FWC

தொண்டைமானாறு வெளிக்கள நிலையம் நடாத்தும்

ஐந்தாம் தவணைப் பரீட்சை - 2022

Conducted by Field Work Centre, Thondaimanaru.

5th Term Examination - 2022

பௌதிகவியல் - I Physics - I	Two Hours Gr -13 (2022)	01	E	I

01) Which of the following statement(s) is/ are true?

A- The SI unit of the sound intensity is $W\ m^{-2}$

B- Unit of the loudness is dB

C- Unit of pitch is Hz

(1) Only A *(2)* Only B *(3)* Only A,B

(4) Only B, C *(5)* All A, B and C

02) X, Y and Z are physical quantities having **different** dimensions. If dimensions of X, Y and Z are MLT^{-2}, $ML^{-1}T^{-2}$ and L^2 respectively. Which of the following mathematical expressions have a physical meaning?

(1) XY + Z (2) X + YZ (3) X^2 + YZ

(4) Y + XZ (5) XY + YZ

03) In a factory, smoke is continuously emitted from the chimney at a constant speed with related to the surrounding air. At first the wind is steady, then to the right, and after a while the wind becomes steady. Which of the following effectively represent the shape of a smoke plume?

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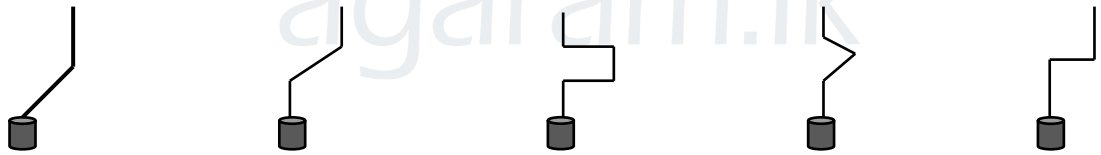


(1) (2) (3) (4) (5)

04) Which of the following statement(s) is/ are not true?

A- Laser light has transverse waves

B- Ultra sound waves are longitudinal waves

C- FM waves are longitudinal wave.

(1) Only A *(2)* Only B *(3)* Only C

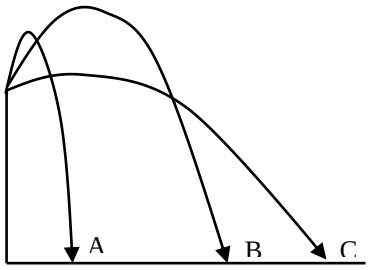
(4) Only A,B *(5)* Only B,C

05) Objects A, B and C are thrown simultaneously from the top of the hill. Their path is shown in Fig. If their times to reach the ground are T_A, T_B, T_C respectively, which of the following relation is true?

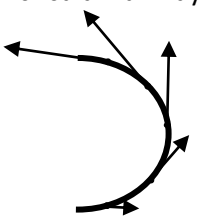
(1) $T_A < T_B < T_C$ *(2)* $T_A < T_C < T_B$

(3) $T_c < T_B < T_A$ *(4)* $T_c < T_A < T_B$

(5) Not enough data



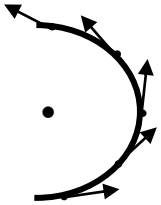
06) A car is driven on a semi-circular runway. The speed of the car is shown in various points on the track.



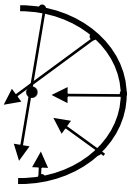
A better indication of the car's accelerations at those points,

.

(1)

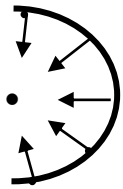


(2)



(3)

(4)



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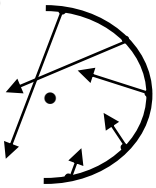
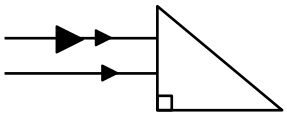


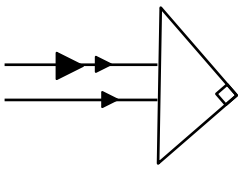
07) A closed container contains a small amount of water. There is constant water in the vessel to increase the temperature of the water in the vessel. Which of the following statements is true in this situation?

(1) The partial pressure of the vapor inside the vessel will decrease
(2) The partial pressure of the vapor inside the vessel will increase
(3) The partial pressure of the vapor inside the vessel remains constant
(4) The average kinetic energy of the vapor molecules will decrease
(5) The average kinetic energy of the vapor molecules remains constant.

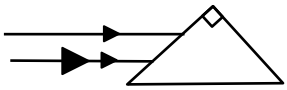
08) The figure shows the parallel rays of light in different paths in an isosceles triangular prism. The deviations of each of the ray at A, B and C are respectively.



(A)



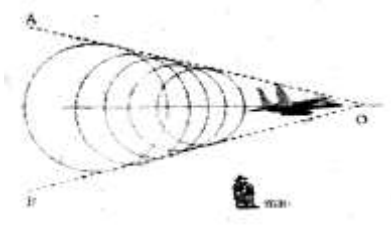
(B)



(C)

(1) $180°, 90°, 0°$
(2) $90°, 180°, 0°$
(3) $0°, 90°, 0°$
(4) $90°, 360°, 0°$
(5) $90°, 180°, 150°$

09) Figure shows the following wave fronts when a supersonic jet with Mach number k is flying horizontally. The angle made by the line joining the man and the jet to the horizontal when a man standing on the ground hears the sonic boom?



(1) $\tan^{-1}(k)$
(2) $\sin^{-1}(k^{-1})$
(3) $\cos^{-1}(k)$
(4) $\cos^{-1}(k^{-1})$
(5) $\sin^{-1}(k)$

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10) A man opens a parachute and gets out of a plane. At this time

A – His kinetic energy depends on the velocity

B – His potential energy will decrease

C – His mechanical energy is not conserved

Of the above statements,

(1) Only A is true

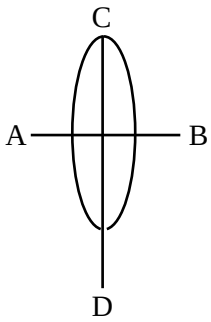
(2) Only A, B are true

(3) Only A, C are true

(4) Only B, C are true

(5) All A, B and C are true

11) Focal length of bi-convex lens f. Lens is cutting as two pieces along CD of lens. Consider the following statements about the cut piece,



A – The power of the lens will be halved

B – Parallel rays converge twice as far as before

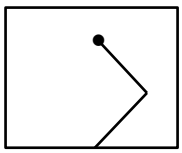
C – Focal length of convex lens will be halved

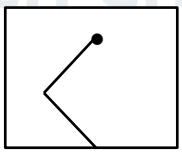
Of the above statements,

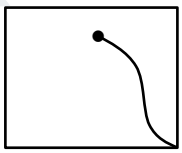
(1) Only A is true (2) Only B is true (3) Only C is true

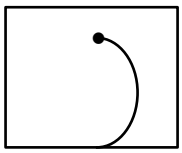
(4) Only A, B are true (5) All A, B and C are true

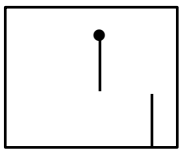
12) Initially, Sand is dropped from a helicopter moving horizontally with constant velocity v to the right. The helicopter suddenly runs to the left with the same speed v. The shape of sand that would appear to an observer on the ground if air resistance is negligible. (Black mark indicates helicopter)

(1) 

(2) 

(3) 

(4) 

(5) 

13) Radius and mass of the uniform sphere planets A, B are $2R, R$ and $M, 2M$ respectively. The ratio between the gravitational potentials on the surfaces of A and B is

(1) 1:1 (2) 1 : 2 (3) 1 : 4 (4) 1 : 8 (5) 4 : 1

14) An ideal gas exerts a pressure of $60\ Pa$ at $400\ K$ and the number of molecules per unit volume is n. Another sample of the same gas at $300\ K$ exerts a pressure of $30\ Pa$. What is the number of molecules per unit volume of the second gas?

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

15) A parallel plate condenser is connected to the cell and charged to a certain potential difference. The cell is then disconnected and the plates of the condenser are just moved away from each other. Which of the following statements is/ are correct?

