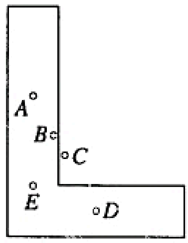
1. Which of the following does not represent a fundamental unit in the SI system?
(1) m (2) N (3) kg (4) s (5) K

2. If the distance between two masses is doubled the gravitational force between them will decrease by a factor of
(1) 2 (2) 4 (3) 6 (4) 8 (5) 12

3. Figure shows a thin uniform L-shaped metal sheet. The centre of gravity of the sheet is most likely to be found at the point



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

4. The minimum amount of work that has to be done in order to fix a light elastic string of initial length l_0 between two parallel walls separated by a distance d ($d > l_0$) with a tension T is
(1) $\frac{1}{2}T(d-l_0)$ (2) $\frac{Td}{l_0}$ (3) $T(d-l_0)$ (4) $\frac{1}{2}\frac{T}{(d-l_0)}$ (5) $\frac{1}{2}\frac{(d-l_0)^2}{T}$

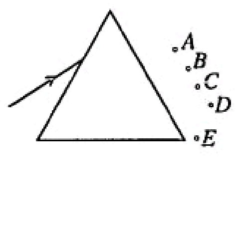
5. A vessel contains an ideal gas at 27 °C. If the temperature of the gas is increased to 127 °C, the ratio, $\frac{\text{mean kinetic energy of the gas atoms at 127 °C}}{\text{mean kinetic energy of the gas atoms at 27 °C}}$ will become
(1) $\frac{127}{27}$ (2) $\frac{16}{9}$ (3) $\frac{4}{3}$ (4) $\frac{3}{4}$ (5) $\frac{27}{127}$

6. The mass of body A is twice that of body B. The specific heat capacity of the material of body A is three times that of body B. They are supplied with equal amounts of heat. If the body A experiences a temperature change of ΔT, then body B will experience a temperature change of
(1) $\frac{\Delta T}{2}$ (2) $\frac{2}{3}\Delta T$ (3) ΔT (4) $\frac{3}{2}\Delta T$ (5) $6\Delta T$

7. Consider the following statements made about laser light.
(A) The energy of a photon in a laser beam of certain frequency is higher than the energy of a photon of the same frequency in a normal light beam.
(B) A laser beam cannot be refracted by a glass prism.
(C) All the photons in a laser beam have the same energy, the same phase, and the same direction.
Of the above statements,
(1) only (B) is true. (2) only (C) is true.
(3) only (A) and (B) are true. (4) only (B) and (C) are true.
(5) all (A), (B) and (C) are true.

8. A noisy workplace has a noise level of 90 dB. This was reduced to a less uncomfortable level of 70 dB. The ratio $\frac{\text{new intensity of the noise}}{\text{old intensity of the noise}}$ is equal to
(1) 0.9 (2) 0.5 (3) 0.1 (4) 0.01 (5) 0.001

9. A monochromatic ray of light is incident on a glass prism and suffers minimum deviation while going through the prism. The emergent ray most likely will go through the point



(1) A (2) B (3) C
(4) D (5) E

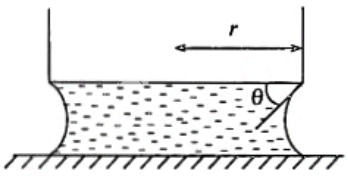
10. Which of the following statements made about electric field lines is false?
(1) Electric field lines can be either straight or curved.
(2) Electric field lines can be parallel to one another.
(3) Electric field lines can form closed loops.
(4) Electric field lines begin on positive charges and end on negative charges.
(5) Electric field lines can never intersect with one another.

11. A spherical Gaussian surface surrounds a point charge q. The following changes were made to the system.
(A) The magnitude of the charge was tripled.
(B) The radius of the spherical Gaussian surface was doubled.
(C) The spherical Gaussian surface was changed to a surface of a cube.
(D) The charge was moved to another location inside the surface.
Of the changes mentioned above, the net electric flux through the surface is changed only in
(1) (A) (2) (A) and (B) (3) (C) and (D)
(4) (A), (B) and (D) (5) all (A), (B), (C) and (D).

