අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2017 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2017 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2017

භෞතික විද්‍යාව I பௌதிகவியல் I **Physics I**	**01 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***Two hours***

Instructions:

* *This question paper consists of* **50** *questions in* **10** *pages.*
* *Answer* ***all*** *the questions.*
* *Write your* ***Index Number*** *in the space provided in the answer sheet.*
* *Read the instructions given on the back of the answer sheet carefully.*
* *In each of the questions* **1** *to* **50**, *pick one of the alternatives from* (1), (2), (3), (4), (5) *which is* ***correct*** *or* ***most appropriate*** *and* ***mark your response on the answer sheet with a cross*** (×) ***in accordance with the instructions given on the back of the answer sheet.***

Use of calculators is not allowed.

(Acceleration due to gravity, $g = 10\,N\,kg^{-1}$)

1. Unit of current density is

(1) $A\,m^2$ (2) $A\,m^{-2}$ (3) $A\,m^{-3}$ (4) $A\,m^{-1}$ (5) $A\,m$

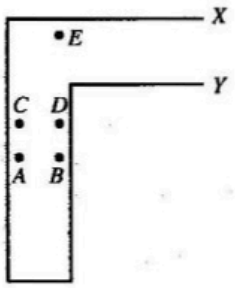
2. a, b, c and d are physical quantities having **different** dimensions, and k is a dimensionless constant. Consider the following relationships.

(A) $ka^3 = b$ (B) $d = ac$ (C) $a = kb$

Of the above relationships

(1) only B is dimensionally valid.
(2) only C is dimensionally valid.
(3) only A and B are dimensionally valid.
(4) only A and C are dimensionally valid.
(5) all A, B and C are dimensionally valid.

3. A uniform thin wire is bent into a wire-frame with its two ends X and Y kept opened as shown in the figure. The centre of gravity of the wire-frame is most likely to be at the point,



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

4. A tube with one end closed resonates at its fundamental frequency with a tuning fork of frequency f. When the closed end is opened, the same length of the tube will resonate at its fundamental frequency with a tuning fork of frequency approximately equal to

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

5. A potentiometer is **not** used for

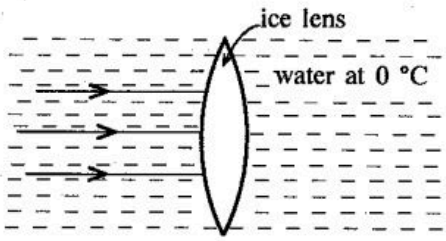
(1) comparing resistances.
(2) comparing e.m.f.s.
(3) measuring the internal resistance of a cell.
(4) measuring very small e.m.f.s.
(5) measuring varying voltages.

6. Two rods A and B are connected end to end. Sound wave travelling in rod A has a speed v. If it enters the rod B whose Young's modulus is four times that of A but having the same density as A, the speed of the sound wave in rod B will be

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

|See page two

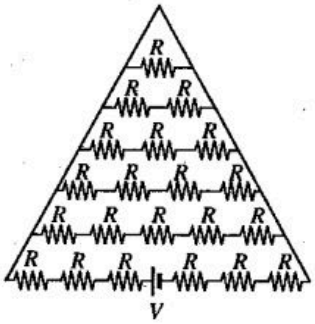
7. A thin transparent convex lens made of ice is immersed in water at 0 °C, and rays of parallel light are made to incident on the lens as shown in the figure. Refractive indices of ice and water relative to air are 1.31 and 1.33 respectively. Consider the following statements.



(A) Parallel light rays get converged to a point on the right side far away from the lens.
(B) Ice lens behaves as a diverging lens under this situation.
(C) Real images cannot be observed under this situation.

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

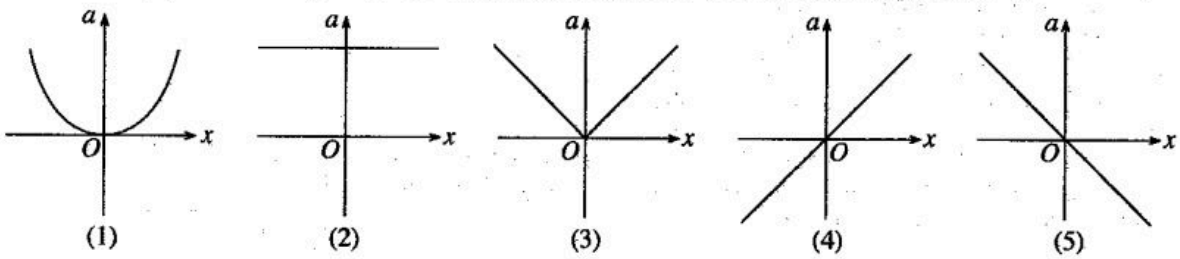
8. Current drawn from the battery in the circuit shown is



(1) $\frac{V}{6R}$ (2) $\frac{20V}{27R}$ (3) $\frac{V}{21R}$
(4) $\frac{27V}{182R}$ (5) $\frac{137V}{882R}$

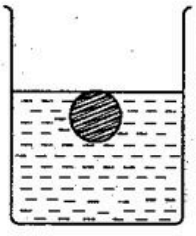
9. In a compound microscope under normal adjustment,
(1) the object distance is less than the focal length of the objective.
(2) the image formed by the objective is virtual.
(3) the image formed by the objective is located within the focal length of the eyepiece.
(4) the final image is real.
(5) overall angular magnification can be increased by using an objective having a larger focal length.