A – The energy stored in the condenser increases

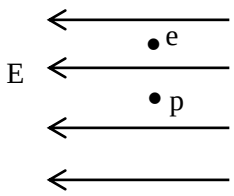
B – The Electric field intensity increases between the plates

C - The potential difference increases across the plates

(1) Only A is true
(2) Only A, B are true
(3) Only A, C are true
(4) Only B, C are true
(5) All A, B and C are true

16) An electron and a proton are released simultaneously from rest into a uniform electric field E as shown in the figure. If they both remain in the same uniform electric field after some time, which quantity is equal to them?

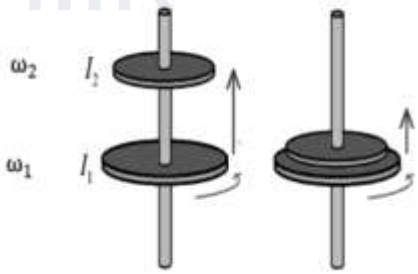
(1) Kinetic energy
(2) Speed
(3) Displacement
(4) Magnitude of acceleration
(5) Magnitude of acting force



17) Figure (a) shows two circular disks rotating about a common axis passing through their center in the same direction with angular speeds $\omega_1, \omega_2, (\omega_1 > \omega_2)$. Moment of inertia about the rotating axis of A and B are I_1, I_2 respectively. The figure (b) shows that due to the difference in angular velocities when the disks touch each other, friction causes the two disks to rotate with a common angular velocity, keeping them tight and non-slip. What is the energy lost by friction during this process?

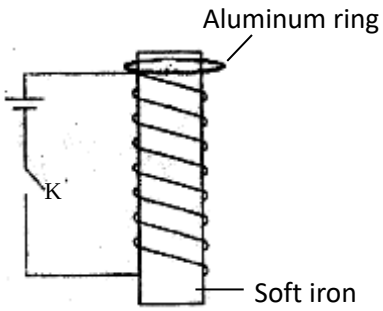
(1) $\frac{1}{2}\ \frac{I_1 I_2}{(I_1+I_2)}\ (\omega_1 - \omega_2)^2$
(2) $\frac{1}{2}\ \frac{I_1 I_2}{(I_1-I_2)}\ (\omega_1 + \omega_2)^2$
(3) $\frac{1}{2}\ \frac{1_1 I_2}{(I_1+I_2)}\ (\omega_1^2 + \omega_2^2)$
(4) $\frac{1}{2}\ \frac{I_1 I_2}{(I_1+I_2)}\ (\omega_1^2 - \omega_2^2)$
(5) $\frac{2I_1 I_2}{(I_1+I_2)}\ \ (\omega_1^2 + \omega_2^2)$

Fig (a) Fig (b)



18) Soft iron is placed inside a long vertical solenoid. The aluminum ring is placed horizontally on the upper end of the soft iron for easy movement. The ring is thrown off when switch K is closed because,

1) The ring is magnetized
2) Charge is induced in the ring
3) Current is induced in the ring
4) Aluminum does not attract a magnet
5) Due to gravitational force



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19) An isosceles frame work is made up of a rod AB of length l_1, linear expansivity α and rods AC, BC each of length l_2, linear expansivity β. This frame work is balanced on the knife edge placed at K. If the distance between K and C to remain constant for small temperature rise

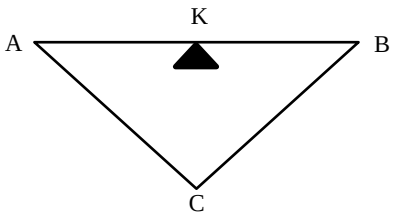
(1) $\frac{\alpha}{\beta} = \frac{l_2}{l_1}$

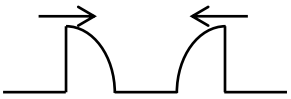
(2) $\frac{\alpha}{4\beta} = \frac{l_2^2}{l_1^2}$

(3) $\frac{\alpha}{\beta} = \frac{l_2^2}{l_1^2}$

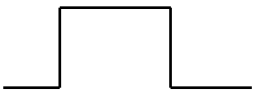
(4) $\frac{\alpha}{4\beta} = \frac{l_1^2}{l_2^2}$

(5) $\frac{4a}{\beta} = \frac{l_2^2}{l_1^2}$

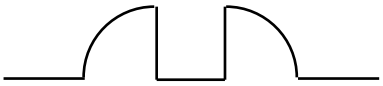


20)  The shape of the resultant pulse that **cannot be obtained** when two equal pulses overlap as shown in figure?

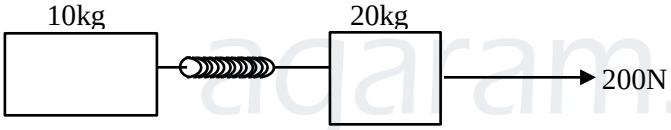
(1) 

(2) 

(3) 

(4) 

(5) 

21) 

Two blocks of mass $10\,kg$ and $20\,kg$ are connected by a light spring and placed on a smooth horizontal surface as shown in the figure. A horizontal force of $200\,N$ is applied to a block of mass $20\,kg$. Maximum instantaneous acceleration for masses $10\,kg$ and $20\,kg$ respectively

(1) $10ms^{-2}, 10ms^{-2}$

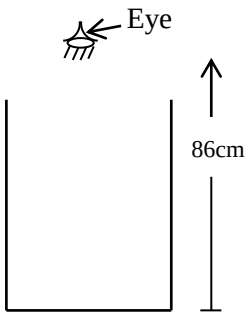
(2) $\frac{20}{3}ms^{-2}, \frac{20}{3}ms^{-2}$

(3) $10ms^{-2}, \frac{20}{3}\,ms^{-2}$

(4) $0, \frac{20}{3}ms^{-2}$

(5) $\frac{20}{3}\,ms^{-2}, 10ms^{-2}$

22) A mark affixed to the bottom of the vessel is not clearly visible when observed by a person viewed from a vertical height of 86 cm as shown in Figure. But if the mark becomes clear when the height of the water in the vessel is raised to 24 cm, find the lens he should wear to remedy this defect. (Refractive index of water is $\frac{4}{3}$)



(1) A convex lens of focal length 86 cm

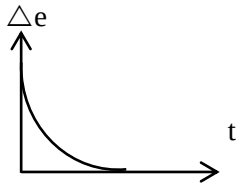
(2) A concave lens of focal length 86 cm

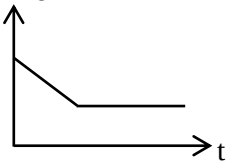
(3) A convex lens of focal length 80 cm

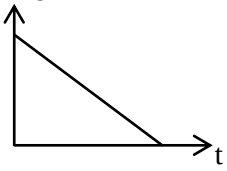
(4) A concave lens of focal length 80 cm

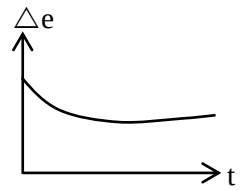
(5) A concave lens of focal length 40 cm

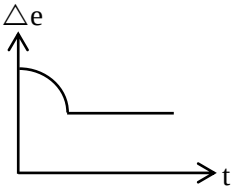
23) A water tank made of steel filled with water. If water is removed at a constant rate through the bottom hole, the variation of compression (Δ e) of rod AB with time (t) is best represented by?

(1) 

(2) 

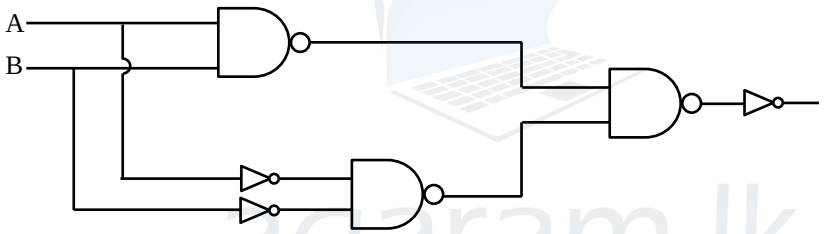
(3) 

(4) 

(5) 

24) As a gas of constant mass absorbs $1500\ J$, of heat energy, the volume of the gas is increased from $0.06\ m^3$ to $0.08\ m^3$ at a pressure of $3 \times 10^4\ Pa$, What is the change in the internal energy of the gas during this?

(1) $900\ J$ increase (2) $600\ J$ increase (3) $900\ J$ decrease
(4) $600\ J$ decrease (5) $1500\ J$ decrease

25) 

Which gate is equivalent to the logic circuit shown above?

