ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව / இலங்கைப் பரீட்சைத் திணைக்களம் / Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2001 අගෝස්තු
கல்விப் பொதுத் தராதரப்பத்திர(உயர் தர)ப் பரீட்சை, 2001 ஒகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2001

භෞතික විද්‍යාව I
பௌதிகவியல் I
Physics I

01
E | I

පැය දෙකයි / இரண்டு மணித்தியாலம் / Two hours

Important :
- ✻ *This question paper includes* **60** *questions in* ***fourteen*** *pages.*
- ✻ *Enter your* ***Index Number*** *in the space provided on the answer sheet.*
- ✻ ***Answer all the questions.***
- ✻ *Instructions are given on the back of the answer sheet. Follow them carefully.*
- ✻ *In each of the questions* **1** *to* **60**, *pick one of the alternatives* (1), (2), (3), (4), (5) *which is* ***correct or most appropriate*** *and mark your response on the answer sheet* ***in accordance with the instructions given therein.***

Use of calculators is not allowed.

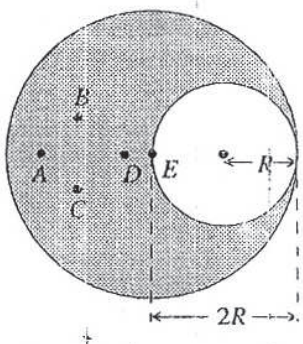
(g = 10 N kg^{-1})

1. eV (electron-volt) is a unit of
   (1) power. (2) energy. (3) charge.
   (4) voltage. (5) potential difference.

2. A sound with intensity 10^{-12} W m^{-2} is defined to have an intensity level of 0 decibels. The intensity level of a sound of intensity 10^{-8} W m^{-2} is
   (1) −40 dB. (2) 20 dB. (3) 40 dB. (4) 60 dB. (5) 80 dB.

3. Two particles A and B have equal momenta, but the velocity of the particle B is four times that of A. The ratio $\frac{\text{kinetic energy of } A}{\text{kinetic energy of } B}$ is
   (1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) 1 (4) 2 (5) 4

4. A uniform circular plate of radius $2R$ has a circular hole of radius R cut out of it as shown in the figure. The centre of gravity of the plate with the hole is most likely to be found at
   (1) A
   (2) B
   (3) C
   (4) D
   (5) E



5. Consider the following statements made about infrared, ultraviolet, X-rays, radio waves and gamma rays.
   (A) All of them are electromagnetic waves.
   (B) All of them travel with the same speed in free space.
   (C) Radio waves have the longest wavelength.

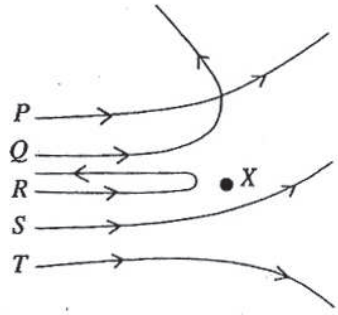
   Of the above statements
   (1) only (A) is true. (2) only (A) and (B) are true.
   (3) only (A) and (C) are true. (4) only (B) and (C) are true.
   (5) all (A), (B) and (C) are true.

6. The mercury column rises in a mercury-in-glass thermometer when the temperature is raised. The most appropriate reason for this is
   (1) mercury is a good conductor of heat.
   (2) glass is a poor conductor of heat.
   (3) glass expands when heated.
   (4) glass expands less than mercury when heated.
   (5) mercury expands uniformly with rise in temperature.

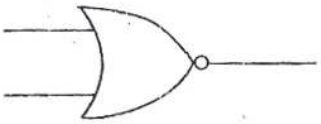
7. The electrical energy stored in a 1 μF capacitor connected across a 2 V cell is
   (1) 5×10^{-7} J (2) 1×10^{-6} J (3) 2×10^{-6} J (4) 4×10^{-6} J (5) 6×10^{-6} J

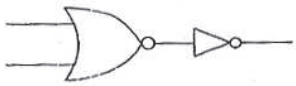
8. The mass and radius of the earth is M and R respectively. The escape velocity of a rocket of mass m on the earth surface is
   (1) $\sqrt{\frac{2GM}{R}}$ (2) $\sqrt{\frac{GM}{R}}$ (3) $\frac{\sqrt{2GM}}{R}$ (4) $\frac{\sqrt{GM}}{R}$ (5) $\sqrt{\frac{2GmM}{R}}$

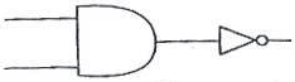
9. A proton is fired at an atomic nucleus (X). Which one of the paths shown in the diagram is **not** possible for the proton?
   (1) P (2) Q
   (3) R (4) S
   (5) T

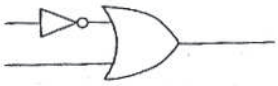


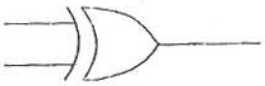
10. The gate shown in the figure is equivalent to

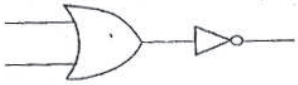



(1)


(2)


(3)


(4)


(5)

11. In the equation $v^i = ka^j s$, v represents the velocity, a represents the acceleration and s represents the displacement. k is a constant and i and j are integers. What should be the values of i and j in order to make the equation dimensionally correct?
   (1) 1, 1 (2) 1, 2 (3) 2, 1 (4) 2, 2 (5) 2, 3

12. A train travels along a straight track. Another train travels in the same direction behind the first train at the same speed. The first train blows a whistle of frequency f_0. If the apparent frequency of the whistle heard by a stationary passenger sitting in the second train is f, then
   (1) $f > f_0$ (2) $f < f_0$ (3) $f = f_0$ (4) $f = 2f_0$ (5) $f = \frac{1}{2}f_0$

13. A 50 cm long hollow cylindrical tube open at both ends is placed in air. A sound source that produces pure tones is placed adjacent to one end of the tube. The frequency of the emitted sound is increased gradually starting from a very low value. At a frequency of 320 Hz, the tube resonates. The speed of sound in air is
   (1) 160 m s^{-1} (2) 320 m s^{-1} (3) 340 m s^{-1} (4) 360 m s^{-1} (5) 640 m s^{-1}

14. The velocity of sound in a gas at 27°C is V. The temperature at which the velocity of sound in the gas becomes $2V$ is
   (1) 54°C (2) 108°C (3) 600°C (4) 927°C (5) 1200°C

15. A convex lens of focal length 25 cm is kept in contact with a concave lens of focal length 10 cm. The power of the lens combination in diopters is
(1) 4 (2) 6 (3) 10 (4) 14 (5) 15

16. The viscous force acting on a sphere moving in a fluid is
(A) directly proportional to the velocity of the sphere.
(B) directly proportional to the mass of the sphere.
(C) inversely proportional to the radius of the sphere.