10. A body executes simple harmonic motion along the x-axis around the point O. The variation of the acceleration (a) of the body with the displacement (x) from O is correctly represented in



11. Which of the following statements is **not** true regarding progressive transverse waves in a stretched string?
(1) Direction of the motion of particles in the string is normal to the direction of propagation of the wave.
(2) Speed of the wave is inversely proportional to the square root of the mass per unit length of the string when the tension of the string is constant.
(3) Energy carried by the wave depends on the amplitude of the wave.
(4) Waves formed on the string cannot be reflected.
(5) Two adjacent particles of the string do not move with the same speed at a given instant.

12. A solid sphere at θ°C with volume expansivity γ_s is completely immersed and floating in a liquid at θ°C as shown in the figure. Volume expansivity of the liquid is $\gamma_f (> \gamma_s)$. The **entire** sphere with the liquid is cooled down to a certain temperature.

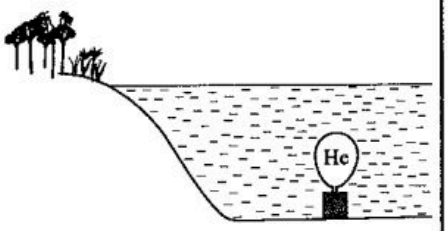


Consider the following statements.
(A) A part of the sphere will be above the surface of the liquid after cooling.
(B) The magnitude of the upthrust acting on the sphere will not change.
(C) The density of the sphere will be greater than the liquid after cooling.

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

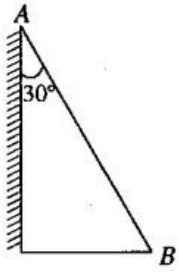
[See page three

13. A solid block of metal of volume $1\,m^3$ and density $8\times10^3\ kg\ m^{-3}$ rests at the bottom of a lake. What is the volume of a helium filled balloon connected as shown in the figure to make the block just float at the bottom of the lake? Neglect the mass of the balloon with helium. (Density of water = $1\times10^3\ kg\,m^{-3}$)



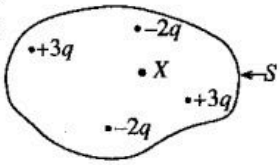
(1) $7\,m^3$ (2) $8\,m^3$ (3) $70\,m^3$
(4) $80\,m^3$ (5) $700\,m^3$

14. One of the surfaces of a glass prism of refractive index 1.5, is silvered as shown in the figure. A ray of light falling on the face AB with an angle of incidence θ gets reflected from the silvered surface and returns along the same path. Which one of the following values is closest to θ ?



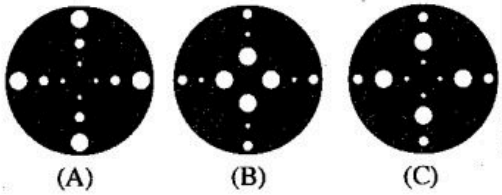
(1) 37° (2) 41° (3) 49°
(4) 51° (5) 56°

15. Figure shows a distribution of static electric charges enclosed by a Gaussian surface S. X is an unknown charge. If the net outward electric flux through the surface S is $\frac{-q}{\varepsilon_0}$, then charge X is



(1) $-3q$ (2) $-2q$ (3) $-q$
(4) $+q$ (5) $+2q$

16. Three identical uniform metal discs are perforated to form twelve holes in each disc with three different radii as shown in the figures (A), (B) and (C). The three discs A, B and C when arranged so that their moments of inertia, about an axis normal to the plane of the disc and passing through the centre, are in the ascending order, is

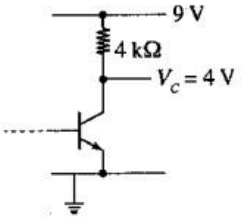


(1) B, C, A (2) A, B, C (3) C, B, A
(4) A, C, B (5) B, A, C

17. A person with surface body temperature 30 °C is in an environment of temperature 20 °C. The net rate of loss of heat due to radiation from the body is proportional to (Assume that the black body radiation-conditions can be applied.)

(1) 303^4-293^4 (2) 293^4 (3) 10^4 (4) 303^4+293^4 (5) 30^4-20^4

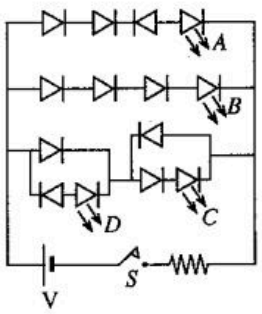
18. When the transistor shown in the circuit is biased in the active mode, the collector current will be



(1) 0.60 mA (2) 0.80 mA (3) 1.25 mA
(4) 1.40 mA (5) 2.50 mA

19. When the switch S is closed in the circuit shown,

(1) only A will glow.
(2) only B and C will glow.
(3) only B and D will glow.
(4) only B, C and D will glow.
(5) all A, B, C and D will glow.



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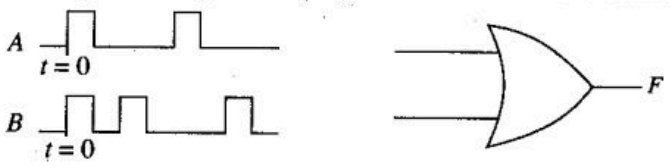
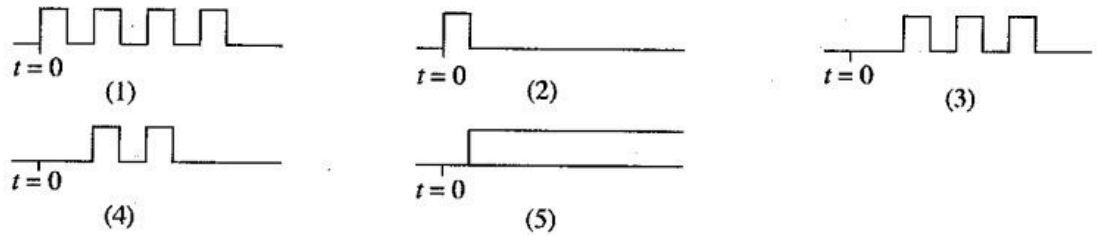
20. Two digital voltage waveforms A and B shown are connected to the two inputs of the gate shown.