(1) AND (2) OR (3) NAND
(4) NOR (5) EX - OR

26) Consider the following statements about relative humidity and absolute humidity.

(A) Absolute humidity and relative humidity increase as the temperature decreases at a constant rate in a closed room containing unsaturated water vapor

(B) A large ice block is placed in a closed room. Relative humidity near the ice block is 100 % and absolute humidity of the room decreases.

(C) Relative humidity increases while absolute humidity decreases.

Of the above statements,

(1) Only A is true

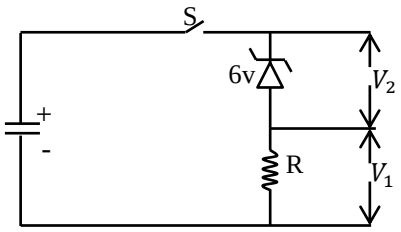
(2) Only A, B are true

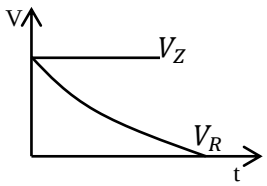
(3) Only A, C are true

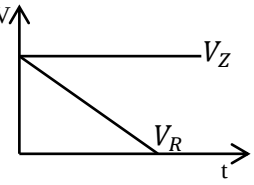
(4) Only B, C are true

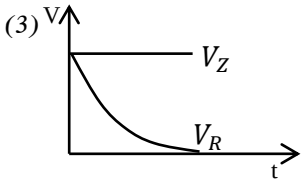
(5) All A, B and C are true

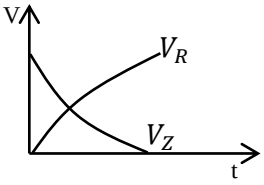
27) A capacitor is charged to a potential difference of $12\,V$. The breakdown voltage of the Zener diode is $6\,V$. From the moment switch S is closed, which of the following graph is best representing the variation of V_Z, V_R.

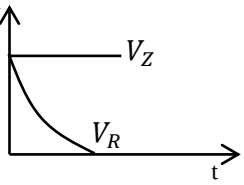


(1) 

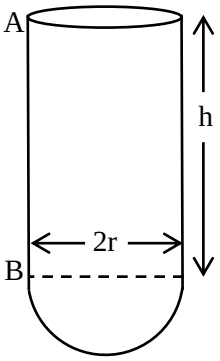
(2) 

(3) 

(4) 

(5) 

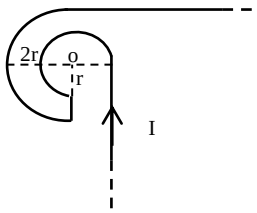
28) A hollow hemisphere and a hollow cylinder of same thickness and same radius formed of same material are joined together as shown in figure. Height of the cylinder is h. What is the angle AB makes with the vertical when the combined body is suspended from A?



(1) $\theta = \tan^{-1}\left(\frac{r}{h+2r}\right)$ (2) $\theta = \tan^{-1}\left(\frac{r}{h+r}\right)$

(3) $\theta = \tan^{-1}\left(\frac{2r}{h+r}\right)$ (4) $\theta = \tan^{-1}\left(\frac{h}{h+r}\right)$

(5) $\theta = \tan^{-1}\left(\frac{2h}{r+h}\right)$

29) 

In the circuit shown in figure, magnetic flux density at point O is?

(1) $\frac{\mu oI}{4r}$ (2) $\frac{\mu oI}{8r}$ (3) $\frac{\mu oI}{8r} + \frac{\mu oI}{2\pi r}$

(4) $\frac{\mu oI}{4r} + \frac{\mu oI}{4\pi r}$ (5) $\frac{\mu oI}{4r} + \frac{\mu oI}{2\pi r}$

30) To increase the sensitivity of the liquid-glass thermometer

(A) Use of high expansion liquid.
(B) The inner radius of the thermometer stem should be reduced.
(C) Increasing the length of the thermometer capillary tube.
(D) Increasing the volume of the thermometer bulb.

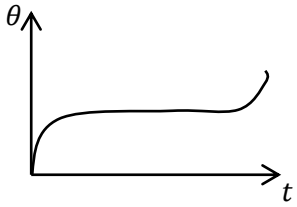
Which of the following statements are correct?

(1) Only A, B are true (2) Only A, B, C are true (3)Only A, C, D are true
(4) Only A, B, D are true (5) All A, B, C and D are true

31) The frequency of an elephant's trumpet is $17\,kHz$. The threshold sound intensity level for this frequency in a young man is $30\,dB$. Another elderly man's threshold sound intensity for this frequency is $50\,dB$. The young man hears this sound when he is $1\,m$ away. How far does the old man have to go from the young man to hear this sound?

(1) 100m towards the elephant (2) 100m away from the elephant
(3) 900m towards the elephant (4) 900m from the elephant (5) 900m away from the elephant

32) The curve gives the change in temperature of a given substance with time when heated at a constant rate. Consider the statements made about the information that can be gathered from this curve.



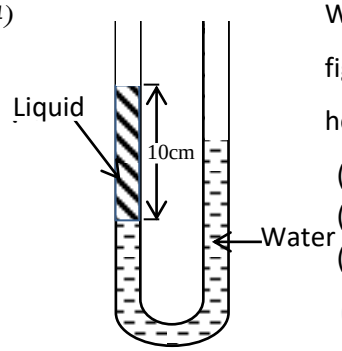
(A) The substance shows a phase change with temperature.
(B) Latent heat of fusion/ vaporization of the substance may have a higher value.
(C) The melting or boiling point of the substance may be higher than room temperature.
Of the above statements,

(1) Only A is true (2) Only C is true (3) Only A, B are true
(4) Only B, C are true (5) All A, B and C are true

33) The temperature and pressure of an equal volume of gas are maintained equal.
(A) The number of molecules in each specimen is equal.
(B) The mass ratio of the gases is proportional to the molar mass ratio of those gases.
(C) The density ratio of gases is equal to the molar mass ratio of those gases.
Of the above statements,

(1) Only A is true (2) Only B is true (3) Only A, C are true
(4) Only B, C are true (5) All A, B and C are true

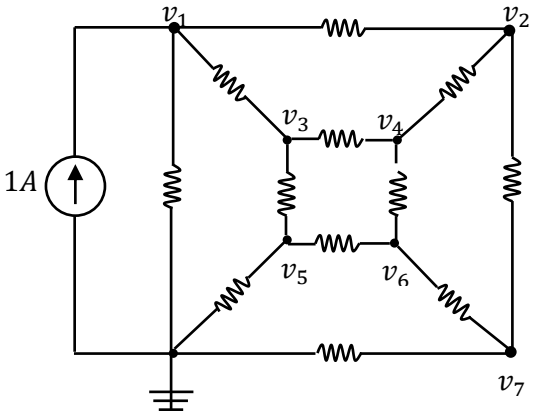
34)



Water and liquid of density $800\ kg\ m^{-3}$ are taken in U tube as shown in figure. Now, if the height of the liquid column is changed to $15\ cm$, the height at which the common level changes from the initial level is

(1) $5\ cm$ Decline below (2) $2.5\ cm$ decline below
(3) $3\ cm$ Decline below (4) $2\ cm$ rise above
(5) $2\ cm$ Decline below

35) Twelve resistances of 12 ohms each are connected as shown in figure. Current through the galvanometer is $1\ A$. Potentials of each junction with respect to earth are $V_1, V_2, V_3, V_4, V_5, V_6, V_7$. Which of the following relationship is true?

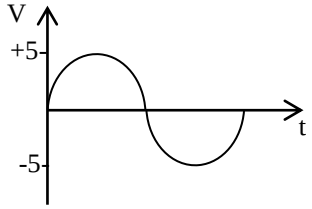


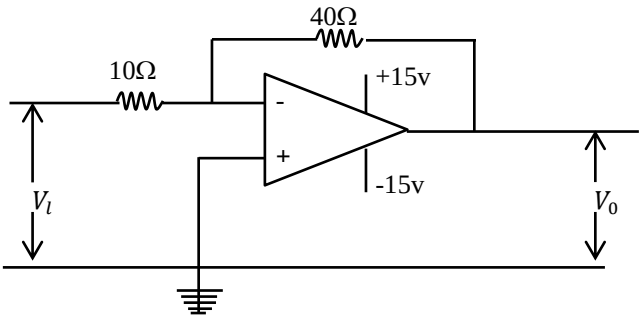
(1) $V_2 = V_3 > V_5 = V_7$
(2) $V_2 > V_7 = V_5 > V_4$
(3) $V_3 = V_4 < V_5 > V_6$
(4) $V_2 < V_7 < V_5 = V_6$
(5) $V_1 < V_3 < V_4 > V_7$

36) When comparing two resistances using a meter bridge, the resistance values should be approximately equal and greater. Choose the statement(s) that best explain the above statement
(A) To reduce the percentage error in the measurement of the balance length of the wire.
(B) To obtain the balance length.
(C) To neglect the resistance of the connecting wires when compared with the resistors being compared

(1) Only A (2) Only C (3) Only A, C
(4) Only A, B (5)All A, B and C.