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) only (A), (B) and (C) are true.

17. A monochromatic ray of light undergoes minimum deviation after passing through a prism. If the angle of deviation produced by one of the prism surfaces is 20°, the angle of minimum deviation of the ray is
(1) 10° (2) 20° (3) 30° (4) 40° (5) 60°

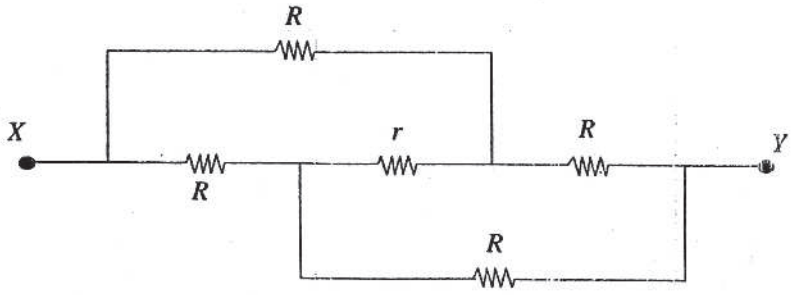
18. A person who is long sighted has near point at 50 cm. What spectacles are required for him to view objects comfortably at 25 cm?
(1) Converging lens of focal length 100 cm
(2) Diverging lens of focal length 100 cm
(3) Converging lens of focal length 50 cm
(4) Diverging lens of focal length 50 cm
(5) Converging lens of focal length 25 cm

19. An electric heater is used to raise the temperature of water from 20°C to 30°C and supply hot water at a rate of 1 kg per minute. The minimum power of the heating element is
(specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$)
(1) 7 W (2) 70 W (3) 700 W (4) 4200 W (5) 8400 W

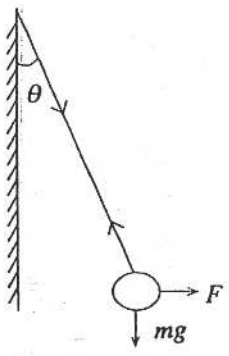
20. Relative humidity inside a closed chamber can be increased by
(A) adding water vapour to the chamber.
(B) by decreasing the temperature inside the chamber.
(C) by decreasing the volume of the chamber.

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.

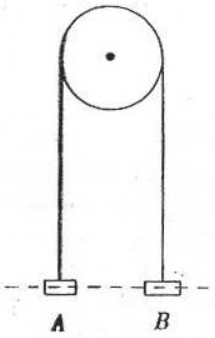
21. The equivalent resistance between X and Y in the network of resistances shown is
(1) r
(2) R
(3) $2R$
(4) $2R + r$
(5) $4R + r$



22. An object of mass m is hung by a string and is kept in equilibrium as shown in the diagram by a horizontal force F. The magnitude of F is
(1) $mg \tan\theta$ (2) $mg \sin\theta$
(3) mg (4) $mg \cos\theta$
(5) $\frac{mg}{\tan\theta}$

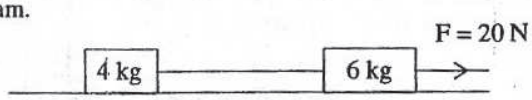


23. Two equal masses A and B are attached to a light inextensible string passing over a smooth light pulley as shown in the diagram. The mass B is moved down, held it stationary and then released it. Which of the following statements is correct for the subsequent motion of B?



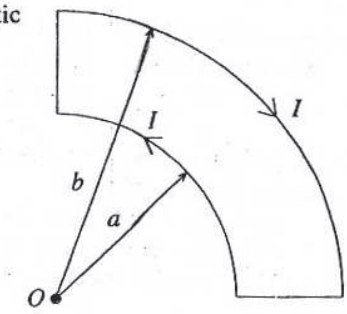
(1) B will move back to the original position.
(2) B will start to oscillate up and down and come to rest.
(3) B will stay stationary.
(4) B will start to move downwards.
(5) B will start to move upwards.

24. Two masses joined by a light string are pulled along a smooth horizontal table as shown in the diagram.



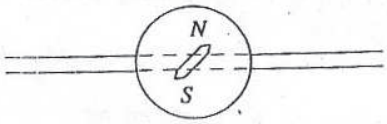
What is the tension in the string joining the masses?
(1) 4 N (2) 8 N (3) 12 N (4) 20 N (5) 30 N

25. A current I flows around a closed loop as shown in the figure. The magnetic flux density produced at the centre O is given by

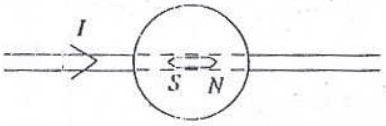


(1) $\frac{\mu_0 I}{2}\left(\frac{1}{a}+\frac{1}{b}\right)$ (2) $\frac{\mu_0 I}{4}\left(\frac{1}{a}+\frac{1}{b}\right)$
(3) $\frac{\mu_0 I}{8}\left(\frac{1}{a}+\frac{1}{b}\right)$ (4) $\frac{\mu_0 I}{8}\left(\frac{1}{a}-\frac{1}{b}\right)$
(5) $\frac{\mu_0 I}{16}\left(\frac{1}{a}-\frac{1}{b}\right)$

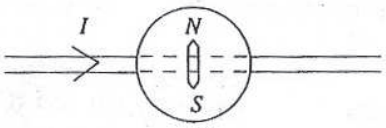
26. A compass is placed on top of a wire as shown in the diagram.



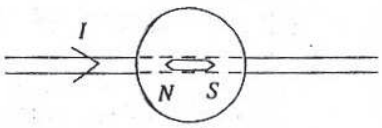
When a large current is passed through the wire, which one of the following diagrams best represents the direction of the compass needle? Neglect the effects due to the earth's magnetic field.



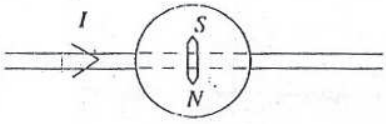
(1)



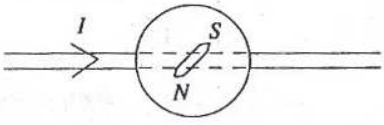
(2)



(3)



(4)



(5)

27. Radioactive $^{234}_{90}\text{Th}$ nucleus emits two β^- emissions followed by an α emission. The resulting nucleus will have

(1) 86 protons and 140 neutrons.
(2) 88 protons and 140 neutrons.
(3) 90 protons and 140 neutrons.
(4) 90 protons and 142 neutrons.
(5) 96 protons and 142 neutrons.