12. An ideal transformer operates at V_p = 12.0 kV ac on the primary side and supplies electricity to a number of nearby houses at V_s = 240 V, ac. The turns ratio, $\frac{\text{number of turns in the primary}}{\text{number of turns in the secondary}}$ of the transformer is
(1) 0.02 (2) 0.2 (3) 25 (4) 50 (5) 100

13. Two copper wires have the same volume, but wire 2 is 20% longer than wire 1. The ratio, $\frac{\text{resistance of the wire 2}}{\text{resistance of the wire 1}}$ is
(1) 0.83 (2) 0.91 (3) 1.11 (4) 1.20 (5) 1.44

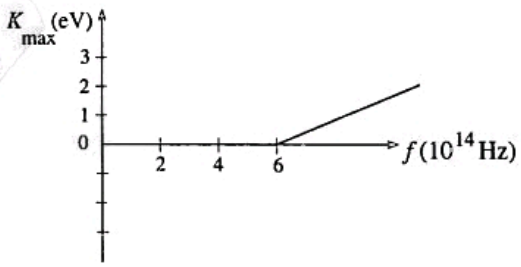
14. A water layer exists between the bottom of a cylindrical bottle and a glass plate as shown in the figure. The radius of the bottom of the bottle is r. When the bottle is raised slowly, at one instant the contact angle between water and the bottom of the bottle becomes θ. (see figure)
The magnitude of the force on the bottom of the bottle at that instant due to surface tension T of water, is



(1) $2\pi rT\sin\theta$ (2) $2\pi rT\cos\theta$ (3) $\pi r^2T\sin\theta$ (4) $\pi r^2T\cos\theta$ (5) $4\pi rT\sin\theta$

15. Which of the following is **not true** regarding the rate at which a body emits radiant energy?
(1) It is proportional to the surface area of the body.
(2) It is proportional to the 4th power of the absolute temperature of the body.
(3) It is proportional to the emissivity of the surface of the body.
(4) It depends on the temperature of the surrounding.
(5) It **does not** depend on the thermal capacity of the body.

16. The graph shows the variation of the maximum kinetic energy (K_{max}) of emitted photo-electrons from a metal with the frequency (f) of the incident radiation. The work function of the metal is
(1) 6.0 eV
(2) 4.0 eV
(3) 2.5 eV
(4) 2.0 eV
(5) 1.0 eV



17. A radioactive isotope of iodine, $^{131}_{53}\text{I}$ decays to $^{131}_{54}\text{Xe}$. What type of particle is emitted in this decay?
(1) α (2) β^- (3) β^+ (4) p (5) n

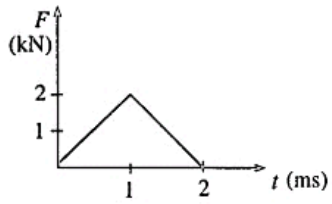
18. Consider the following statements made about the the information that can be obtained from dimensional analysis.
(A) Numerical values of constants of proportionality that may appear in a physical equation can be determined by dimensional analysis.
(B) Numerical signs of constants of proportionality that may appear in a physical equation can be determined by dimensional analysis.
(C) The units of constants of proportionality that may appear in a physical equation can be determined by dimensional analysis.
Of the above statements
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.
(4) only (B) and (C) are true. (5) all (A), (B) and (C) are true.

19. Equal masses of three liquids of densities d_1, d_2 and d_3 are added together. If the liquids mix together without causing any change, then the density of the composite liquid will be

(1) $\frac{d_1+d_2+d_3}{3}$ (2) $\frac{d_1d_2d_3}{3}$ (3) $\frac{3d_1d_2d_3}{d_1d_2+d_2d_3+d_3d_1}$

(4) $\frac{d_1d_2+d_2d_3+d_3d_1}{3}$ (5) $\frac{d_1d_2d_3}{d_1d_2+d_2d_3+d_3d_1}$

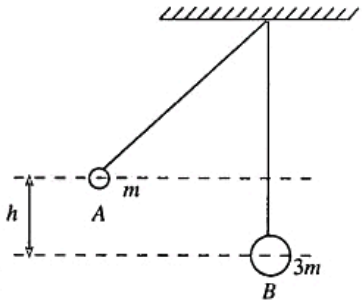
20. A ball of mass 0.5 kg which is initially at rest, is struck by a bat. The variation of the force (F) on the ball with time (t) is shown in the figure. The speed of the ball when it leaves the bat is



(1) 10 m s^{-1} (2) 8 m s^{-1} (3) 6 m s^{-1}

(4) 4 m s^{-1} (5) 2 m s^{-1}

21. Two small spheres A and B of putty of mass m and $3m$ respectively are suspended from a ceiling by means of strings of equal length. Sphere A is drawn aside so that it is raised to a height h as shown, and then released. Sphere A collides with sphere B which is at rest, and they stick together. The maximum height to which the composite body swings is



