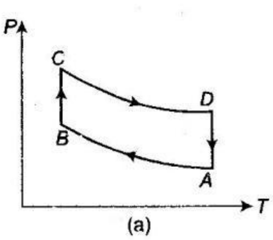
(a) temperature differences across AB and CD are equal
(b) temperature difference across AB is greater than that across CD
(c) temperature difference across AB is less than that across CD
(d) temperature difference may be equal or different depending upon thermal conductivity of the rod.

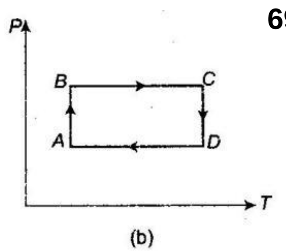
64. The opposite faces of a cubical block of iron of cross-section 4 square cm are kept in contact with steam and melting ice. Calculate the quantity of ice melted at the end of 10 minutes, k for iron = 0.2 CGS units.

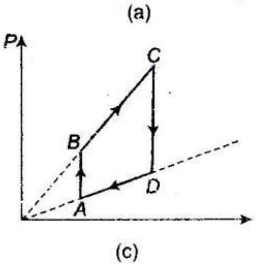
(a) 300g (b) 150 g
(c) 75 g (d) 450 g

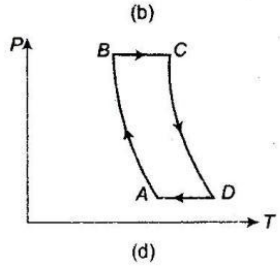
65. Density vs volume graph is shown in the figure. Find corresponding pressure vs temperature graph:



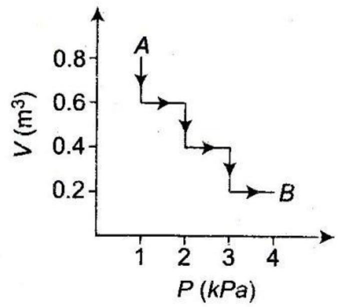
(a)


(b)


(c)


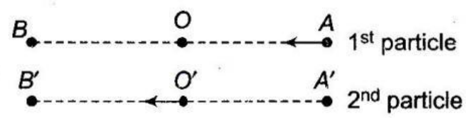
(d)


66. An ideal gas is taken along the path AB as shown in the figure. The work done by the gas is



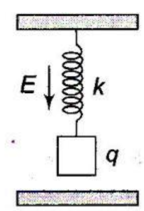
(a) 600 J (b) 1200 J
(c) –600 J (d) –1200 J

67. Two particles undergoes SHM along parallel lines with the same time period (T) and equal amplitudes. At a particular instant, one particle is at its extreme position while the other is at its mean position. They move in the same direction. They will cross each other after a further time.



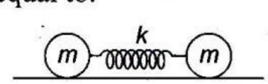
(a) $T/8$ (b) $3T/8$
(c) $T/6$ (d) $4T/3$

68. Time period of a block when suspended from the upper plate of a parallel plate capacitor by a spring of stiffness k, is T; when block is uncharged. If a charge q is given to the block then new time period of oscillation will be:



(a) T (b) $> T$
(c) $< T$ (d) $\geq T$

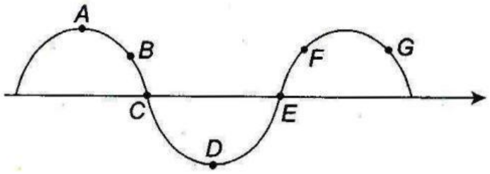
69. Two identical particles each of mass m are interconnected by a light spring of stiffness k, the time period for small oscillation is equal to:



(a) $2\pi\sqrt{\frac{m}{k}}$ (b) $\frac{\pi}{2}\sqrt{\frac{m}{k}}$

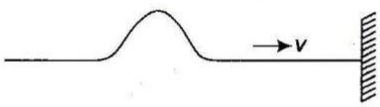
(c) $\pi\sqrt{\frac{m}{2k}}$ (d) $\pi\sqrt{\frac{2m}{k}}$

70. The following figure depicts a wave travelling in a medium. Which pair of particles are in phase?



(a) A and D (b) B and F
(c) C and E (d) B and G

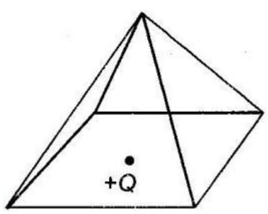
71. When a wave pulse travelling in a string is reflected from a rigid wall to which string is tied as shown in figure. For this situation two statements are given below.