28. A fossil is found to be 72,000 years old by carbon –14 dating. If the half life of ^{14}C is 6,000 yrs, the ratio $\frac{\text{amount of } ^{14}C \text{ present in the fossil}}{\text{amount of } ^{14}C \text{ present in living tissue}}$ is

(1) $\frac{1}{2}$ (2) $\frac{1}{2^3}$ (3) $\frac{1}{2^5}$ (4) $\frac{1}{2^{12}}$ (5) $\frac{1}{2^{16}}$

29. An astronomical telescope has an eyepiece of focal length 5 cm. At normal adjustment the separation between the eyepiece and the objective is 85 cm. The angular magnification of the telescope at normal adjustment is

(1) 90 (2) 85 (3) 80 (4) 17 (5) 16

30. A uniform elastic wire is suspended vertically from the ceiling and a mass is hung from the bottom end. Consider the following statements assuming that the proportional limit of the wire is not exceeded.

(A) If the length of the wire is doubled, the strain in the wire doubles.
(B) If the area of cross section of the wire is doubled, the strain in the wire doubles.
(C) If the hung mass is doubled, the strain in the wire doubles.

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.

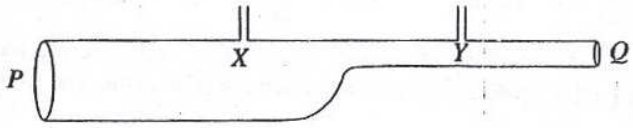
31. A steel razor blade can be made to stay on the surface of water. Consider the following statements regarding this.

(A) Staying of the steel razor blade on the surface of water contradicts the Archimede's principle because there is no upthrust acting on the blade.
(B) The steel razor blade is kept on the surface of water by the forces due to the surface tension of water.
(C) Adding soap to water would cause the steel razor blade to sink because soap reduces the surface tension of water.

Of the above statements

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

32.



Air flows through the tube PQ at a constant rate. Two ping-pong balls are levitated in equilibrium above the tiny vertical tubes X and Y through which the air escapes. The heights of the two balls from the tube at equilibrium are h_x and h_y respectively. Which one of the following statements is true?

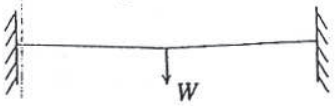
(1) If air flows from P to Q, $h_x > h_y$
(2) If air flow from P to Q, $h_x = h_y$
(3) If air flows from P to Q, $h_x < h_y$
(4) If air flows from Q to P, $h_x = h_y$
(5) If air flows from Q to P, $h_x < h_y$

33. An object moves along a horizontal circular path on the inner surface of a smooth conical shaped vessel, as shown in the figure. The force/ forces acting on the object as observed by a stationary observer is/are



(1) weight of the object only.
(2) weight of the object and reaction force normal to the surface only.
(3) weight of the object and centripetal force only.
(4) reaction force normal to the surface and centripetal force only.
(5) centripetal force only.

34. A weight W is hung on a tightly fixed rope as shown in the diagram.



The tension in the rope is

(1) approximately W (2) approximately $\frac{W}{2}$ (3) less than $\frac{W}{2}$

(4) in-between $\frac{W}{2}$ and W (5) much greater than W

35. A child of mass 20 kg is sitting on a swing of negligible mass. The swing is attached to its pivot points by two ropes, each of 3 m length. The maximum speed of the child during a swing is found to be $3\ m\ s^{-1}$. The maximum tension in each rope is

(1) 130 N (2) 160 N (3) 200 N (4) 260 N (5) 300 N

36. A given mass of water is in a calorimeter. When a 90 W heater is immersed in water, the temperature of water increases and comes to a steady value at 35°C. If a 180 W heater is used, the steady temperature is 45°C. What should be the room temperature?

(1) 10°C (2) 15°C (3) 20°C (4) 25°C (5) 30°C

37. If an object is placed on the principal axis 31 cm from a concave mirror the image formed is slightly smaller than the object. If the object is placed 29 cm from the mirror the image formed is slightly larger than the object. The approximate focal length of the mirror is

(1) 7·5 cm (2) 15 cm (3) 28 cm (4) 30 cm (5) 32 cm

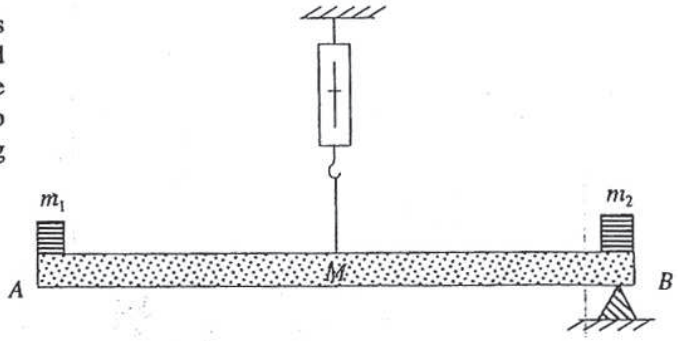
38. A glass cube of side 24 cm and refractive index 1·5 contains a small air bubble. When viewed through the block from one side, the air bubble appears to be 12 cm from that side. When viewed from the opposite side, how far will the air bubble appear from that side?

(1) 16 cm (2) 12 cm (3) 8 cm (4) 6 cm (5) 4 cm

39. A rocket carries $1{\cdot}8 \times 10^4$ kg of liquid oxygen in a vertical tank of cross section $3{\cdot}0\ m^2$. At the lift-off the rocket accelerates vertically upward at $2{\cdot}0\ m\ s^{-2}$ relative to the earth. The pressure on the bottom of the tank at the lift-off is

(1) $1{\cdot}2 \times 10^3\ N\ m^{-2}$ (2) $7{\cdot}2 \times 10^3\ N\ m^{-2}$ (3) $1{\cdot}2 \times 10^4\ N\ m^{-2}$
(4) $6{\cdot}0 \times 10^4\ N\ m^{-2}$ (5) $7{\cdot}2 \times 10^4\ N\ m^{-2}$

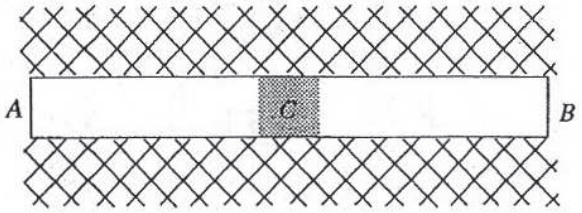
40. A uniform bar of mass M is suspended from its midpoint by a spring balance. Two masses m_1, and m_2 ($m_2 > m_1$) are placed at the two ends of the bar. A wedge supports the bar at the end B to keep it horizontally as shown in the figure. The reading of the spring balance is