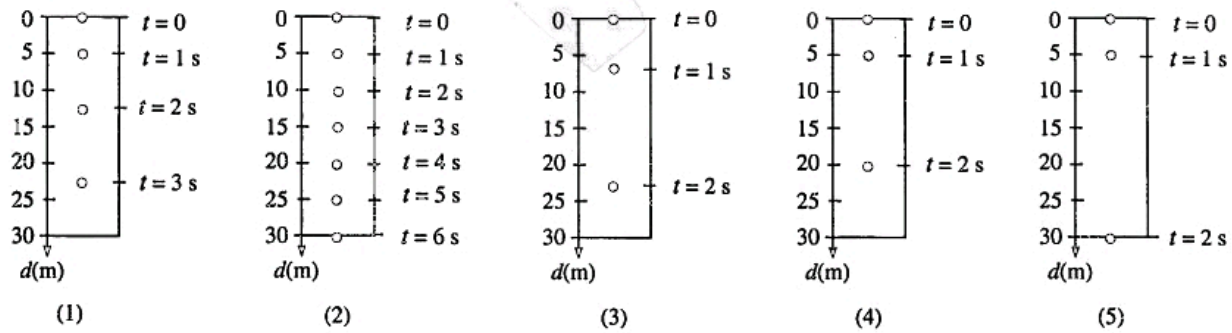
(1) $\frac{1}{16}h$ (2) $\frac{1}{8}h$ (3) $\frac{1}{4}h$

(4) $\frac{1}{3}h$ (5) $\frac{1}{2}h$

22. A car of mass m manoeuvres a circular bend of radius of curvature r in a horizontal flat road with a speed v. If the car skids then (μ is the coefficient of friction between the road and a tyre).

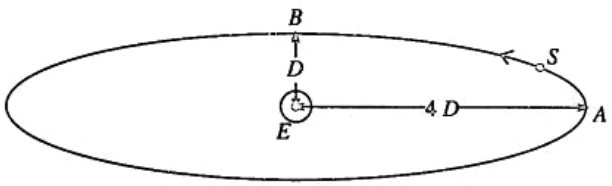
(1) $v>\sqrt{\mu rg}$ (2) $v<\sqrt{\frac{\mu rg}{4}}$ (3) $v>\sqrt{\frac{\mu rg}{m}}$ (4) $v<\sqrt{\mu rmg}$ (5) $v>\sqrt{\frac{\mu mg}{r}}$

23. Photographs of an object that starts falling freely from rest at $t = 0$ are taken by a camera, first at $t = 0$, and thereafter at the end of each second. Which of the following diagrams correctly indicates the location of the object at the end of each second? The vertical axes of the diagrams represent the distance (d) travelled by the object.



(1) (2) (3) (4) (5)

24. A satellite (S) moves in an elliptical orbit about the earth (E). If the speed of the satellite at point A is v, then its speed at point B will be

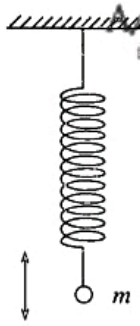


(1) $\frac{v}{8}$ (2) $\frac{v}{4}$

(3) v (4) $2v$

(5) $4v$

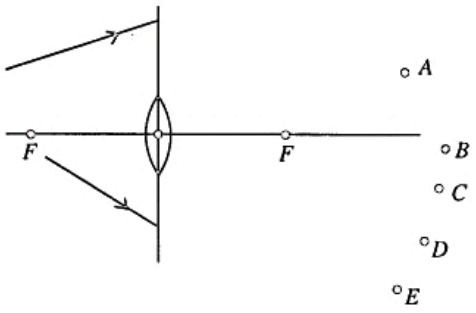
25. Consider the following statements made about a particle of mass m attached to a light spring and performing simple harmonic motion as shown in the figure.



(A) The acceleration of the particle is always towards the centre of motion.
(B) The force on the particle is proportional to the square of the displacement from the centre.
(C) The period of oscillation depends on the mass of the particle.

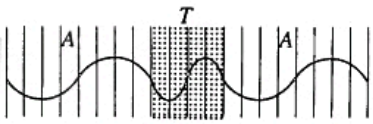
Of the above statements,
(1) only (A) is true.
(2) only (C) is true.
(3) only (A) and (B) are true.
(4) only (A) and (C) are true.
(5) all (A), (B) and (C) are true.