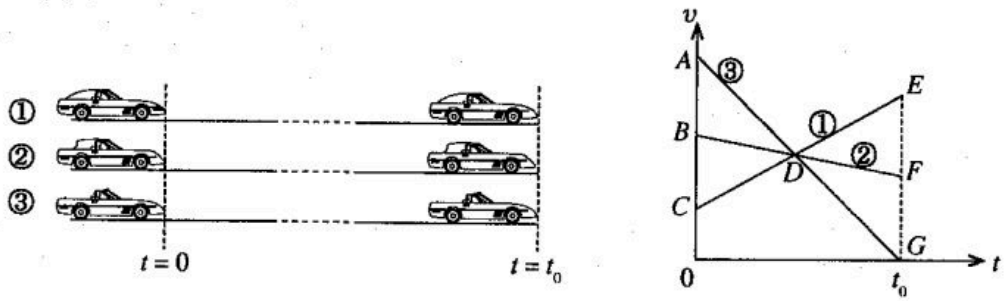
The correct output voltage waveform at F is



21. A beam of monochromatic light is incident on a metal surface which is capable of producing photoelectrons. If the frequency of the light is above the cut-off frequency of the metal, the number of photoelectrons ejected from the metal surface is proportional to the

(1) reciprocal of the kinetic energy of a photoelectron.
(2) work function of the metal.
(3) frequency of the incident light.
(4) number of photons that hits the metal surface.
(5) energy of a single photon.

22. Positions of three motor cars ①, ② and ③ travelling along three parallel straight lanes of a road at time $t = 0$, and $t = t_0$ are shown in figure (a), and their corresponding velocity (v) – time (t) graphs are shown in figure (b).



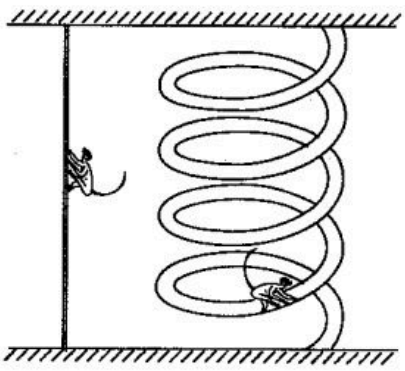
(a) (b)

The situation shown in figure (a) could have happened only if the areas in the graphs satisfy the conditions

(1) $ABD = DEF$ and $ABD = DEG$ (2) $BCD = DEF$ and $ABD = DFG$
(3) $CDB = DEG$ and $ABD = DEF$ (4) $BCD = ABD$ and $DEF = DFG$
(5) $ACD = DFG$ and $BCD = DFG$

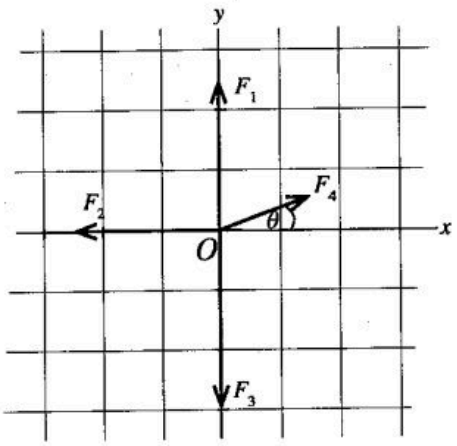
23. A monkey climbed a certain vertical height along a vertical rope with uniform speed in 30 seconds. (See figure.) Later the same monkey climbed the same **vertical** height along a spiral-path of 75 m path length with another uniform speed. If the monkey applied the same power throughout its motion in both cases, the speed with which the monkey has climbed the spiral path is

(1) $0.33\ m\ s^{-1}$ (2) $2.5\ m\ s^{-1}$ (3) $5\ m\ s^{-1}$
(4) $7.5\ m\ s^{-1}$ (5) $10\ m\ s^{-1}$



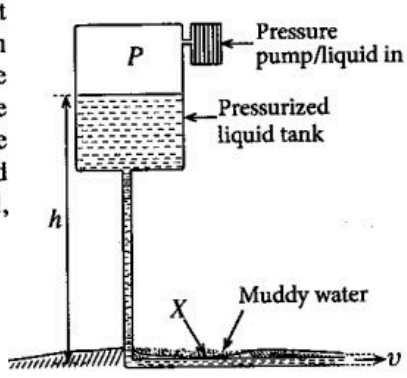
[See page five

24. In the figure shown F_1, F_2 and F_3 represent fixed vectors of three forces acting at the point O in the x-y plane. F_4 is a vector representing a rotating force about the point O in the same x-y plane. Which of the following best represents the **direction** of the resultant vector, when the vector F_4 is at angles $\theta = 0°$, 90°, and 180°?



	0°	90°	180°
(1)	→	←	→
(2)	←	←	←
(3)	←	→	→
(4)	→	←	←
(5)	←	→	←

25. A pipe line laid horizontally carries a liquid of density d at a constant speed v from a pressurized large over-head tank. Pipe line passes through a shallow region of muddy water as shown in the figure. Pressure above the liquid surface in the over-head tank is P and the atmospheric pressure is P_0. Suppose a small crack has been developed on the pipe at X. The condition for muddy water to seep into the pipe is (Assume that the liquid level in the tank is maintained at a constant height h from the ground, and that the seeping of muddy water does not change the speed v.)