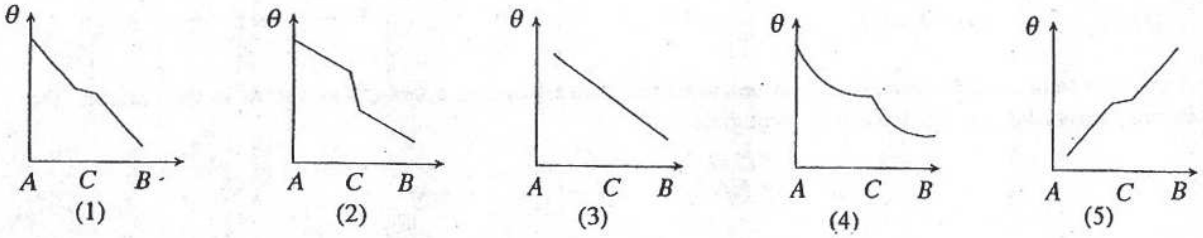
(1) 0 (2) $m_1 g$
(3) $(M+m_1)g$ (4) $(M+2m_1)g$
(5) $(M+m_1+m_2)g$

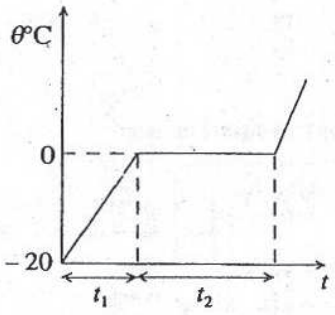
41. The frequency of a tuning fork is 256 Hz. When it sounded with a sonometer wire, 3 beats per second were heard. When the tension of the wire was reduced, again 3 beats per second were heard. The frequency of the sonometer wire after reducing the tension is

(1) 250 Hz (2) 253 Hz (3) 256 Hz (4) 259 Hz (5) 262 Hz

42. 

The rod AB is made by connecting two identical metal rods with a thin piece of a poorly conducting material C as shown in the figure. The rod is well lagged except at the two ends. If a steady heat flow in maintained from A to B, the variation of the temperature (θ) along the rod is best represented by



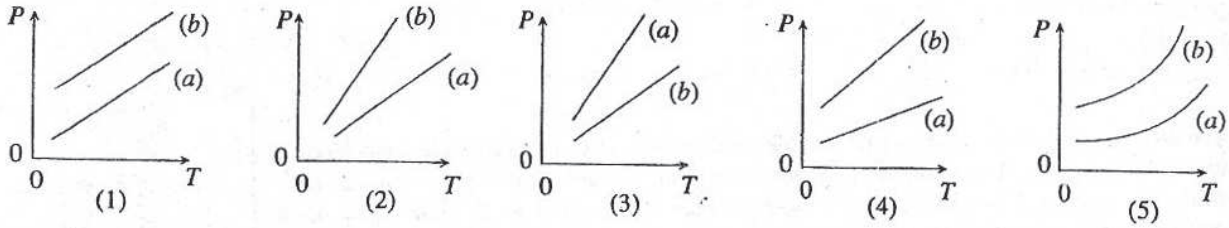
43. 

Heat is supplied at a constant rate to a certain amount of ice. The variation of temperature θ with time t is shown in the figure. If the specific heat capacity of ice is C and specific latent heat of fusion of ice is L, $\frac{t_2}{t_1}$ ratio is

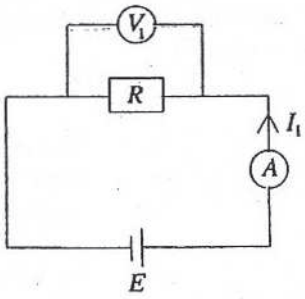
(1) $\frac{L}{C}$ (2) $\frac{C}{L}$ (3) $\frac{20L}{C}$

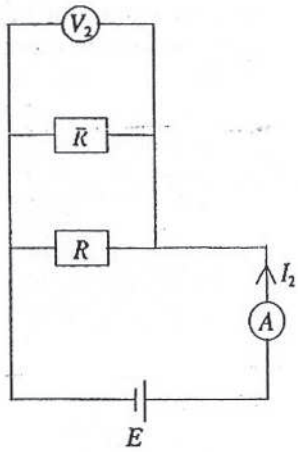
(4) $\frac{L}{20C}$ (5) $\frac{LC}{20}$

44. An ideal gas is kept inside a rigid container. Then another ideal gas is added into the container. The variations of pressure (P) inside the container with the absolute temperature (T) before adding the second gas *(a)* and after adding the second gas *(b)* are best represented by



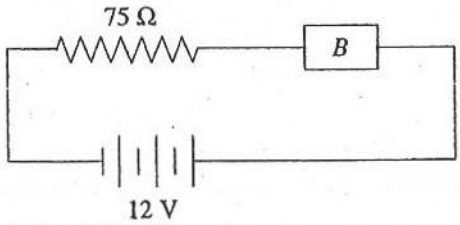
45. Consider the following two circuit diagrams. V_1 and V_2 are voltmeter readings and I_1 and I_2 are ammeter readings. If the voltmeters and ammeters are ideal and the internal resistance of the cells are negligible which of the following is true?



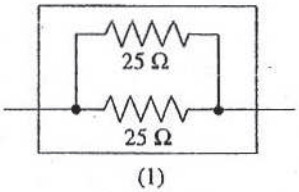


(1) $V_2 = V_1$ and $I_2 > I_1$
(2) $V_2 = V_1$ and $I_2 < I_1$
(3) $V_2 > V_1$ and $I_2 > I_1$
(4) $V_2 > V_1$ and $I_2 < I_1$
(5) $V_2 = V_1$ and $I_2 = I_1$

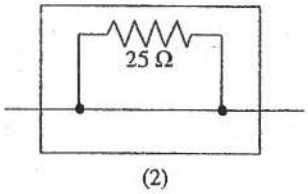
46. A circuit contains 75 Ω resistor and an unknown resistor/resistors in a box (B) as shown in the diagram. The internal resistance of the battery is negligible.



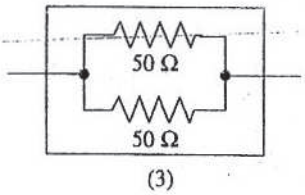
If the voltage across 75 Ω is 9 V, which of the following represents the unknown resistor/resistors?