26. Consider two rays moving towards a thin converging lens as shown in the figure. After passing through the lens, the two rays are most likely to be met at the point



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

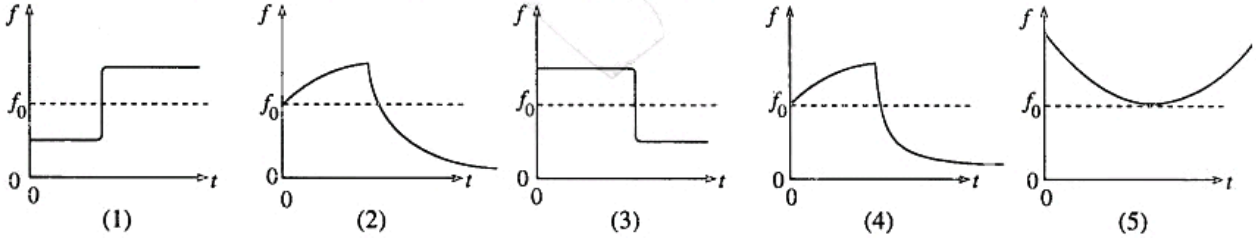
27. Figure shows the changes occurred to a waveform of a monochromatic ray of light travelling in air (A) when incident normally and transmitted through a transparent medium (T). The refractive index of the transparent medium is



(1) 1.5
(2) 2.0
(3) 2.5
(4) 3.0
(5) 3.5

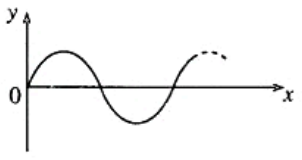
28. The human vocal tract (larynx) can be considered as a tube that is open at one end. If the length of this tube is 17 cm, the frequencies of the lowest two harmonics produced are given by (The speed of sound in air = 340 m s^{-1})
(1) 500 Hz, 1500 Hz
(2) 500 Hz, 1000 Hz
(3) 1000 Hz, 2000 Hz
(4) 1000 Hz, 3000 Hz
(5) 1500 Hz, 2500 Hz

29. A train travelling at a constant velocity while continuously sounding its horn with a frequency f_0 moves towards an observer standing on a platform and then moves away from him. The variation of the frequency (f) of the horn as heard by the observer with time (t) is best represented by



(1) (2) (3) (4) (5)

30. The graph shows the variation of a quantity y with another quantity x. Consider the following statements.



(A) If the graph represents a wave travelling in a stretched string, along the x direction, y could be the displacement of a particle of the string in a direction perpendicular to the motion of the wave, at a given instant.
(B) If the graph represents a wave travelling in water, x could be the time and y could be the displacement of a water molecule along the direction of the wave.
(C) If the graph represents a vibration of a tuning fork, x could be the time and y could be the velocity of the tip of one prong of the fork.

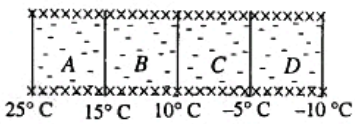
Of the above statements,
(1) only (A) is true.
(2) only (C) is true.
(3) only (A) and (C) are true.
(4) only (B) and (C) are true.
(5) all (A), (B) and (C) are true.

31. A planet is observed by an astronomical telescope in normal adjustment, having an objective of focal length 14 m and an eyepiece of focal length 2 cm. Consider the following statements.
(A) The distance between the objective and the eye piece is 1402 cm.
(B) Angular magnification of the planet is 700.
(C) The image of the planet is formed at the near point of the observer.
Of the above statements
(1) only (A) and (B) are true.
(2) only (A) and (C) are true.
(3) only (B) and (C) are true.
(4) only (B) is true.
(5) all (A), (B) and (C) are true.

32. Consider a process where air is quickly leaking out of a balloon. Which of the following is true for this process?

	ΔQ	ΔW	ΔU
(1)	+	+	+
(2)	–	–	–
(3)	0	0	0
(4)	0	–	–
(5)	0	+	–

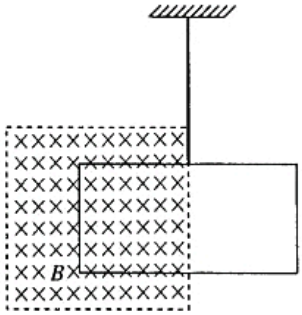
33. The figure indicates the face and interface temperatures of a lagged composite slab consisting of four materials A, B, C and D of identical thickness and surface area through which the heat transfer is steady. If k_A, k_B, k_C and k_D are the thermal conductivities of materials A, B, C and D respectively then



(1) $k_A > k_B > k_C > k_D$
(2) $k_A < k_B < k_C < k_D$
(3) $k_B = k_D > k_A > k_C$
(4) $k_B = k_D < k_A < k_C$
(5) $k_B = k_D = k_A > k_C$

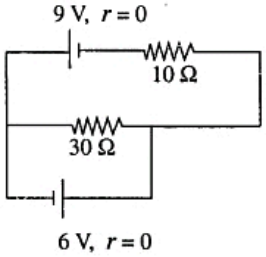
34. Consider the following statements made about the capability of a given thermometer to produce an accurate value for a temperature measurement.
(A) In situations where quick changes of temperature with time have to be measured, the given thermometer must be a one having large variation of the thermometric property with temperature.
(B) Thermal capacity of the thermometer must be negligible when compared to the thermal capacity of the environment of which the temperature is measured.
(C) Thermometric property must have a linear variation with the temperature.
Of the above statements
(1) only (B) is true.
(2) only (A) and (B) are true.
(3) only (B) and (C) are true.
(4) only (A) and (C) are true.
(5) all (A), (B) and (C) are true.