(1) The reflected pulse will be in same orientation of incident pulse due to a phase change of π radians
(2) During reflection the wall exert a force on string in upward direction

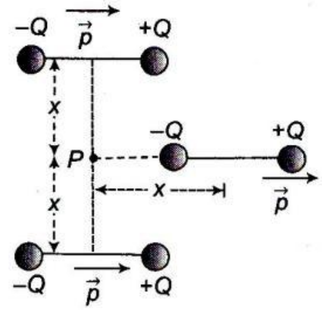
For the above given two statements choose the correct option given below.
(a) Only (1) is true (b) Only (2) is true
(c) Both are true (d) Both are wrong

72. A point charge $+Q$ is positioned at the centre of the base of a square pyramid as shown. The flux through one of the four identical upper faces of the pyramid is



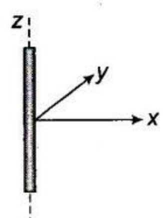
(a) $\frac{Q}{16\varepsilon_0}$ (b) $\frac{Q}{4\varepsilon_0}$
(c) $\frac{Q}{8\varepsilon_0}$ (d) None of these

73. Three identical dipoles are arranged as shown below. What will be the net electric field at $P\left(k=\frac{1}{4\pi\varepsilon_0}\right)$



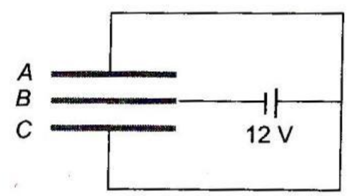
(a) $\frac{k.p}{x^3}$ (b) $\frac{2kp}{x^3}$
(c) Zero (d) $\frac{\sqrt{2}kp}{x^3}$

74. An infinitely long wire is kept along z-axis from $z=-\infty$ to $z=+\infty$, having uniform linear charge density $\frac{10}{9}$ nC/m. The electric field at point (6 cm, 8 cm, 10 cm) will be



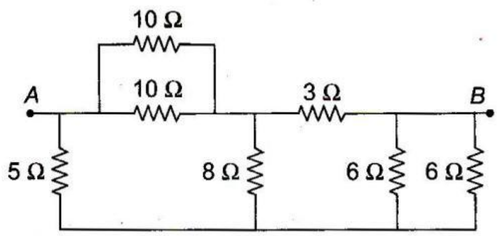
(a) $(120\hat{i}+160\hat{j}+200\hat{k})$V/m
(b) $200\hat{k}$ V/m
(c) $(160\hat{i}+120\hat{j})$V/m
(d) $(120\hat{i}+160\hat{j})$V/m

75. Three plates A, B, C each of area 50 cm^2 have separation 3 mm between A and B and 3 mm between B and C. The energy stored when the plates are fully charged is



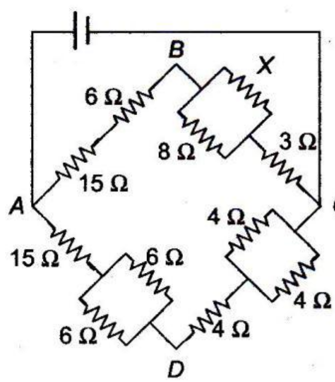
(a) 1.6×10^{-9} J (b) 2.1×10^{-9} J
(c) 5×10^{-9} J (d) 7×10^{-9} J

76. Seven resistances are connected as shown in the figure. The equivalent resistance between A and B is



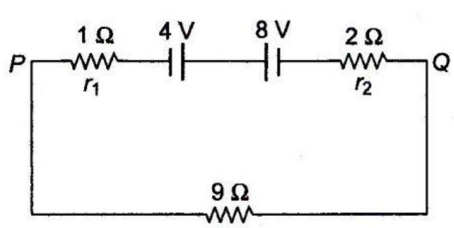
(a) 3 Ω (b) 4 Ω
(c) 4.5 Ω (d) 5 Ω

77. In the figure given the value of X resistance will be, when the p.d. between B and D is zero



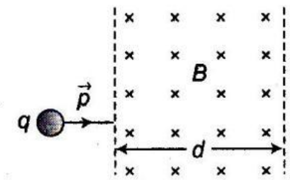
(a) 4 ohm (b) 6 ohm
(c) 8 ohm (d) 9 ohm

78. Two batteries of e.m.f. $4V$ and $8\ V$ with internal resistances 1 Ω and 2 Ω are connected in a circuit with a resistance of 9 Ω as shown in figure. The current and potential difference between the points P and Q are



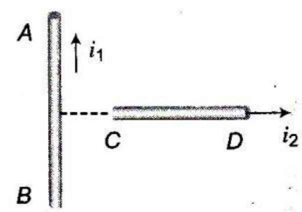
(a) $\frac{1}{3}$ A and 3 V (b) $\frac{1}{6}$ A and 4 V
(c) $\frac{1}{9}$ A and 9 V (d) $\frac{1}{2}$ A and 12 A

79. A particle with charge q, moving with a momentum p, enters a uniform magnetic field normally. The magnetic field has magnitude B and is confined to a region of width d, where $d < \frac{p}{Bq}$. If the particle is deflected by an angle θ in crossing the field then



(a) $\sin\theta = \frac{Bqd}{p}$ (b) $\sin\theta = \frac{p}{Bqd}$
(c) $\sin\theta = \frac{Bp}{qd}$ (d) $\sin\theta = \frac{pd}{Bq}$