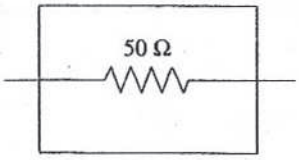
(1)



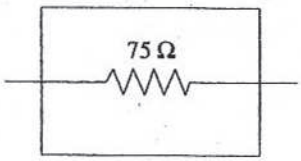
(2)



(3)

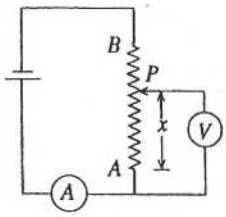


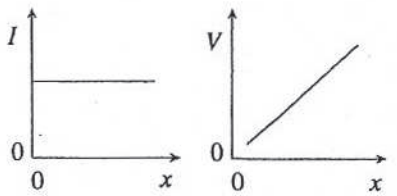
(4)



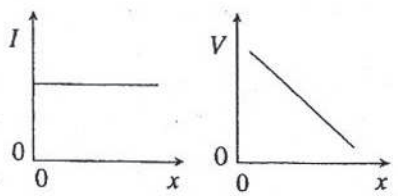
(5)

47. The diagram shows a resistance (AB), an ideal voltmeter and an ideal ammeter connected to a voltage source. The voltmeter reading (V) and the ammeter reading (I) were taken while the contact P is sliding along the resistance AB from A to B. Which pair of graphs would correctly represents the variation of I and V with x?

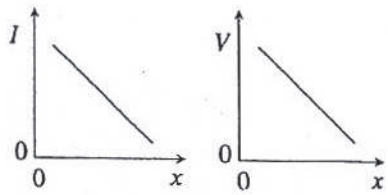




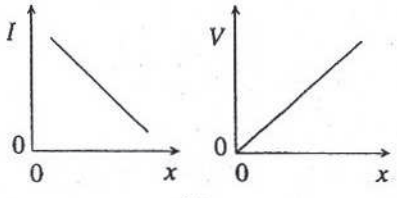
(1)



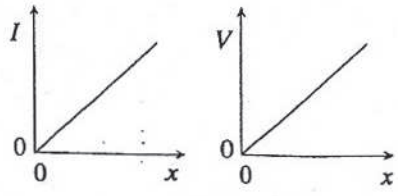
(2)



(3)

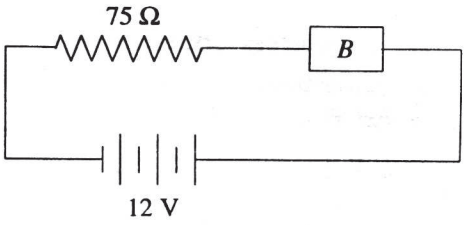


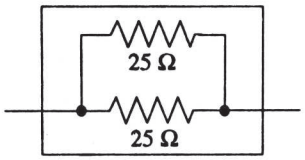
(4)



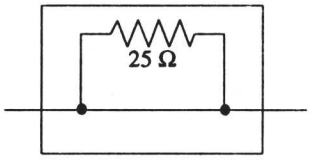
(5)

46. පරිපථයක රූපයේ පෙන්වා ඇති අයුරු 75 Ω ප්‍රතිරෝධයක් සහ පෙට්ටියක (*B*) අඩංගු නොදන්නා ප්‍රතිරෝධයක්/ප්‍රතිරෝධ යුක්ත වේ. බැටරියේ අභ්‍යන්තර ප්‍රතිරෝධය නොසලකා හැරිය හැක. 75 Ω ප්‍රතිරෝධය හරහා විභව අන්තරය 9 V නම් පහත සඳහන් කුමක් නොදන්නා ප්‍රතිරෝධය/ප්‍රතිරෝධ නිරූපණය කරයි ද?

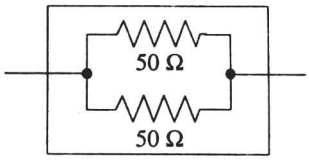




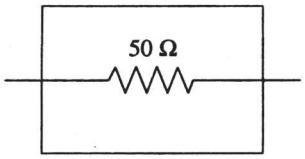
(1)



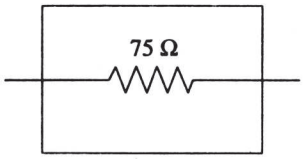
(2)



(3)

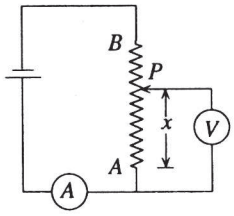


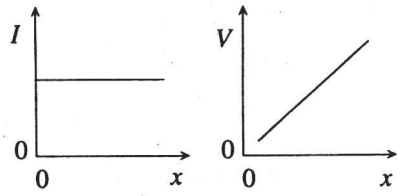
(4)



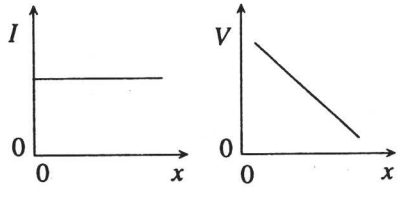
(5)

47. ප්‍රතිරෝධයක් (*AB*), පරිපූර්ණ වෝල්ට්මීටරයක්, පරිපූර්ණ ඇමීටරයක් සහ වෝල්ටීය සැපයුමක් රූප සටහනේ පෙනෙන අයුරු සම්බන්ධ කර ඇත. *P* ස්පර්ශක යතුර *A* සිට *B* දක්වා *AB* දිගේ සර්පණය කරමින් වෝල්ට්මීටරයේ පාඨාංකය (*V*) සහ ඇමීටරයේ පාඨාංකය (*I*) ලබාගන්නා ලදී. පහත දී ඇති කුමන ප්‍රස්තාර යුගලය මගින් *x* සමග *I* හා *V* හි විචලනය වඩාත්ම හොඳින් නිරූපණය කරන්නේ ද?

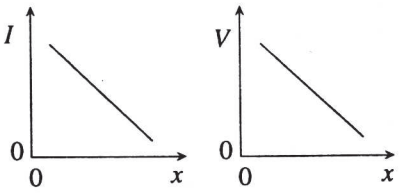




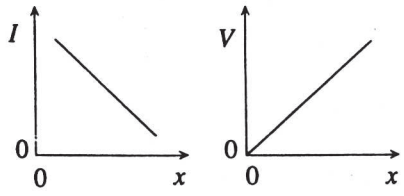
(1)



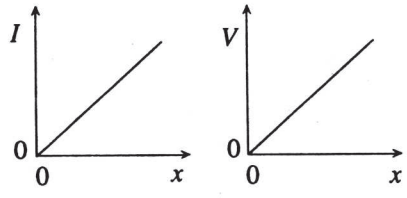
(2)



(3)



(4)

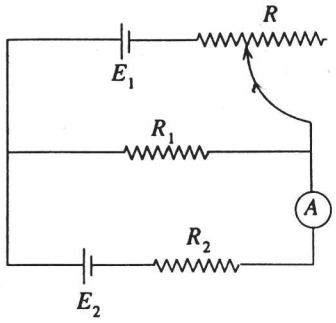


(5)

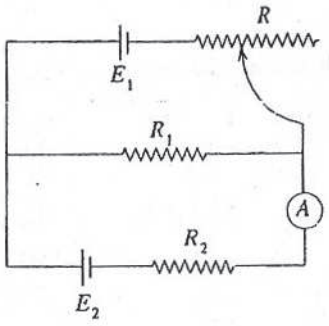
48. පෙන්වා ඇති පරිපථයේ ඇති වි.ගා. බල E_1 සහ E_2 ($E_1 > E_2$) වන කෝෂ දෙකෙහි නොගිණිය හැකි අභ්‍යන්තර ප්‍රතිරෝධ ඇත. *A* ඇමීටරයේ පාඨාංකය ශූන්‍ය වනුයේ *R* හි කුමන අගයකට ද?