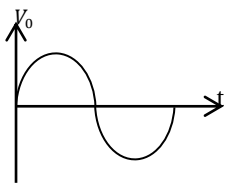
37)



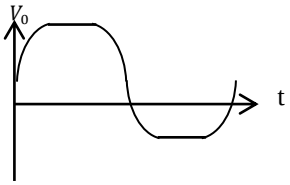


Given an input signal voltage to an operational amplifier as shown in figure, select the suitable graph for the output voltage.

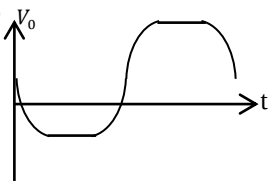
(1)



(2)



(3)



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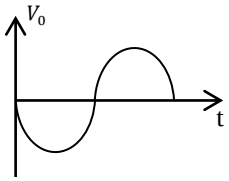
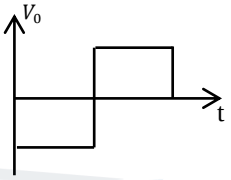
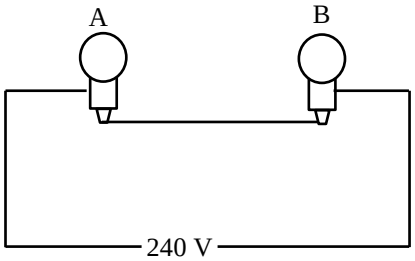


(5)



38) Two tungsten bulbs A and B are connected in series and a potential difference of 240 V is applied as shown in figure. Consider the following statements about the brightness of bulbs.

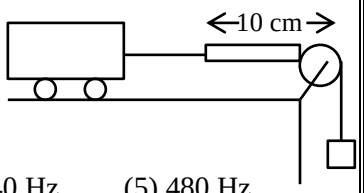


(A) The brightness of B is greater than the brightness of A
(B) Since the same current passes through both A and B, the brightness of both are equal.
(C) The brightness of A is greater than the brightness of B
(D) The ratio of brightness of the two bulbs is 1:2

Which of the following statements is/ are true,

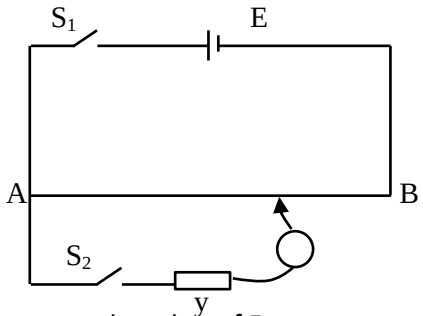
(1) Only A is true (2) Only B is true (3) Only C is true
(4) Only A and D are true (5) Only C and D are true

39) One end of a light string is attached to a movable trolley, the other end is attached to the end of a heavy string passing over a lightly, frictionless pulley and the other end of the heavy string bearing a load. Now that the trolley is moved to the right by 10 cm, the point where the two strings are attached is on the pulley, and now the frequency of the thin string is



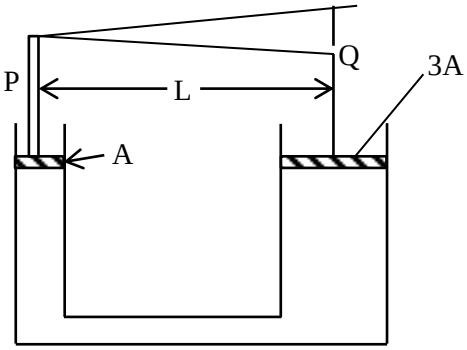
(1) 120 Hz (2) 60 Hz (3) 180 Hz (4) 240 Hz (5) 480 Hz

40) An electrical device Y is connected to the potentiometer as shown in the figure and the deflection of the galvanometer is observed in the same direction when the sliding switch is touched to A, B, but the deflection of B is observed to be less as compared to the values of A. What could be the possible reason for this?



1) Device Y is a cell which is properly connected and the emf of Y is greater than that of E
2) Device Y is a cell which is wrongly connected and the emf of Y is greater than that of E
3) Device Y is a cell which is properly connected and E is greater than the emf of Y
4) Device Y is a cell which is properly connected but switch S_2 is open
5) Device Y is a cell that is properly connected but switch S_2 may be open

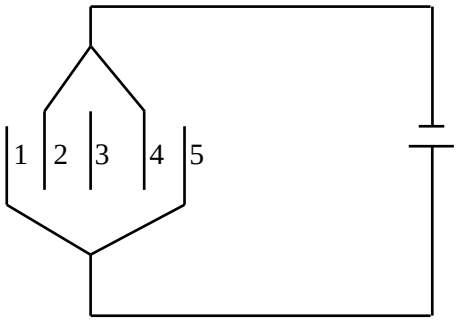
41) Pistons of cross section A, 3A are connected together and filled with incompressible fluid as shown in figure. A no uniform cone of length L is placed over the pistons when the distance between the pistons P, Q is L If the pistons are in equilibrium at that time, what is the distance of the center of gravity of the cone from point P.



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

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

42) Five identical capacitor plates each of area A and separation d are connected to a cell as shown in the figure. What are the charges of plates 1 and 4 respectively?



(1) $\frac{\varepsilon_o AV}{d}, \left(\frac{-2\varepsilon_o AV}{d}\right)$

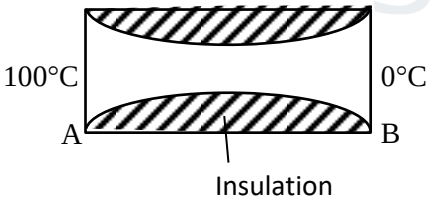
(2) $\frac{\varepsilon_o AV}{2d}, \frac{\varepsilon_o AV}{d}$

(3) $\left(\frac{-\varepsilon_o AV}{d}\right), \frac{F_o AV}{d}$

(4) $\frac{2\varepsilon_o AV}{d}, \left(\frac{-\varepsilon_o AV}{d}\right)$

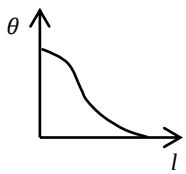
(5) $\frac{\varepsilon_o AV}{d}, \left(\frac{-\varepsilon_o AV}{d}\right)$

43)

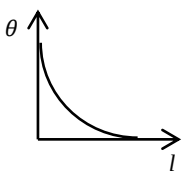


One end of the rod is maintained at 100^0C and the other end at 0^0C as shown in figure. Rod is perfectly insulated. The variation of the temperature (θ) with length (l) from A to B the is best represented by.

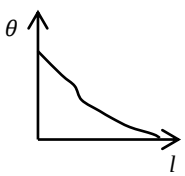
(1)



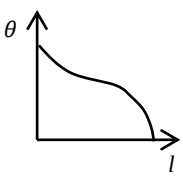
(2)



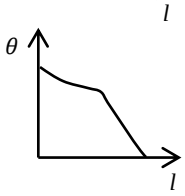
(3)

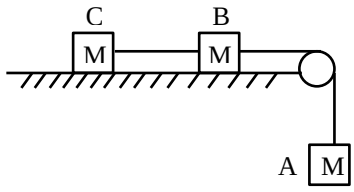


(4)



(5)



44) 

The motion of the equal mass blocks A, B and C is shown in the figure. Blocks B and C are placed on a surface with coefficient of kinetic friction μ, the acceleration of A if the system.

(1) $\frac{g(1-\mu q)}{9}$ (2) $\frac{g(1-2\mu)}{3}$ (3) $\frac{2g\mu}{3}$

(4) $\frac{g(1-2\mu)}{2}$ (5) $\frac{g(1+\mu g)}{9}$

45) When a Plane of armature (rotor) is parallel to the magnetic field in an electric power generator.