35. A light, conducting loop is suspended freely, and a half of the loop is inserted into a magnetic field as shown in the figure. If the magnetic field begins to increase rapidly in strength,



(1) the loop begins to move in the direction of the magnetic field.
(2) the loop begins to move against the direction of the magnetic field.
(3) the loop begins to move (to the left) into the field.
(4) the loop begins to move (to the right) out of the field.
(5) the loop does not move at all.

36. Current through the 10 Ω resistor is



(1) 0
(2) 1.5 A
(3) 3.0 A
(4) 5.0 A
(5) 6.0 A

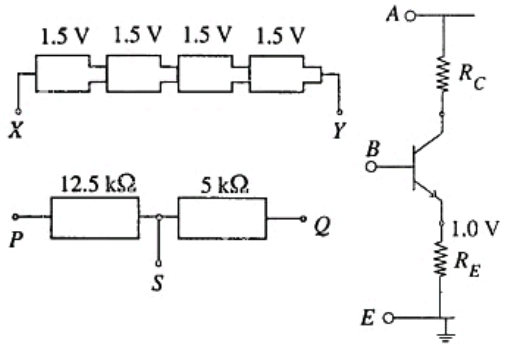
37. A metal wire has resistances R_1 and R_2 at temperatures θ_1 and θ_2 respectively. The temperature coefficient of resistivity of the metal, is given by

(1) $\frac{(\theta_1-\theta_2)}{(R_1-R_2)}$ (2) $\frac{(R_1-R_2)}{(\theta_1-\theta_2)}$ (3) $\frac{(R_1-R_2)}{(\theta_1-\theta_2)(R_1+R_2)}$

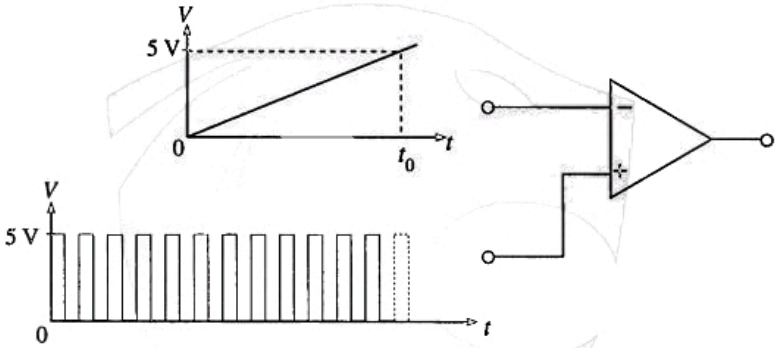
(4) $\frac{(R_1-R_2)}{(R_2\theta_1-R_1\theta_2)}$ (5) $\frac{(R_2\theta_1-R_1\theta_2)}{(R_1-R_2)}$

38. Which of the following connections will have to be made in order to operate the transistor (Si) circuit given in the figure as a common emitter amplifier?

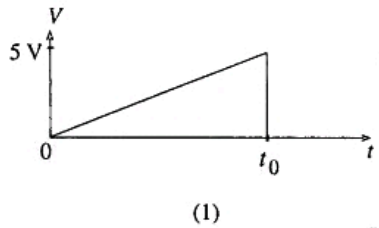
(1) *XE, YB, AP, BQ, SE*
(2) *PA, YE, XP, BS, QE*
(3) *SB, YA, AQ, BQ, SE*
(4) *XE, YB, AQ, BP, SA*
(5) *YA, XE, AP, BS, QE*



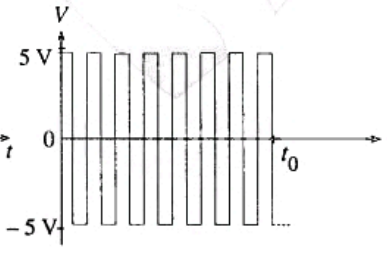
39.