80. An infinitely long, straight conductor AB is fixed and a current is passed through it. Another movable straight wire CD of finite length and carrying current is held perpendicular to it and released. Neglect weight of the wire

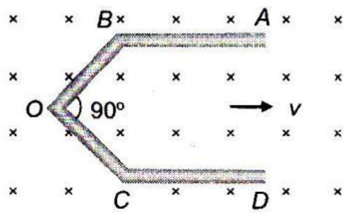


(a) The rod CD will move upwards parallel to itself
(b) The rod CD will move downward parallel to itself
(c) The rod CD will move upward and turn clockwise at the same time
(d) The rod CD will move upward and turn anti –clock-wise at the same time

81. The real angle of dip, if a magnet is suspended at an angle of 30° to the magnetic meridian and the dip needle makes an angle of 45° with horizontal, is:

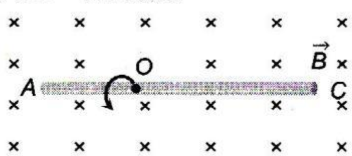
(a) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (b) $\tan^{-1}(\sqrt{3})$
(c) $\tan^{-1}\left(\frac{\sqrt{3}}{\sqrt{2}}\right)$ (d) $\tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$

82. A conductor $ABOCD$ moves along its bisector with a velocity of 1 m/s through a perpendicular magnetic field of 1 wb/m^2, as shown in fig. If all the four sides are of 1m length each, then the induced emf between points A and D is



(a) 0 (b) 1.41 *volt*
(c) 0.71 *volt* (d) None of these

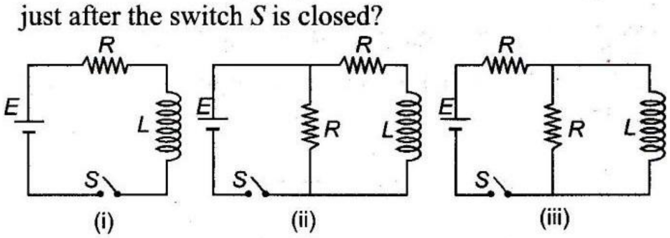
83. A conducting rod AC of length $4l$ is rotated about a point O in a uniform magnetic field $\vec{B}$ directed into the paper. $AO = l$ and $OC = 3l$. Then



(a) $V_A - V_O = \frac{B\omega l^2}{2}$ (b) $V_O - V_C = \frac{7}{2}B\omega l^2$

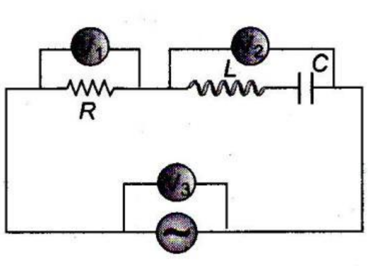
(c) $V_A - V_C = 4B\omega l^2$ (d) $V_C - V_O = \frac{9}{2}B\omega l^2$

84. In which of the following circuits is the current maximum just after the switch S is closed?



(a) (i) (b) (ii)
(c) (iii) (d) Both (ii) and (iii)

85. In the figure shown, three AC voltmeters have been connected. At resonance, the reading of



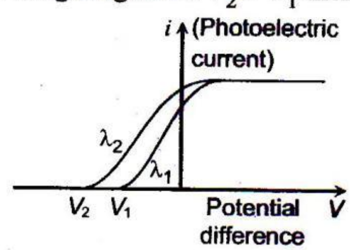
(a) V_1 is zero (b) V_2 is zero
(c) V_3 is zero (d) $V_1 = V_2 = V_3 =$ zero

86. A 220 V, 50 Hz AC generator is connected to an inductor and a 50 Ω resistance in series. The current in the circuit is 1.0 A. What is P.D. across inductor?
(a) 102.2 V (b) 186.4 V
(c) 213.6 V (d) 302 V

87. A convex lens A of focal length 20 cm and a concave lens B of focal length 5 cm are kept along the same axis with the distance d between them. If a parallel beam of light falling on A leaves B as a parallel beam, then distance d in cm will be
(a) 25 (b) 15
(c) 30 (d) 50

88. In two separate set-ups of the Young's double slit experiment, fringes of equal width are observed when lights of wavelengths in the ratio 1 : 2 are used. If the ratio of the slit separation in the two cases is 2 : 1, the ratio of the distances between the plane of the slits and the screen in the two set-ups is
(a) 4 : 1 (b) 1 : 1
(c) 1 : 4 (d) 2 : 1

89. In the following diagram if $V_2 > V_1$ then



(a) $\lambda_1 = \sqrt{\lambda_2}$ (b) $\lambda_1 < \lambda_2$
(c) $\lambda_1 = \lambda_2$ (d) $\lambda_1 > \lambda_2$

90. The half-life period of a radioactive element X is same as the mean life time of another radioactive element Y. Initially both of them have the same number of atoms. Then
(a) X and Y have the same decay rate initially
(b) X and Y decay at the same rate always
(c) Y will decay at a faster rate than X
(d) X will decay at a faster rate than Y