(1) $\frac{E_1}{E_2} R_2$ (2) $\left(\frac{E_1 + E_2}{E_1}\right) R_1$ (3) $\left(\frac{E_1 - E_2}{E_1}\right) R_1$

(4) $\left(\frac{E_1 + E_2}{E_2}\right) R_1$ (5) $\left(\frac{E_1 - E_2}{E_2}\right) R_1$



48. The two cells of e.m.f.'s E_1 and E_2 $(E_1 > E_2)$ shown in the circuit have negligible internal resistance. For what value of R will the ammeter A reads zero current?



(1) $\frac{E_1}{E_2} R_2$

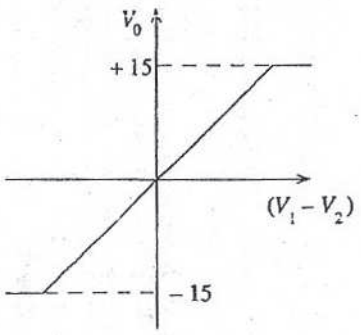
(2) $\left(\frac{E_1 + E_2}{E_1}\right) R_1$

(3) $\left(\frac{E_1 - E_2}{E_1}\right) R_1$

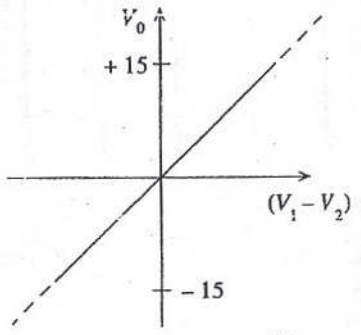
(4) $\left(\frac{E_1 + E_2}{E_2}\right) R_1$

(5) $\left(\frac{E_1 - E_2}{E_2}\right) R_1$

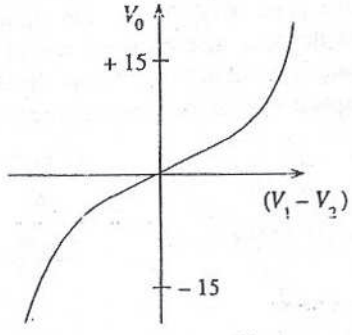
49. A 741 operational amplifier is powered with supply voltages of ± 15 V. If V_1 and V_2 represent the input voltages and V_0 represents the output voltage, the variation of V_0 with $(V_1 - V_2)$ is best represented by



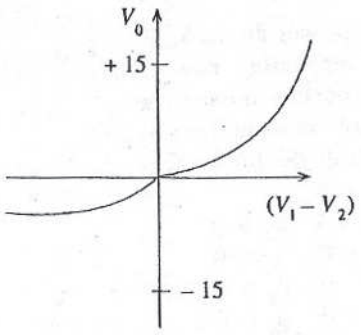
(1)



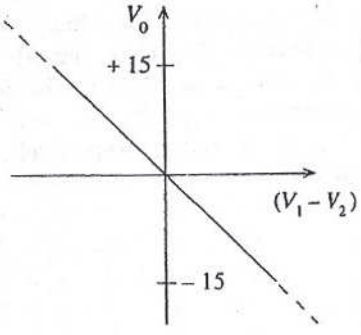
(2)



(3)

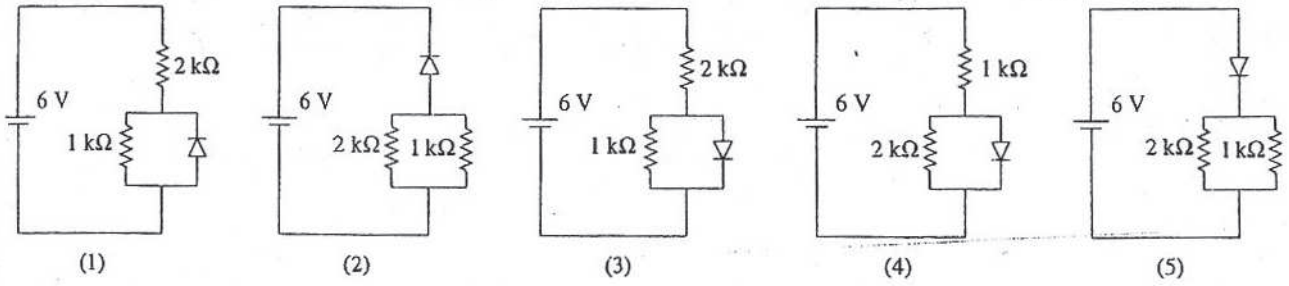


(4)



(5)

50. Which one of the following circuits draws the largest current from the 6 V cell?

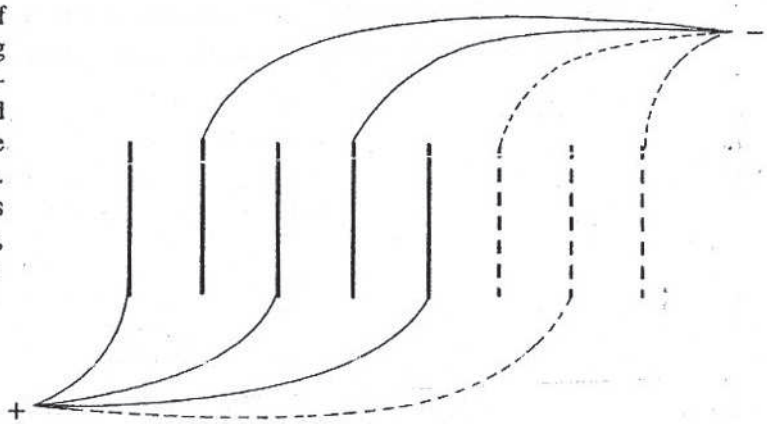


51. A capacitor consists of n number of equally spaced, parallel conducting sheets. Alternate sheets connected together compose the positive plate, and the other alternate sheets compose the negative plate as shown in the figure. If A is the area of each sheet and d is the spacing between two adjacent sheets, the capacitance of the arrangement is