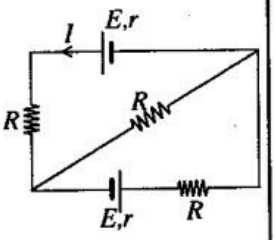


(1) $P + P_0 < hdg + \frac{1}{2}dv^2$ (2) $hdg - \frac{1}{2}dv^2 < P_0$

(3) $P + hdg - \frac{1}{2}dv^2 < P_0$ (4) $P + \frac{1}{2}dv^2 + hdg < P_0$

(5) $P + hdg < P_0$

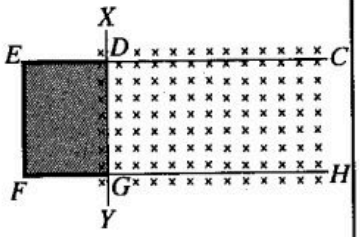
26. In the circuit shown, each cell has e.m.f. E and internal resistance r. Current I is given by



(1) $\frac{2E}{R+r}$ (2) $\frac{2E}{4R+r}$ (3) $\frac{E}{2(R+r)}$

(4) $\frac{E}{R+r}$ (5) 0

27. The part of a smooth horizontal loop $CDEFGH$ in the figure consists of a non-conducting part $DEFG$ and two conducting rails CD and GH. A thin straight conducting wire XY is placed on the rails and a soap film of surface tension T is formed in the region $DEFGD$. A magnetic field of flux density B is applied in the direction shown. The magnitude and the direction of the current needed to setup through DG in order to hold the soap film stationary is



(1) $\frac{T}{2B}$ in the direction of $D \to G$. (2) $\frac{2T}{B}$ in the direction of $G \to D$.

(3) $\frac{2T}{B}$ in the direction of $D \to G$. (4) $\frac{4T}{B}$ in the direction of $G \to D$.

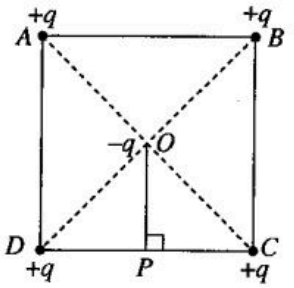
(5) $\frac{4T}{B}$ in the direction of $D \to G$.

28. If the coefficient of viscosity of all fluids is reduced below the existing value without reaching the conditions for turbulence, which of the following is **not** true?

(1) Liquid flow rates in narrow tubes will be higher.
(2) Heart may have to do less work to pump blood.
(3) Sucking cool drinks using a straw is easier.
(4) Resistance due to air drag on moving motor cars will decrease.
(5) Terminal speeds acquired by rain drops will become smaller.

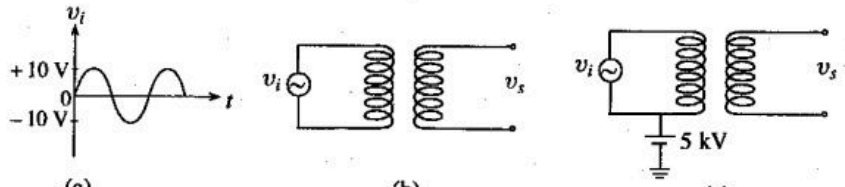
[See page six

29. Four charges each of $+q$ are fixed at the vertices of a square $ABCD$ as shown in the figure. A movable particle with charge $-q$ is placed at the centre O of the square. If the two charges at A and B are vanished simultaneously, which of the following is **not true** regarding the movement of the particle with charge $-q$? (Neglect the gravitational effects and the air resistance on the particle.)



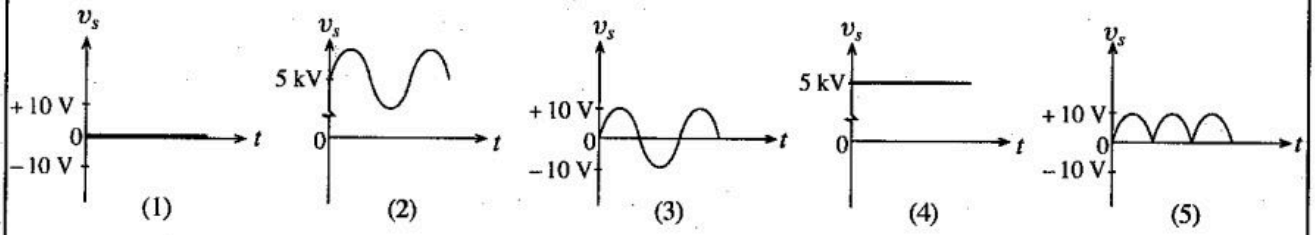
(1) It will begin to accelerate in the direction OP.
(2) Speed of the particle becomes maximum at P.
(3) Once it arrives at P from O, it will move a further distance of magnitude OP along OP direction.
(4) It will always have maximum acceleration at P.
(5) It will again return to O.

30. As shown in the figure (b), an alternating voltage source v_i producing the voltage waveform shown in figure (a) is connected to the primary circuit of a transformer. The primary circuit is now connected to a dc potential of 5 kV as shown in figure (c). Assume that the primary coil is well insulated electrically from the secondary coil.