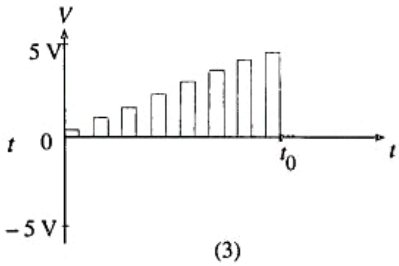
The inverting input of a 741 operational amplifier operating with ±10 V power supply voltages is provided with a voltage signal which increases linearly with time (t) as shown in the figure.
The non-inverting input is provided with a rectangular voltage waveform of amplitude 5 V as shown. The output waveform of the operational amplifier is best represented by



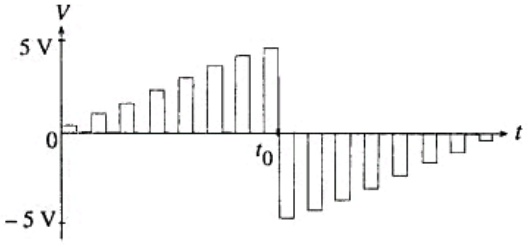
(1)



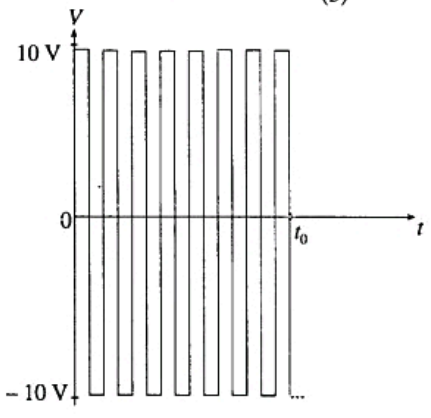
(2)



(3)

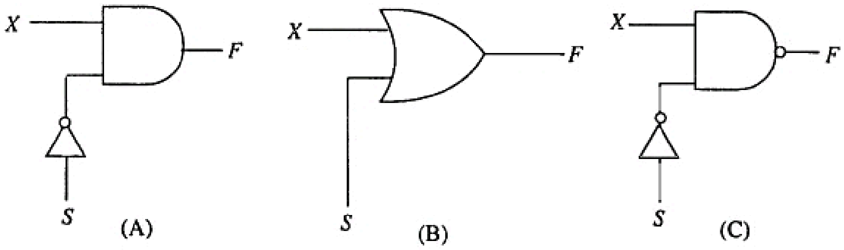


(4)



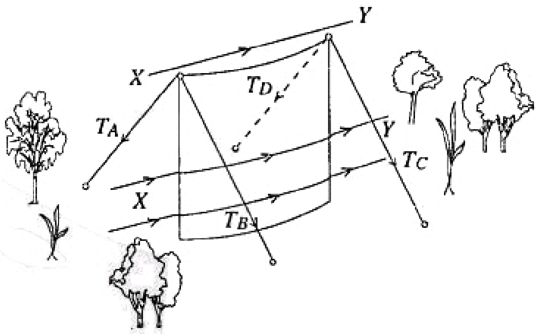
(5)

40. Which of the logic circuits shown will operate in the following manner?
When $S = 0$, output $F = X$ (value of X can be either 1 or 0)
When $S = 1$, output $F = 0$ (irrespective of the value of X)



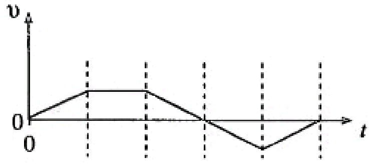
(1) (A) only.
(2) (B) only
(3) (C) only.
(4) (A) and (B) only
(5) (B) and (C) only.

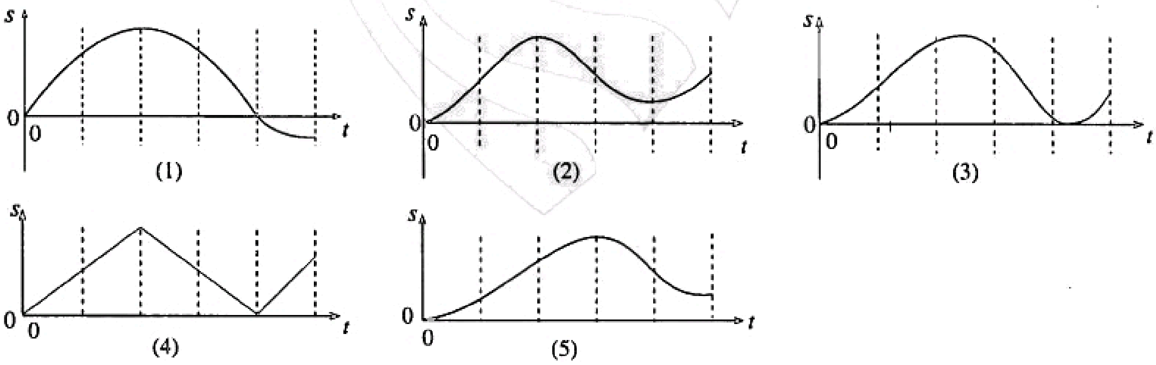
41. A large metal sheet bent into the shape shown in the figure is kept upright on the ground by means of four stretched ropes fixed to the ground.
Magnitudes of the tensions in all ropes, T_A, T_B, T_C, and T_D in still air are equal. When wind blows through the sheet in the direction XY