(1) Magnetic flux related to armature and induced emf of the armature are zero.

(2) Magnetic flux related to armature is zero and induced emf of the armature is maximum.

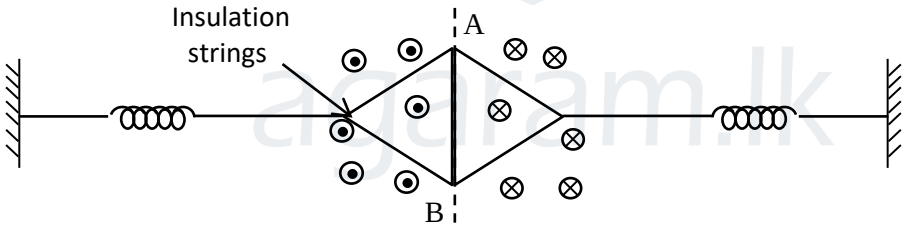
(3) Magnetic flux related to armature and induced emf of the armature are maximum.

(4) Magnetic flux related to armature is maximum and induced emf of the armature are minimum

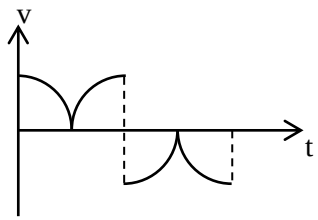
(5) Magnetic flux related to armature and induced emf of the armature having specific value

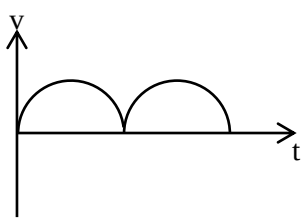
46) On a day when the room temperature is 30^0C, the temperature of a solid sphere drops from 80^0C to 70^0C in 10 minutes. How long does it take for another object of twice the radius to cool from 60^0C to 50^0C in minutes?

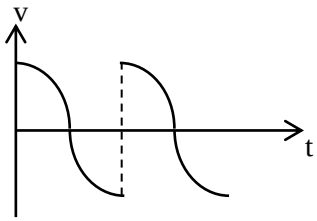
(1) 10 (2) 25 (3) 36 (4) 9 (5) 18

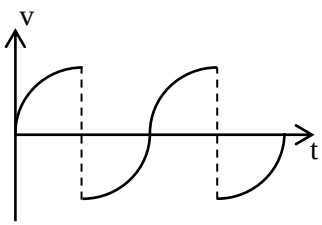
47) 

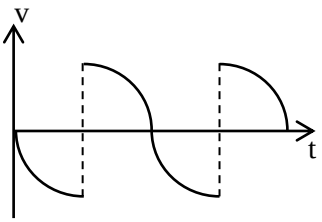
A conducting rod AB is fixed between two springs with the help of insulation strings as shown in figure. The Magnetic fields are inward perpendicular to the paper on the right side and out ward perpendicular to the paper on the left side. Now, when the rod is moved to right and released, the induced potential at point B with respect to A with time is best represented by.

(1) 

(2) 

(3) 

(4) 

(5) 

48) A cylindrical block of wood of density S_W and length L, floats upright in a liquid of density S_O. The density of the liquid is greater than density of the block. Given a small vertical displacement, if the block performs SHM, what is the period of oscillations of the block

(1) $T = 2\pi\sqrt{\frac{S_W g}{S_O L}}$ (2) $T = 2\pi\sqrt{\frac{L}{g}}$ (3) $T = 2\pi\sqrt{\frac{S_O L}{S_W g}}$

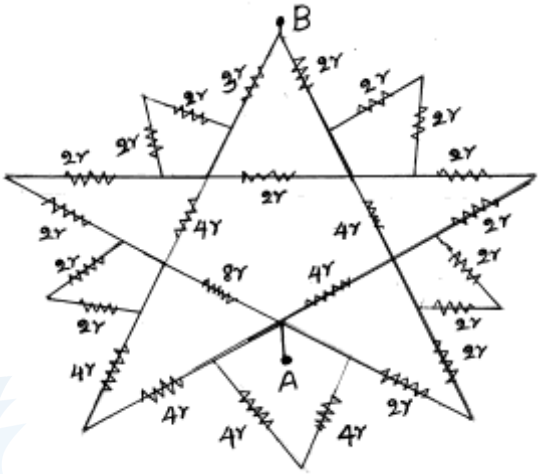
(4) $T = 2\pi\sqrt{\frac{S_W L}{S_O g}}$ (5) $T = 2\pi\sqrt{\frac{S_O g}{S_W L}}$

49) Equivalent resistance between A and B is given by.

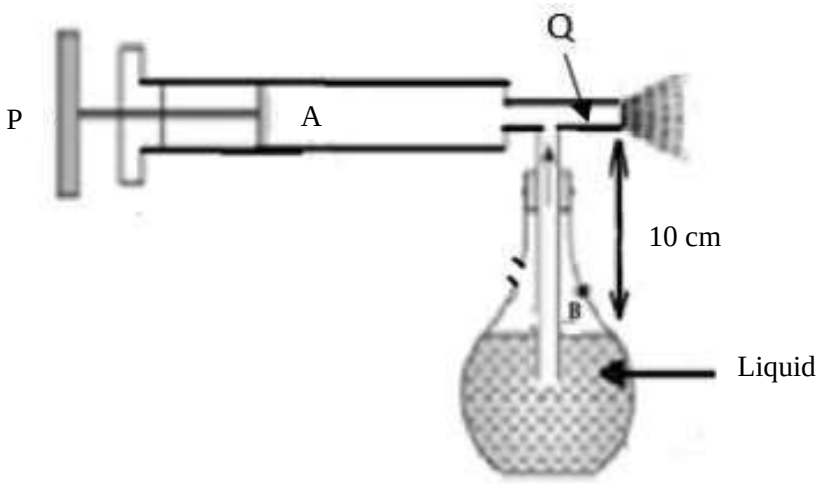
(1) $\frac{18}{5}\,r$ (2) $\frac{10}{3}\,r$

(3) $\frac{9}{4}\,r$ (4) $\frac{6}{7}\,r$

(5) $\frac{20}{3}\,r$



50) The Insecticide sprayer shown in the figure has a $\sqrt{3}\ cm$ radius pump and a $1\ cm$ radius outlet. Oil of density of $800\ kg\ m^{-3}$ is poured. The Vertical height of the horizontal tube above the oil surface is $10\ cm$. Assume that the pressure at point A and pressure at point B are equal and that air obeys Bernoulli's principle. What is the minimum velocity for the piston to have oil in the air jet in tube Q? (Density of air is $2\ kg\ m^{-3}$)



(1) $20\ m\ s^{-1}$ (2) $30\ m\ s^{-1}$ (3) $40\ m\ s^{-1}$

(4) $50\ m\ s^{-1}$ (5) $60\ m\ s^{-1}$

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ஐந்தாம் தவணைப் பரீட்சை - 2022
Conducted by Field Work Centre, Thondaimanaru.
5th Term Examination - 2022

பௌதிகவியல் - II A Physics - II A	Three Hours 10 min Gr -13 (2022)	01	E	II

Part – II A
Structured Essay Questions

($g = 10\ m\ s^{-2}$)

✶ **Answer all four questions on this paper itself**

01) You are provided with a parallelogram law apparatus, two known masses (m_1 and m_2), two balance pans of known masses, a short plane mirror strip, 4 drawing pins and a white sheet in order to determine the mass of a small stone.

a) Give a list of other items needed in order to carry out this experiment accurately.

……

b) What is the additional instrument that you need to find the percentage error in the measurement of mass of the stone ?

……

c) How do you check whether the pulleys have friction?

……

……

……

d) If friction is present in the pulleys state how do you minimize it.

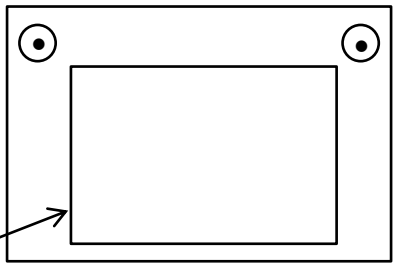
……

……

e) Why is the parallelogram law apparatus fixed in the vertical plane?