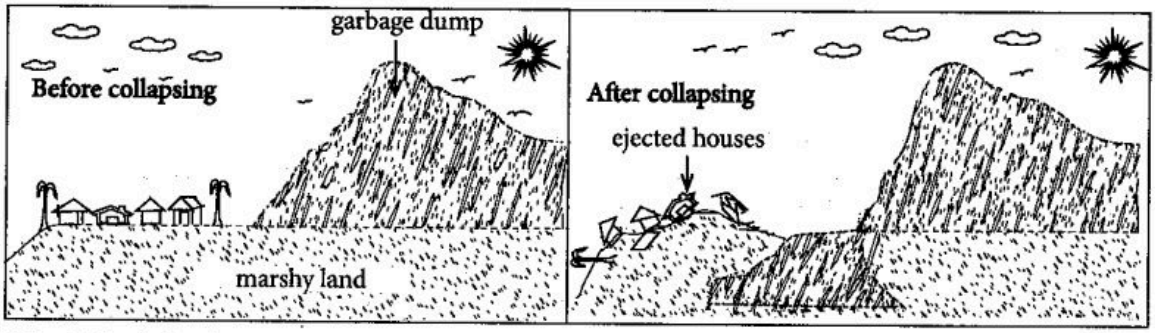


(a) (b) (c)

Which of the following figures correctly represents the voltage waveform v_s in figure (c) of the secondary circuit?



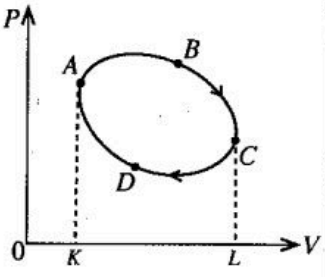
31. Part of a huge man-made garbage dump on a large marshy land suddenly collapsed and sank **ejecting nearby houses up** which had been built on the marshy land.



Which of the following physics principles that you have learnt is most suitable to understand the ejecting the houses up?

(1) Principle of flotation
(2) Principle of conservation of momentum
(3) Archimedes' principle
(4) Pascal's principle
(5) Principle of moments

32. A certain mass of an ideal gas is taken from A through a cyclic process $ABCDA$ as shown in the P–V diagram. Which of the following is **not** true?



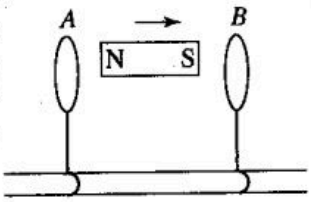
(1) Work done by the gas through the section of the path ABC is equal to the area $ABCLKA$.
(2) Net heat absorbed by the gas after completing the cycle is zero.
(3) Net work done by the gas after completing the cycle is equal to the area $ABCDA$.
(4) Net change in internal energy of the gas after completing the cycle is zero.
(5) Net change in temperature of the gas after completing the cycle is zero.

[See page seven

33. A flute maker produces a flute in a location where the speed of sound in air is 330 ms^{-1} so that when the note A is played, it occurs exactly at 440 Hz. A flutist plays note A with this flute in a different location where the speed of sound in air is 333 ms^{-1}. If a tuning fork of 440 Hz is sounded simultaneously with the note A of this flute, at the new location, how many beats per second will the flutist hear?

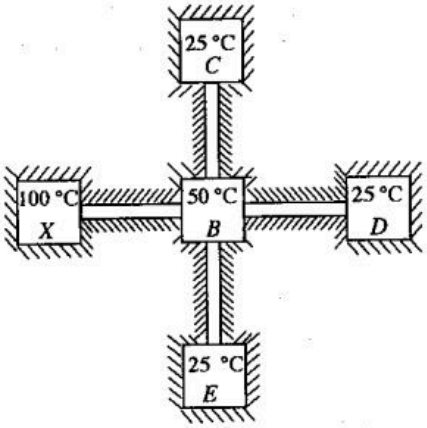
(1) 2 (2) 4 (3) 8 (4) 10 (5) 12

34. Two conducting loops A and B, made of a material that is not attracted to magnets are placed on a frictionless insulated rail as shown in the figure. The loops are free to move along the rail, and the planes of the loops are perpendicular to the rail. The two loops and the bar magnet kept between the loops are initially at rest. The bar magnet is then suddenly moved to the right as shown in the figure. As a result,



(1) both loops A and B move towards right.
(2) both loops A and B move towards left.
(3) loops A and B move towards each other.
(4) loops A and B move away from each other.
(5) both loops A and B will remain at rest.

35. Figure shows an insulated network of heat reservoirs X, B, C, D and E of which C, D and E are identical. The reservoir X operating at 100 °C supplies heat and maintains the four other reservoirs B, C, D and E at the temperatures shown. Heat is supplied by connecting the reservoirs with insulated heat conducting rods of same material and having identical areas of cross-section. Lengths of the rods are not drawn to the scale. If the length of the conducting rod between X and B is L, the length of the conducting rod between B and D will be



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

36. In an experiment to determine the specific latent heat of fusion (L) of ice using method of mixtures, a student obtained a value for L which is less than the standard value. Reasons for the lower value for L have been explained by the student with following statements.

(A) It may have been due to the dew being formed on the outer surface of the calorimeter while doing the experiment.
(B) Water on the pieces of ice may have not been properly wiped out before adding to the calorimeter.
(C) Temperature of the ice used may have been lower than 0 °C.

Of the above statements,

(1) only A can be accepted. (2) only B can be accepted.
(3) only A and B can be accepted. (4) only B and C can be accepted.
(5) all A, B and C can be accepted.

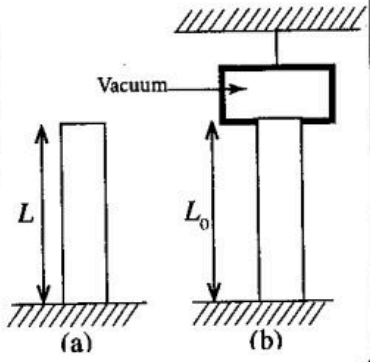
37. A person wearing sweated clothes of temperature 35 °C has to enter to one of the three large closed rooms X, Y and Z which are maintained at 40 °C, 35 °C and 20 °C, respectively. Assume that all the rooms are saturated with water vapour. Consider the following statements.