(1) $T_A < T_B$ and $T_D < T_C$
(2) $T_A > T_B$ and $T_D > T_C$
(3) $T_A = T_B$ and $T_C = T_D$
(4) $T_A > T_B$ and $T_C > T_D$
(5) $T_A < T_B$ and $T_C < T_D$

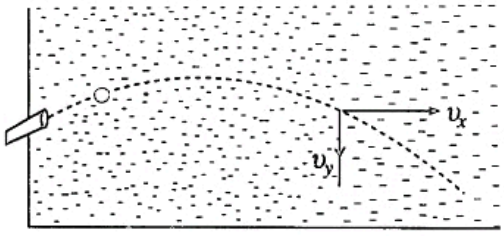
42. The variation of the velocity (v) with time (t) of a particle is shown in the figure. The corresponding displacement (s) - time (t) curve is best represented by





43. A grain of sand is stuck to a tyre of a vehicle at a distance r from its centre. The radius of the tyre is R. When the tyre is rotating at an angular speed of ω, the sand grain detaches suddenly from the tyre. If the air resistance is neglected, the horizontal component of the velocity of the grain relative to the vehicle immediately after detachment could have a value between
(1) 0 and $(R - r)\omega$.
(2) 0 and $(r + R)\omega$.
(3) 0 and $r\omega$.
(4) $-r\omega$ and $r\omega$.
(5) $(R - r)\omega$ and $(r + R)\omega$.

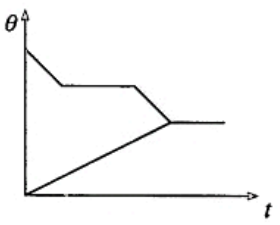
44. A lead ball of radius a is fired from a toy gun in water in a large swimming pool as shown in the figure. The densities of water and lead are ρ_w and ρ_{pb} respectively and the viscosity of water is η. If the x and y components of the velocity of the ball at a certain instant are v_x and v_y respectively then the magnitudes of the corresponding acceleration components at that instant would be



	x (horizontal)	y (vertical)
(1)	$\frac{9\eta v_x}{2a^2\rho_{pb}}$	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g-\frac{9\eta v_y}{2a^2\rho_{pb}}$
(2)	0	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g-\frac{9\eta v_y}{2a^2\rho_{pb}}$
(3)	$\frac{9\eta v_x}{2a^2\rho_{pb}}$	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g$
(4)	$\frac{9\eta v_x}{2a^2\rho_{pb}}$	g
(5)	0	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g$

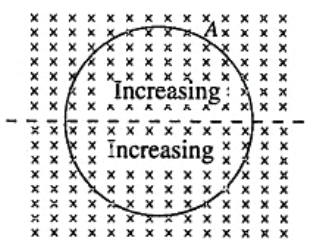
45. Water is found to condense on the outer surface of a cooled glass bottle of soft drink when kept in the atmosphere. The total amount of water condensed before it reaches the atmospheric temperature will not depend on
(1) initial temperature of the cooled bottle of soft drink.
(2) thermal capacity of the bottle of soft drink.
(3) rate of increase of temperature of the bottle of soft drink.
(4) dew point of the atmosphere.
(5) the thermal conductivity of glass.

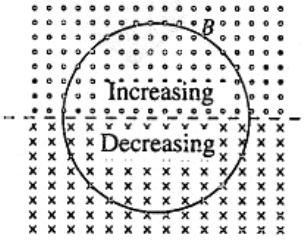
46. Small amounts of water and ice of identical masses are placed in a thermally insulated container and allowed to come to thermal equilibrium. The variations of the temperature (θ) of water and ice are recorded with time (t) and are shown in the same graph. Which of the following conclusions can be drawn about the behaviour of water and ice from the given graph?

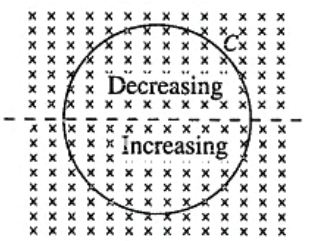


(1) Water has fully frozen and no ice has melted.
(2) Water has partly frozen and no ice has melted.
(3) Water has partly frozen and ice has fully melted.
(4) Water has fully frozen and ice has fuily melted.
(5) Water has fully frozen and ice has partly melted.