……

f) Complete the experimental set up given below. Masses are placed in the balance pans and the stone is hung in the middle directly.



g) How would you locate the position of the strings using strip of mirror?

……

……

……

h) After completing the parallelogram it was noticed that the relevant diagonal was not exactly vertical. State two reasons for this observation (masses of the pans were added relevantly)

……

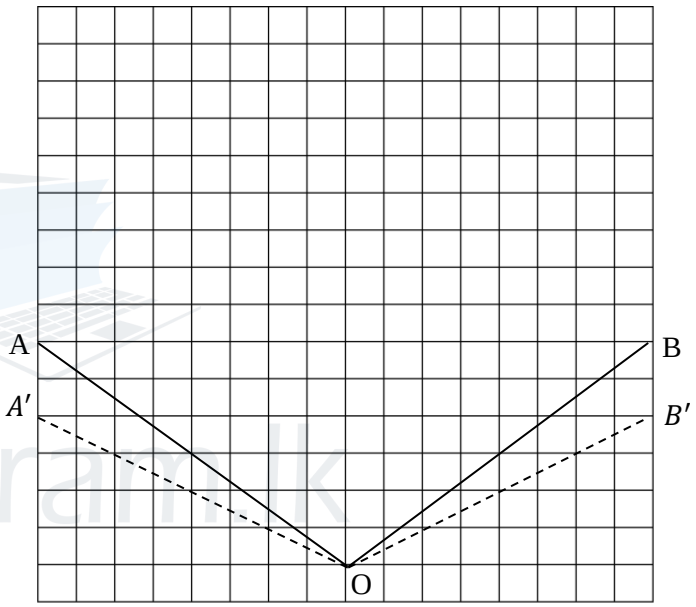
……

i) The adjacent sides of the parallelogram OA and OB are shown in the figure when this experiment was carried out with masses m_1,= m_2 = *40* g and the scale pans of masses $10g$ each. Take the length of 1 division as 0.5 cm

i) Identify the scale used..

ii) Complete the parallelogram.

iii) Find the mass of the stone.



`

j) Now the stone is fully submerged in water. The adjacent sides of the parallelogram corresponding to this situation are shown with dotted lines OA^1 and OB^1

i) Complete the parallelogram in the same figure (use dotted lines).

ii) Hence find the relative density of this stone.

……

……

……

02) You have been asked to determine the frequency of a tuning fork. You are provided with the following items: Sonometer, a tuning fork of unknown frequency, $\frac{1}{2}$ kg set of masses, a sample piece of the sonometer wire, metre ruler and triple beam balance.

a) What is the other item that you need to perform this experiment?

……

b) i) What is the purpose of having a piece of sample sonometer wire?

……..

……..

ii) Give the list of measurements and the corresponding measuring instruments used in fulfilling the purpose you mentioned in b (i) above.

	measurement	measuring instrument
1.	…….	…….
2.	…….	…….

c) Where the vibrated tuning fork should be placed in order to achieve the resonance state in this experiment? State the reason.

……..

……..

d) Write down the main experimental steps you follow to detect the optimum resonance state..

……..

……..

……..

e) i) Draw the wave pattern when the sonometer is vibrated in fundamental mode..

……

……

……

ii) State the nature of wave formed in the sonometer wire. (Transverse / longitudinal) (Progressive / standing)

……

iii) How is this wave formed?

……

……

f) Suppose that the wire resonates with frequency f. Obtain an expression for the amplitude of the wire, A, in terms of f and g when a paper rider placed in the middle of the wire just flies off from the wire.

……

……

g) i) If the mass hung from the wire is M and the mass per unit length of the wire is m, write down an expression for the velocity of sound along the wire V in terms of g, M and m.

……

……

ii) Obtain an expression for the frequency of the tuning fork f in terms of fundamental resonance length *l*, m and M.

……

……

iii) Convert the above equation in c (ii) and then re-arrange it to plot a straight line graph.

……

……

……

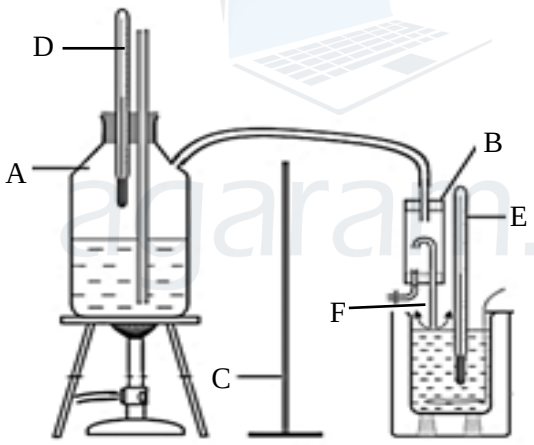
h) Calculate the frequency f if the gradient of the graph plotted in f(ii) is $1x10^{-3}m^2\ kg^{-1}$ and the mass per unit length of the wire is $0.01kg\ m^{-1}$.

……

……

……

03) Shown in the diagram is an incomplete apparatus designed by a studet to determine specific latent heat of vaporisation of water using the method of mixtures.



a) Name the items indicated by the letters A, B and C in the above arrangement.

A. ……

B. ……

C. ……

b) State the purpose of having each of the above items .

A. ……

B. ……

C. ……

c) What is the additional instrument that the student needs in order to perform this experiment?

…….....

d) Suppose that the student is provided with a mercury in glass thermometer and an alcohol in glass thermometer. Of these two thermometers, select the appropriate thermometer to be used for D and E give reasons for the selection.

D. ……Reason……...

E. …… Reason ……...

e) Give the reason for keeping the end of the tube F slightly above the water surface.

…….

…….

f) The student carried out the compensation method to minimize the heat loss to the surrounding. State the main experimental steps that involve in this method.

…….

…….

…….

g) An important aspect about the environmet has to be taken into account when the student plans to use the above method. What is it?

…….

…….

h) Write down the readings that should be taken in this experiment in the order they are taken.

……(X_1)

……(X_2)

……(X_3)

……(X_4)

……(X_5)

i) Write an expression to find the specific latent heat of vaporization of water in terms of the above symbols. Specific heat capacity of water and the material of the calorimeter are C_w and C respectively.

…….

…….

04) Figure I shows an incomplete diagram of an experimental setup of a potentiometer with a 5m long wire, that can be used to determine the internal resistance r of a given cell with electromotive force (emf)E(<Eo).

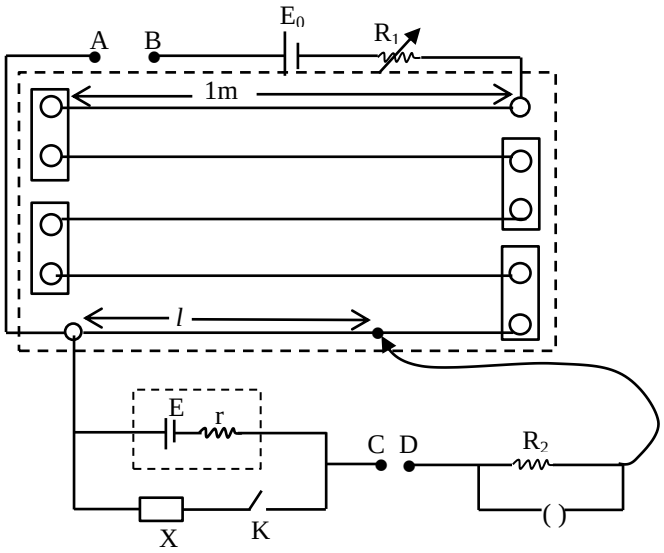
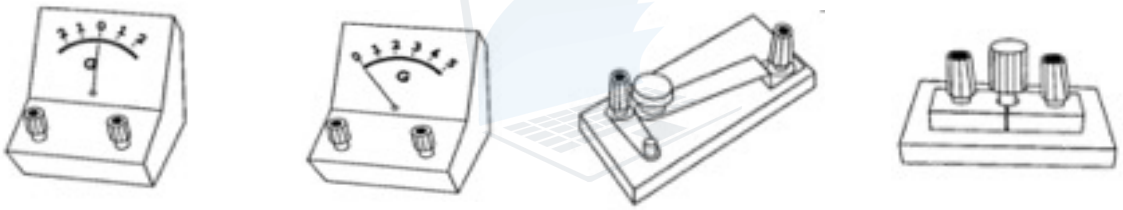


Figure - 1



item *(1)* centre zero galvanometer

item *(2)* Galvanometer

item *(3)* (tap key)

item *(4)* (plug key)

Figure – 2

a) In addition to the items corresponding to the symbols shown in the figure – 1, if you are provided with the items shown in figure – 2 to perform this experiment.