(A) If the person enters the room X, initially some of the sweat will begin to evaporate.
(B) If the person enters the room Y, sweat will not evaporate.
(C) If the person enters the room Z, initially some of the sweat will begin to evaporate.

Of the above statements,

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

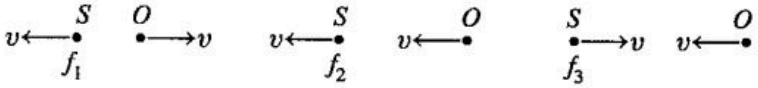
38. The height of a vertical uniform rod, when one end is firmly fixed to a horizontal surface in air as shown in figure (a) is L. Then the other end of the rod is kept in a vacuum chamber hung from the roof as shown in figure (b). Assume that the chamber does not exert any force at contact points with the rod. Y is the Young's modulus of the material of the rod and P_0 is the atmospheric pressure. If L_0 is the height of the rod in figure (b), then the ratio $\frac{L}{L_0}$ is given by



(1) $1-\frac{P_0}{Y}$ (2) $\left(1-\frac{P_0}{Y}\right)^{-1}$ (3) $\frac{P_0}{Y}-1$
(4) $\frac{P_0}{Y}+1$ (5) $1-\frac{Y}{P_0}$

[See page eight

39. The figures (A), (B) and (C) show a moving sound source S producing different frequencies f_1, f_2 and f_3 at three different situations. O is an observer carrying a sound frequency detector. Speed and the direction of motion of the source and the observer in each situation are shown in the figures. If the detector detects the same value for the frequency in all three situations,

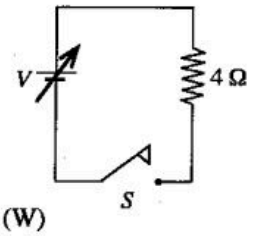


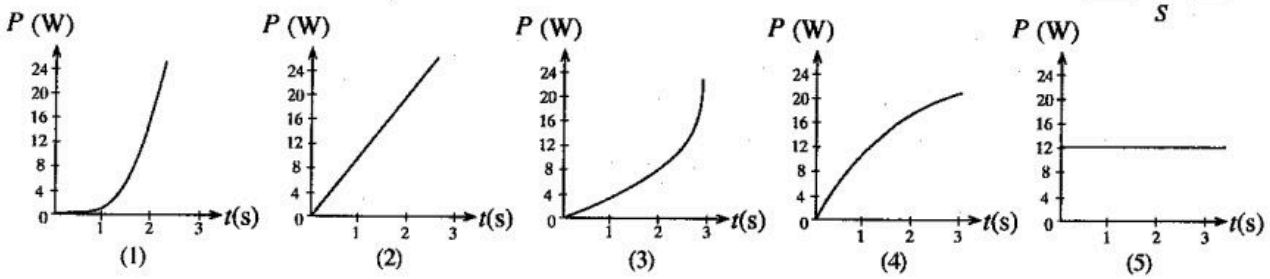
(A) (B) (C)

the frequencies produced by the sound source when arranged in the ascending order is

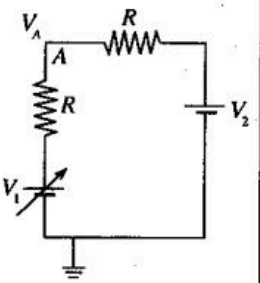
(1) f_1, f_2, f_3 (2) f_3, f_2, f_1 (3) f_1, f_3, f_2 (4) f_2, f_3, f_1 (5) f_2, f_1, f_3

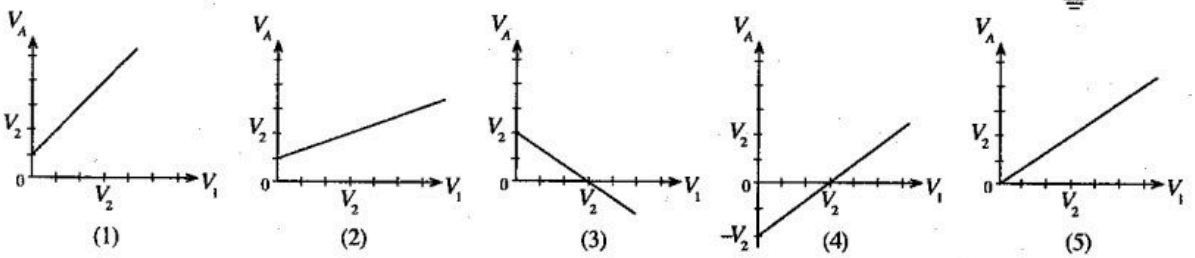
40. When the switch S in the circuit is closed at time $t = 0$, the voltage V of the power supply varies with time (t) according to the equation $V = Kt^2$, where the magnitude of K is 2. The variation of the power dissipation (P) in the 4 Ω resistor with time (t) is best represented by



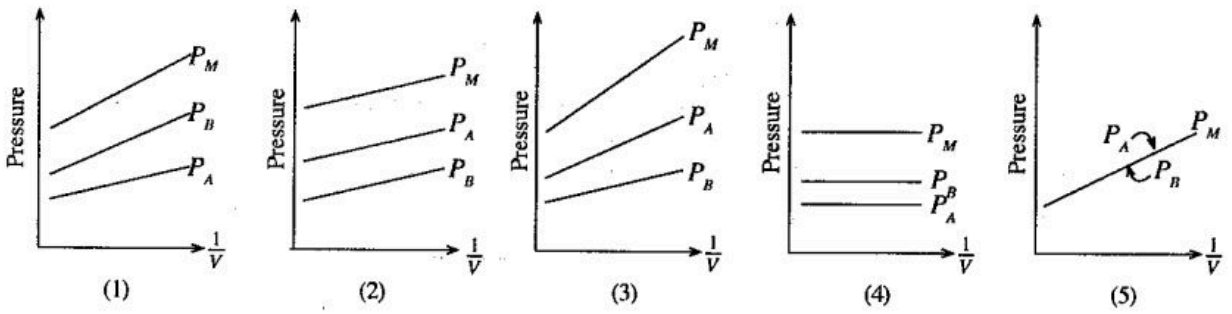


41. In the circuit shown V_1 is a variable voltage provided by a battery. Variation of the potential V_A at point A with respect to the earth, with V_1 is best represented by (Neglect the internal resistances of both power supplies.)