47.



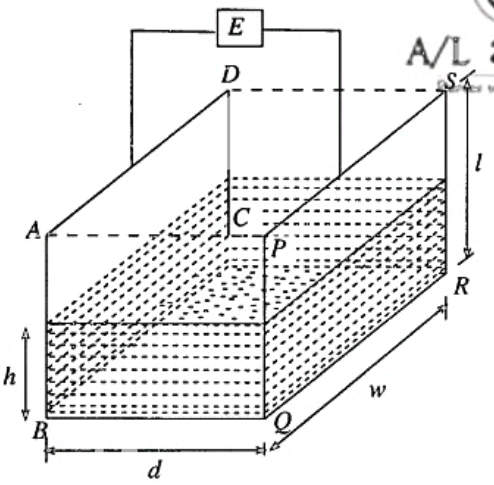




Three identical wire loops A, B and C are placed in uniform magnetic fields as shown in figures. Magnetic fields are either increasing or decreasing in magnitude at the same rate. If i_1, i_2, and i_3 are the magnitudes of the induced currents in loops A, B, and C respectively then

(1) $i_1 > i_2 > i_3$ (2) $i_1 < i_2 < i_3$ (3) $i_1 = i_2 = i_3$
(4) $i_1 = i_2$; $i_3 = 0$ (5) $i_1 = i_2 = i_3 = 0$

48. A fuel-gauge in a vehicle uses a parallel plate capacitor made of two rectangular metal plates to determine the height of the fuel level in the tank. Each of the metal plates (*ABCD* and *PQRS*) has a width w and a height l. The height of the fuel level between the plates is h. (see figure) Appropriate electronic circuitry E determines the effective capacitance of the combined air and fuel capacitors. The effective capacitance of this system is given by (k = dielectric constant of fuel)

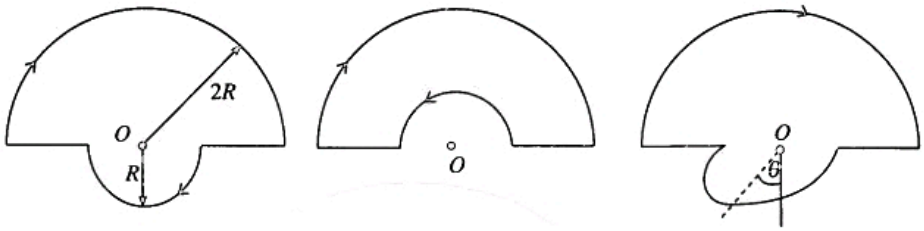


(1) $\frac{w\varepsilon_0}{d}[l+h(k-1)]$ (2) $\frac{(l-h)kh\varepsilon_0 w}{d[l+h(k-1)]}$

(3) $\frac{w\varepsilon_0}{2d}[l+h(k-1)]$ (4) $\frac{(l-h)kh\varepsilon_0 w}{2d[l+h(k-1)]}$

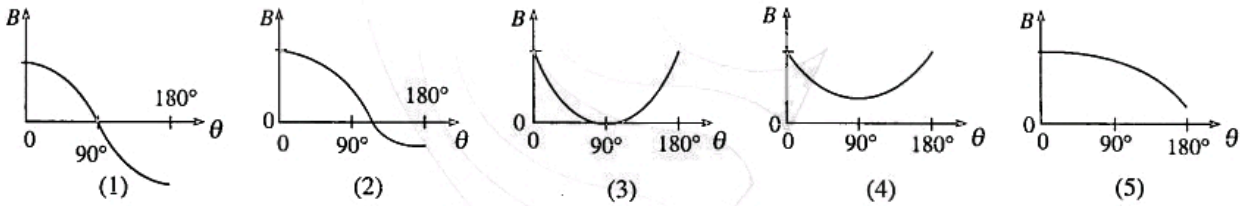
(5) $\frac{k\varepsilon_0 lw}{d}$

49.



(1) (2) (3)

A current carrying wire loop in figure (1) lies in the plane of the paper and consists of two concentric semicircles of radii $2R$ and R and two radial lengths. The smaller semicircle is bent out of the plane gradually until the loop is flipped over and lies entirely on the same plane again as shown in figure (2). An intermediate situation of the system when the loop is bent through an angle θ is shown in figure (3). The variation of the component of the magnetic flux density (B) directed into the page at the center (O) of the loop with angle θ is best represented by



50. In the circuit shown PQ is a variable resistor of 1000 Ω, and the resistance between the terminals P and X varies linearly as terminal X moves from P to Q. As the terminal X moves from P to Q the variation of the ammeter reading (I) is best represented by