(i) Which item would you connect between AB?

……

(ii) Which item would you connect between CD?

……

b) State two qualities of a potentiometer wire that affect the accuracy of measurements.

……

……

c) What is the item used for X in the laboratory in order to obtain a resistance R?

……

d) Can the potentiometer shown is figure – 1 be used as a voltmeter having an adjustable range. Give reason for your answer .

……

……

……

e) A student observed a small deflection of the galvanometer even when there is no current passing through it. Is it advisable to use this galvanometer for this experiment? Give reasons for the answer.

……

……

f) When the switch K is open, the balance length of the potentiometer wire is l_0. When K is closed, the balance length is l_1. Obtain an expression for the internal resistance r of the given cell in terms of l, l_0 and R

……

……

……

g) With the given potentiometer, the balance length can be measured with a maximum error of 1 mm. If $R = 10\,\Omega,\ lo = 72.2\,cm,\ l = 50.2\,cm$ calculate the maximum value that could be obtained for the internal resistance r.

……

……

……

h) Internal resistance r can be determined more accurately by a graphical method considering R as a variable resistance. Rearrange the equation obtained in (*f*) to plot a suitable graph. Identify the independent (x) and dependent (y) variables of the graph.

……

……

……

i) Draw a rough sketch of the graph relevant to the part (h) Write down an expression for r in terms of the parameters that can be extracted from the graph

……

……

……

j) Write down an expression for r in terms of the parameters extracted from the graph

……

……

……

FWC

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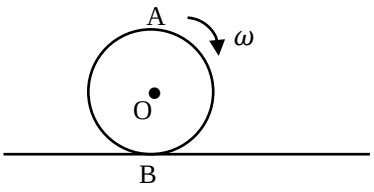
ஐந்தாம் தவணைப் பரீட்சை - 2022
Conducted by Field Work Centre, Thondaimanaru.
5th Term Examination - 2022

பௌதிகவியல் - II B Physics - II B	Three Hours 10 min Gr -13 (2022)	01	E	II

Part – II B Essay
Answer four questions only
$g = 10\ N\ kg^{-1}$

1)

a) A uniform flat circular wheel of mass m and radius r rolls without slipping with constant angular velocity ω. Moment of inertia about O axis of the wheel is I.



i. Find the velocity of O axis with respect to earth.
ii. State the velocities of points A, B with respect to axis O and find the velocities relative to the earth.
iii. Estimate the kinetic energy of the wheel if $m = 12\ kg, r = 0.20\ m$ and drift velocity of the wheel is $0.30\ m\ s^{-1}$.
iv. What can be said about the motion of the wheel if the wheel slips while increasing the angular velocity of the wheel?

b)

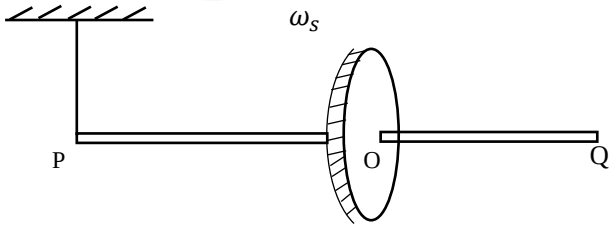


Figure shows a system suspended by a string tied at end P when a flat circular disk rotates with a large angular velocity ω_s about axis PQ. As the wheel rotates counter-clockwise there is a torque $\tau_p = R\,mg$ in the direction perpendicular to the axis PQ into the paper. (Where $PO = R$, mass of the wheel is m and radius of the wheel is r) So the axis will try to rotate about P with angular velocity ω_{pr}, Its period is denoted by T_{pr}.

(i) Find the magnitude of the angular momentum L_S of the wheel in terms of ω_S. What is the direction of the angular momentum?

(ii) If axis rotates through small angle $\Delta\theta$ in a small time Δt, indicate the change of angular momentum ΔL by drawing the angular momentum triangle. Assume that initial angular momentum $|\underline{L_{s1}}|$ and final angular momentum $|\underline{L_{s2}}|$.

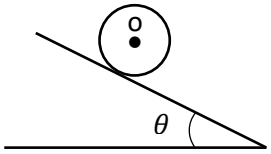
$|\underline{L_{s1}}| = |\underline{L_{s2}}| = L_s$

(iii) Show that $\omega_{pr} = \frac{T_P}{L_S}$ by calculating $\Delta\theta$ from the angular momentum of triangle you drew in question b(ii) above.

(iv) Find the T_{pr} if rotating frequency f_s of the wheel is $5\,Hz$. $OP = R = 18\,cm, r = 30\,cm, m = 2\,kg$.

(v) State what happens to the wheel when ω_S is reduced to near zero.

c) Figure Shows that the cross-section of a solid cylinder A having mass M, radius r and length l is placed on an inclined plane of inclination θ with horizontal and is allowed to roll freely without slipping.



i. Copy the given figure in your answer sheet and indicate the forces acting on it in a force diagram. Identify the forces indicated.

ii. Write an expression for the torque (τ) acting on the cylinder with respect to point O based on specified force/ forces in question c(i) above.

iii. Determine the linear acceleration of the cylinder by considering rotational and translational (linear) motions.

iv. If the coefficient of friction between the inclined plane and the cylinder is μ, derive the necessary condition for the cylinder to roll without slipping in terms of μ, θ. Moment of inertia of the cylinder about the axis is $\frac{Mr^2}{2}$.

v. Does the cylinder slide or roll? on the inclined plane find with adequate calculations that, if μ and θ are 0.6 and 60^0 respectively. (take $\sqrt{3} = 1.73$)

2)

a)

i. Draw a ray diagram to show how to obtain an upright and magnified image of a real object using a converging lens. Indicate the focal point clearly.

ii. A person observes the image in question a(i) above. D is the least distance of distinct vision. Obtain an expression for linear magnification of this lens in terms of f, D. The focal length of the lens is f.

b)

i. The magnifying power M of compound microscope at normal adjustment is defined as,
$M = \frac{\beta}{\alpha}$
Identify the β, α.

ii. A compound microscope consists of two converging lenses with a focal length of 8.0 mm and 50 mm. A small object is placed on the axis of the microscope at a distance of 10 mm from the objective. A virtual image is created 250 mm from the eye piece by change the distance between the lenses.
Find the following. (Least distance of distinct vision is $25\,cm$)
1. The image formed by the object is the distance from the object.
2. Separation between lenses
3. Magnifying power in compound microscope

iii. Now by moving the eye piece the distance between the lenses is changed to 80 mm. Find the following.
1. New stage of final image
2. New value of magnifying power.

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3)

a. A planet's standard gravitational parameter (μ) is given by the product of the planet's mass (M) and the universal gravitational constant (G).

$$\mu = GM$$

i. Write the newton's law of gravitation.

ii. Write the basic SI unit of the standard gravitational parameter.

iii. Derive an expression in terms of μ, r for the speed of a satellite of mass m orbiting the earth with orbital radius r. (Standard gravitational parameter of earth is μ)

iv. Derive an expression in terms of μ, r for the orbital period of the satellite mentioned in question a (iii) above.

b. What do you understand by geostationary satellite?

i. Estimate the angular velocity of the geostationary satellite in $rad\ h^{-1}$ (assume $\pi = 3$ and earth cyclic period is 24 hours)

ii. Obtain the radius of the geostationary satellite in terms of μ from the expression obtained from question a (iv) above.

iii. Determine the tangential speed of the geostationary satellite in $m\ s^{-1}$, by using the results obtained questions b (i), (ii) above. (Approximate orbital radius of the geostationary satellite is 42000 km, assume $\pi = 3$)

c. A resting meteorite enters Earth's gravitational field from far away and moves towards Earth. Radius of earth is R.

i. Obtain the speed of the meteorite in terms of μ, R when it hits the Earth's surface. (Ignore air resistance while answering this question)

ii. Find the speed of the meteorite in m s-1 when it hits the Earth's surface from expression obtained question c (1) above. standard gravitational parameter of earth in SI unit is 4×10^{14}, radius of earth is 6400 km. ($\sqrt{20} = 4.47$)

iii. Explain how the satellite is moved back to the Earth after the mission of a satellite orbiting the Earth is completed. Mention one strategy adopted by a satellite to avoid hitting the Earth's surface with high speed.