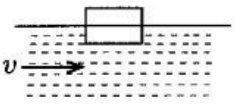


42. A volume V of a mixture of ideal gases contains n_A moles of gas A and $n_B (< n_A)$ moles of gas B at a constant temperature. The variation of the partial pressures P_A and P_B of the gases A and B respectively, and the overall pressure P_M of the mixture with $\frac{1}{V}$ at the above constant temperature is best represented in



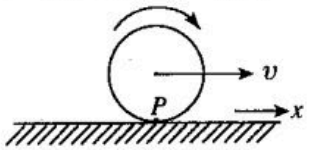
[See page nine

43. A river flows steadily at a constant velocity v. A rectangular block of wood having density less than that of water is first held above the surface of water so that it is stationary with respect to the riverbank, and then slowly lowered to the water until the floating condition is achieved and then released it, as shown in figure. Assume that the initial speed of the wooden block in the direction of v is zero. During the subsequent motion of the block, which of the following is true for magnitudes of the impulsive force acting on the block, the viscous force acting on the block by water, and the momentum of the block? (Neglect effect due to air drag.)

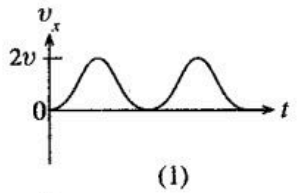


	Impulsive force	Viscous force	Momentum
(1)	Decreases from a higher value to zero	Increases and becomes constant	Decreases from a higher value to zero
(2)	Increases and becomes constant	Decreases from a higher value to zero	Increases and becomes constant
(3)	Decreases from a higher value to zero	Increases and becomes constant	Increases and becomes constant
(4)	Increases and becomes constant	Increases and becomes constant	Decreases from a higher value to zero
(5)	Decreases from a higher value to zero	Decreases from a higher value to zero	Increases and becomes constant

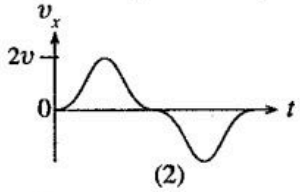
44. A uniform solid wheel rolls along a flat surface at a uniform velocity v without slipping as shown in the figure. P is a point on the circumference of the wheel. Location of the point P at $t = 0$ is also shown in the figure.



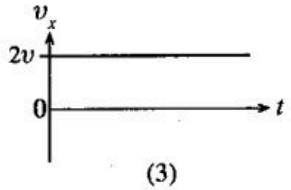
Variation of the horizontal component of the velocity (v_x) of the point P with respect to the surface with time (t) is best represented by



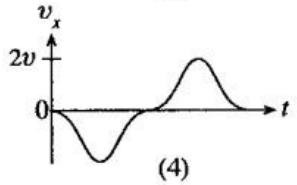
(1)



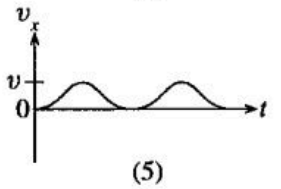
(2)



(3)



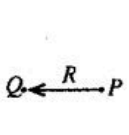
(4)



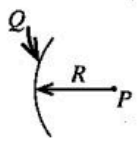
(5)

45. Figures (A), (B) and (C) show distributions of a positive charge Q in three situations. In figure (A), charge Q exists as a point charge placed at a distance R from point P. In figure (B), the charge Q is uniformly distributed in the form of a thin circular arc of radius R with its centre located at point P. In figure (C), charge Q is uniformly distributed in the form of a thin ring of radius R, with its centre at point P. If the potentials, and the magnitudes of the intensity of the electric fields at points P in the situations (A), (B) and (C) are V_A, V_B, V_C, and E_A, E_B, E_C respectively, which of the answers given is true?

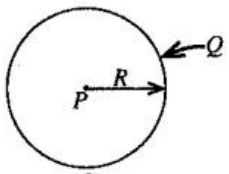
	Potentials at points P	Magnitudes of the intensity of the electric fields at points P
(1)	$V_A > V_B > V_C$	$E_A > E_B > E_C$
(2)	$V_A > V_B > V_C$	$E_C > E_B > E_A$
(3)	$V_A = V_B = V_C$	$E_A = E_B = E_C$
(4)	$V_A = V_B = V_C$	$E_A = E_C > E_B$
(5)	$V_A = V_B = V_C$	$E_A > E_B > E_C$



(A)

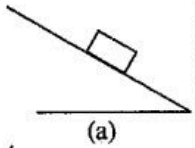


(B)

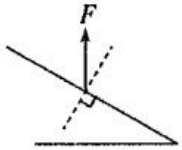


(C)

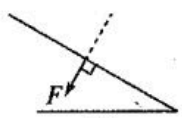
46. A rectangular block rests on an inclined plane as shown in figure (a). The direction of the resultant force F exerted on the inclined plane by the block is best represented by



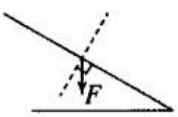
(a)



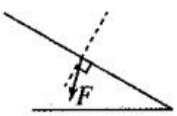
(1)



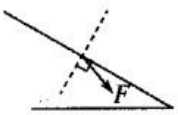
(2)



(3)