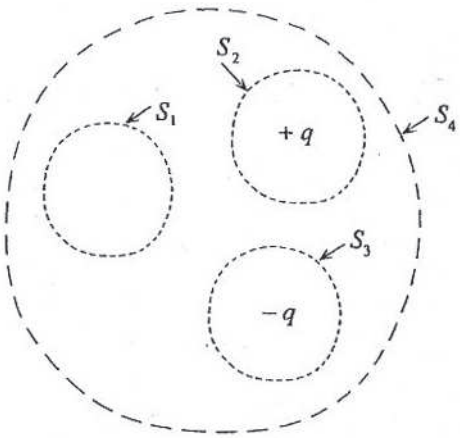
(1) $\frac{\varepsilon_0 A}{(n-1)d}$ (2) $\frac{2\varepsilon_0 A}{nd}$

(3) $\frac{(n-1)\varepsilon_0 A}{d}$ (4) $\frac{n\varepsilon_0 A}{d}$

(5) $\frac{\varepsilon_0 A}{nd}$.



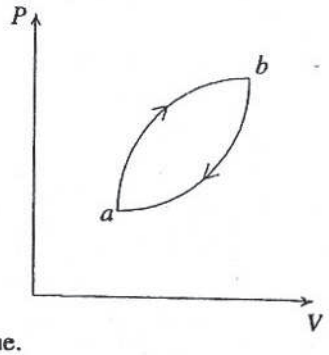
52.



S_1, S_2, S_3 and S_4 are four Gaussian surfaces drawn in the vicinity of two equal and opposite charges $+q$ and $-q$ as shown. The net electric flux through the surfaces S_1, S_2, S_3 and S_4 are represented by ϕ_1, ϕ_2, ϕ_3 and ϕ_4 respectively. Which of the following is correct?

(1) $\phi_1 = 0,\ \phi_2 = 0,\ \phi_3 = 0,\ \phi_4 = 0$
(2) $\phi_1 = 0,\ \phi_2 > 0,\ \phi_3 < 0,\ \phi_4 = 0$
(3) $\phi_1 > 0,\ \phi_2 > 0,\ \phi_3 < 0,\ \phi_4 > 0$
(4) $\phi_1 > 0,\ \phi_2 > 0,\ \phi_3 < 0,\ \phi_4 = 0$
(5) $\phi_1 < 0,\ \phi_2 > 0,\ \phi_3 < 0,\ \phi_4 > 0$

53. An ideal gas is taken through a cyclic process as shown in the $P - V$ diagram.



If $U_b > U_a$, consider the following statements.

(A) The net work done by the gas is positive for the whole process.
(B) Heat is absorbed along the path $a \rightarrow b$ whereas heat is liberated along the path $b \rightarrow a$.
(C) The temperature of the gas at the beginning of the process is same as that at the end of the process.

Of the above statements

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

54. Electrons are emitted from a certain metal when a monochromatic light of wavelength λ is incident on it. h is the Planck constant and c is the velocity of light. Consider the following statements.

(A) Kinetic energy of electrons emitted from the metal is less than hc/λ.

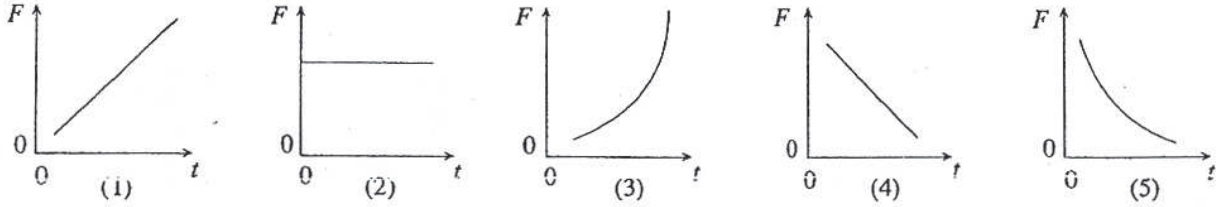
(B) Kinetic energy of electrons emitted from the metal **does not** depend on the material of the metal.

(C) Rate of emission of electrons depends on the wavelength λ.

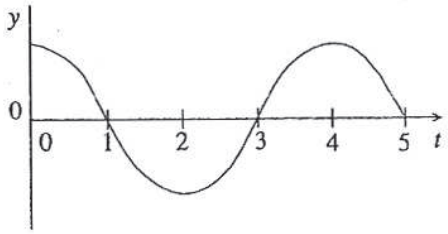
Of the above statements,

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

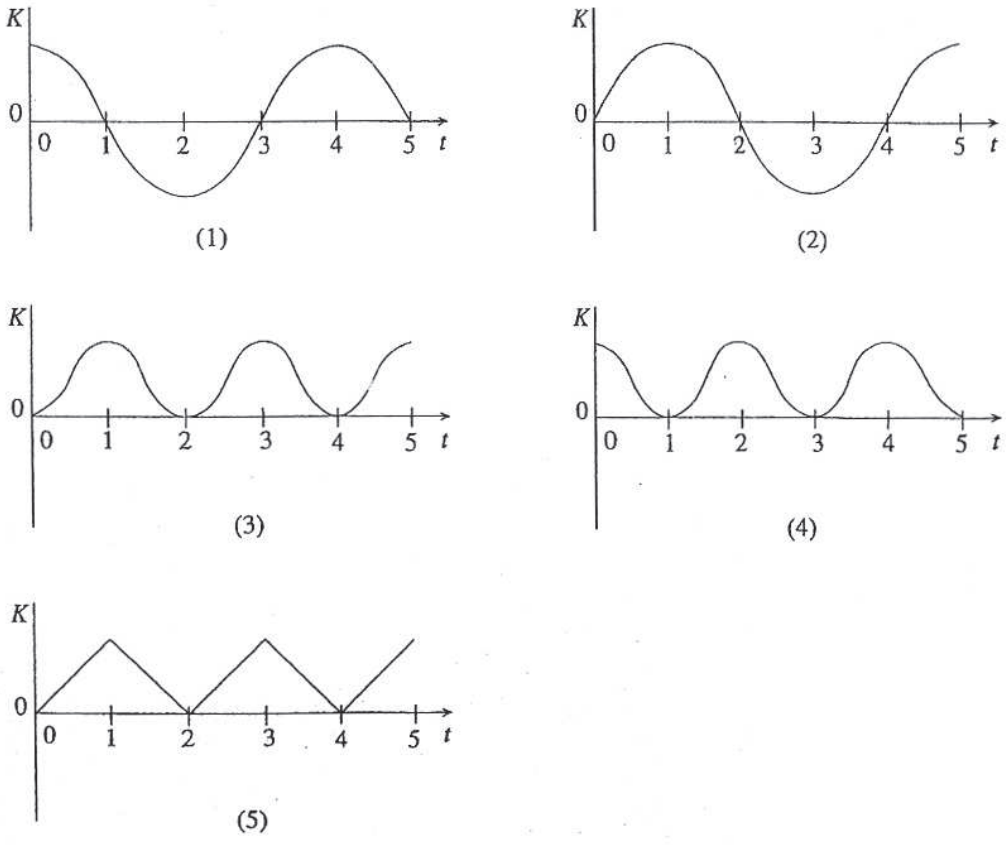
55. A mass is attached to the lower end of a vertical elastic string which is rigidly fixed at the other end. The mass is then moved downward with a constant velocity by applying a force F. The variation of F with time t is best represented by



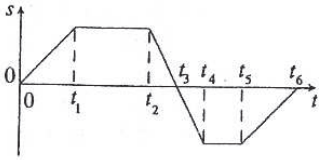
56. The graph shows the variation of displacement *(y)* of an object with time *(t)*.



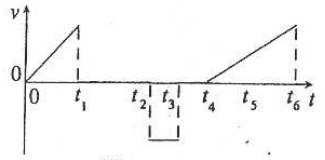
Which one of the following graphs best represents the variation of kinetic energy (K) of the object with time *(t)*?



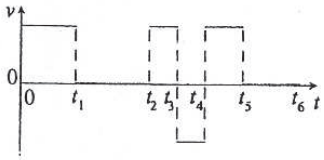
57. The displacement *(s)* - time *(t)* curve of an object is shown in the figure.



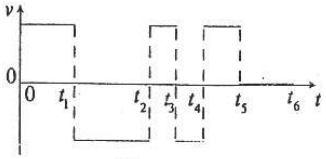
The corresponding velocity *(v)* - time *(t)* curve is best represented by



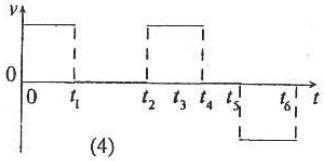
(1)



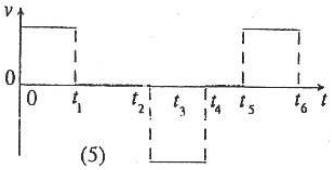
(2)



(3)

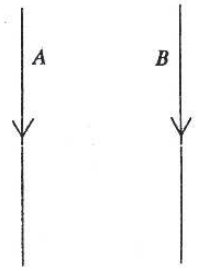


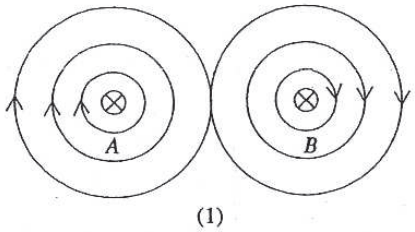
(4)



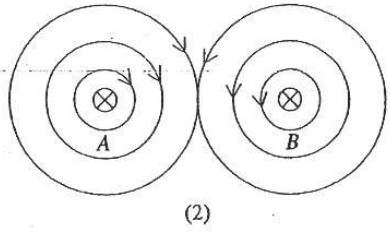
(5)

58. Two parallel long wires *A* and *B* carry identical currents in the same direction as shown in the diagram. Which of the following diagrams best represents the magnetic field in a plane perpendicular to the wires?

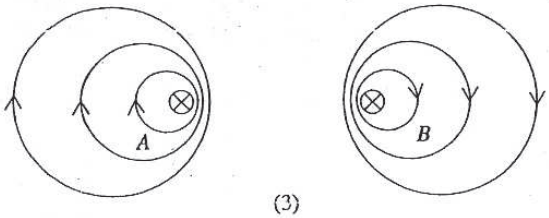




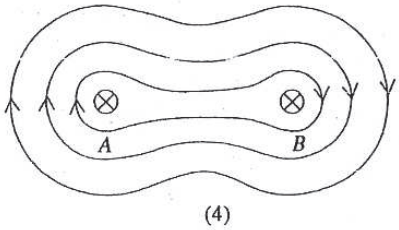
(1)



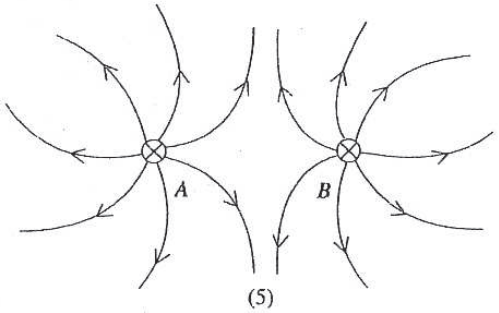
(2)



(3)

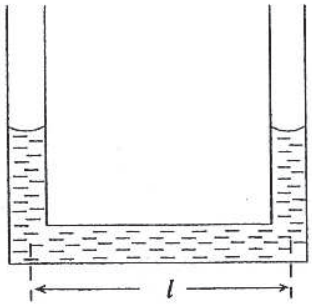


(4)



(5)

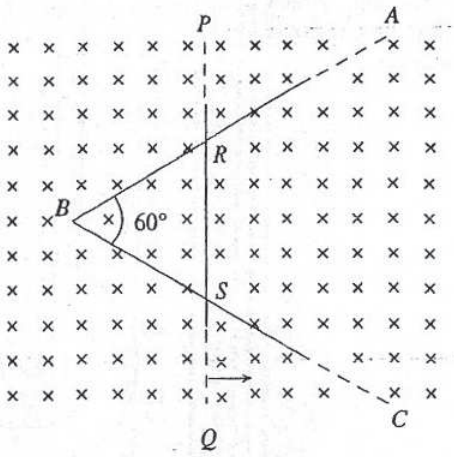
59.



A U-tube contains a liquid as shown in the figure. When the tube is moved horizontally to the right with a constant acceleration a, the difference in the heights of liquid columns in the two limbs is

(1) $\frac{la}{g}$ (2) $\frac{lg}{a}$ (3) $\frac{l(g+a)}{a}$ (4) $\frac{lg}{(a+g)}$ (5) $\frac{l(g+a)}{g}$

60.



A long wire *ABC* is bent to form a 60° angle and kept in a plane perpendicular to a uniform magnetic field, as shown in the figure. Another long straight wire *PQ* made of the same material with the same cross-sectional area is pulled with a constant velocity on the wire *ABC*, so that the triangle *RBS* is always equilateral. The induced current *(I)* in the triangle *RBS* varies with time *(t)* as