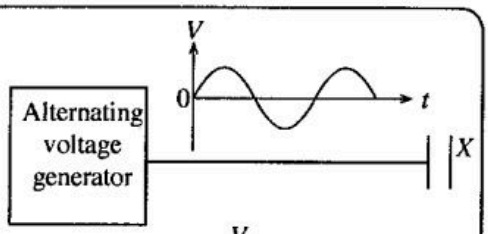
(4)

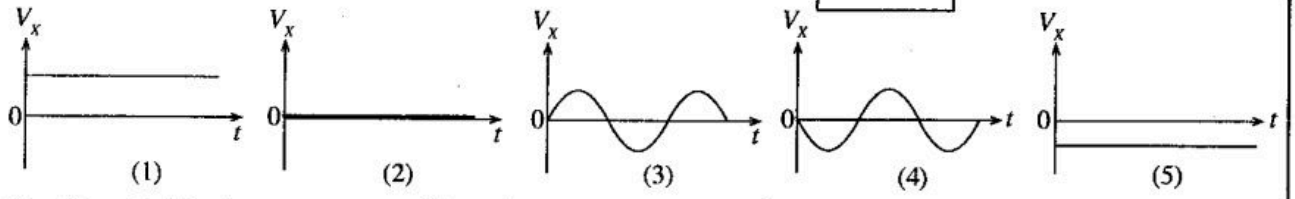


(5)

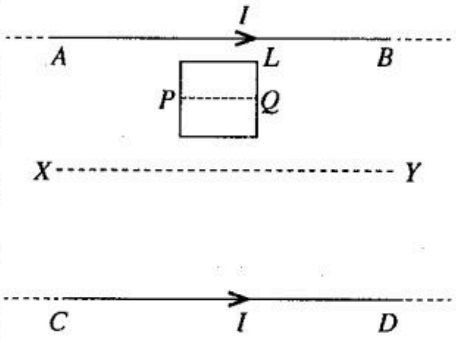
[See page ten

47. Variation of the output potential (V) with time (t) of an alternating voltage generator connected to one plate of an uncharged parallel plate capacitor is shown in the figure. The other plate X of the capacitor is kept unconnected. The variation of the potential (V_X) of the plate X with time (t) is best represented by





48. AB and CD represent two parallel straight long conducting wires fixed to a horizontal plane and carrying current I in each of them. L is a conducting square loop placed on the same horizontal plane, as shown in the figure. XY is the centre line between AB and CD. Consider the following statements made when the loop L is moving towards CD on the same plane at a constant speed.



(A) The induced current in the loop gradually increases as it moves toward XY.

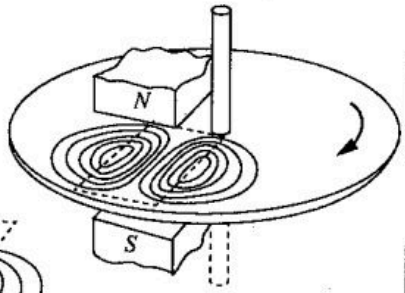
(B) The direction of the induced current in the loop is always clock-wise.

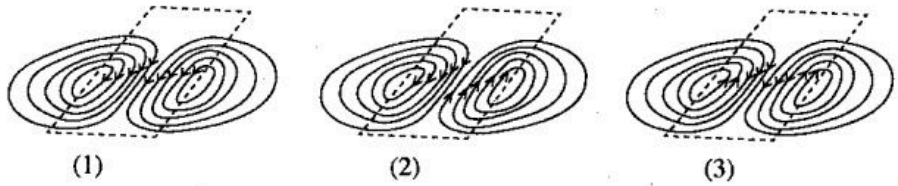
(C) The induced current in the loop is zero at the instant when the centre line PQ of the loop passes through the line XY.

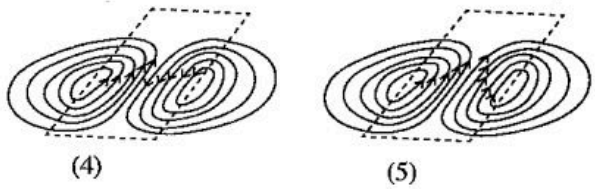
Of the above statements,

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

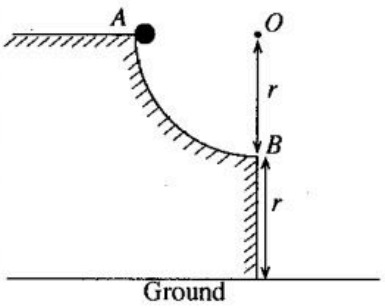
49. A metal disc rotates in the clock-wise direction between north and south poles of a magnet as shown in the figure. The magnet produces a magnetic flux confined to a small region shown with dotted lines. Magnetic field produced is perpendicular to the plane of the disc. Which of the following figures shows the correct direction of the current in the eddy-current loops which are produced in this situation?







50. A small sphere is released from rest from point A in a firmly fixed frictionless track, which is a quarter of a circular path of centre O and radius r as shown in the figure. The sphere leaves the track horizontally at point B and falls under gravity until it hits the ground at a certain point C (C not shown). If the times taken and the distances travelled by the sphere from A to B and B to C are t_{AB}, t_{BC} and S_{AB}, S_{BC} respectively, which of the following is true?



(1) $t_{AB} > t_{BC}$ and $S_{AB} < S_{BC}$
(2) $t_{AB} > t_{BC}$ and $S_{AB} > S_{BC}$
(3) $t_{AB} = t_{BC}$ and $S_{AB} < S_{BC}$
(4) $t_{AB} < t_{BC}$ and $S_{AB} = S_{BC}$
(5) $t_{AB} = t_{BC}$ and $S_{AB} = S_{BC}$

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