4) This question describes about the process occur in neuron when stimulus occurring in the human body. Read the passage carefully and answer the questions given below.

In all cells including neurons, ions are distributed unequally between the cell interior and exterior. Generally, the inside of the cell is negatively charged whereas the exterior is positively charged. These opposite charges are attracted across the plasma membrane and as a result it creates a voltage difference across the membrane that is referred to as membrane potential. When a neuron is non-conducting a single the membrane potential is called the resting potential

is typically between $-60\,mV$ to $-80\,mV$. An action potential occurs due to a change in membrane potential above a threshold value due to a stimulus. The action potential has the following phases, depolarization, repolarization and hyperpolarization. A graph showing the generation of action potential is shown in the figure 01 below

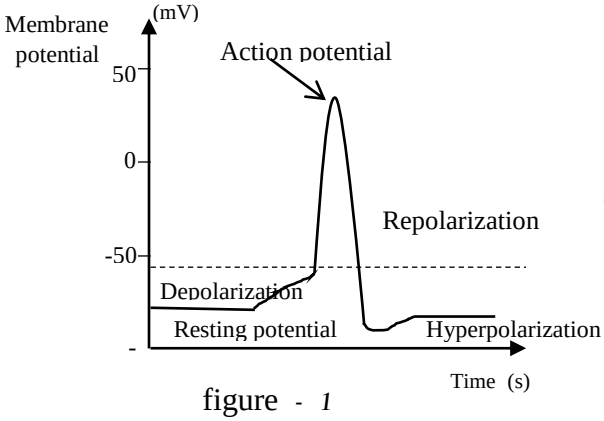

figure - *1*

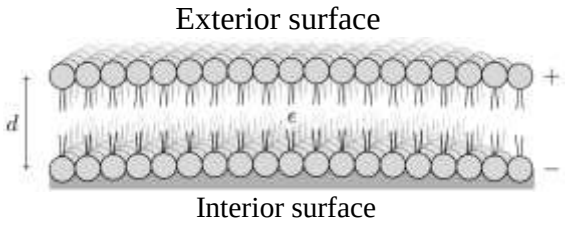

figure - *2*

Neurons have ion pumps. by the ion pumps ions are produced and thus ions can move across the membrane as a result, positive and negative ion charges are uniformly distributed across the exterior and interior surface of the membrane respectively. The wall of a neuron is made up of an elastic membrane. This can oppose the compression like spring. The effective force constant and equilibrium thickness (When no charge) of the elastic membrane are K and d_0 respectively. The elastic membrane has very large area A and negligible curve.

a) (i) What is resting potential?
(ii) is the reason for that the resting potential is marked in negative value in the graph?
(iii) How to occurring the action potential?
(iv) In which phase increase the action potential?

b) After the particular work is done by the ion pumps interior and exterior surface of the membrane is shown $+Q, -Q$ charges respectively. At the time thickness of the membrane is d. Permittivity of the membrane is ϵ. Structure of this membrane shown in figure 2.
   (i) By Using to gauss's theorem, find the electric field intensity is creating each direction by a charged accumulator. (Charges are in interior and exterior surface of the membrane as shown in figure 2)
   (ii) What is the force acting between the interior and exterior surface of the membrane?
   (iii) Find the thickness of the membrane d in terms of d_0, Q, ϵ, A and K.
   (iv) What is the electric field intensity appearing inside the membrane (by interior and exterior surfaces)?
   (v) Obtain an expression for electric potential V between the interior and exterior surface of the membrane in terms of Q and other parameters.
   (vi) What is the capacitance of the membrane?
   (vii) Determine the work done by the ion pumps in following each situation.
      1. When effective force constant K is in very larger, that is when charging from charge less stage.
      2. When effective force constant K is in very smaller, that is when ion pumps work until finishing the capacitance of the membrane.

5) a) Figure 1 shows the curve of stress against strain for a ductile material.

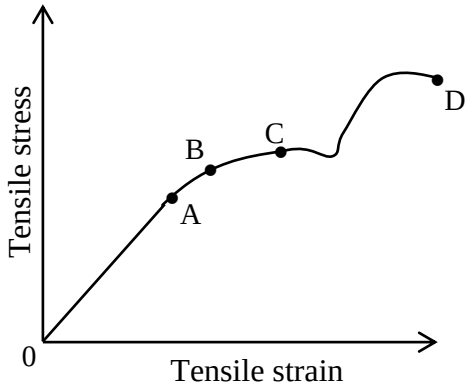

Figure 1

i. Define tensile stress and tensile strain

ii. Identify those shown by points A, B, C, D.

iii. What is the main difference between A and B

iv. Show that the stress – strain behavior roughly for a brittle material like glass.

b) Figure 2 shows the stress – strain behavior of the human body bones under the tension and compression. Considering that this material shows different elastic behavior in these two states.

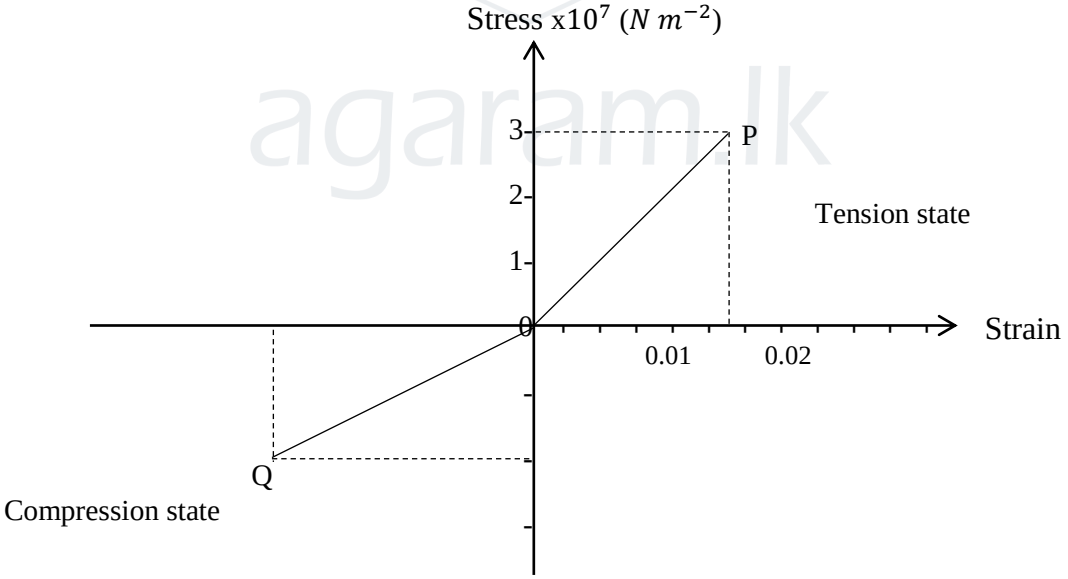

Figure 2

(i) Determine the young's modulus under the tension and compression states separately.

(ii) A particular long bone can be thought of as roughly a rod of uniform cross-section. This long bone has a length L and an internal cavity of uniform radius b. The outer radius of this bone is a.

1. If the force acting on the bone is F_0 when a bone undergoes a fracture under the state of tension, find the similar force in terms of F_0 when this bone undergoes a fracture under the state of compression.

2. Drive an expression for the work done on the bone in terms of $a, b, Y, \Delta l$ and L Δl is when compression is occurs in the bone. Let the young's modules of a bone in the state of tension is Y.

c) Find the force acting on the thigh bone (femur) when the fracture occurs in compression. It is known as that for the thigh bone of a human $a = 2\ cm, b = 1.5\ cm$ and $L = 25\ cm$. ($\pi = 3$ and the thigh bone can be assumed to behaves as in fig 1)

d) The stress, similar stage for fracture of a leg bone (Tibia) of a man having $70\ kg$ is $1500\ MPa$. Uniform cross section area of leg bone approximately3 cm^2. Assuming that this man comes to rest in 0.03 s from the moment his feet touch the ground when he jumps from a height, find the maximum height he can jump to safety.

6)

(A)

a. The circuit in figure 1 shows three resistors R_1, R_2, R_3 and a cell stack with emf E and zero internal resistance connected together.

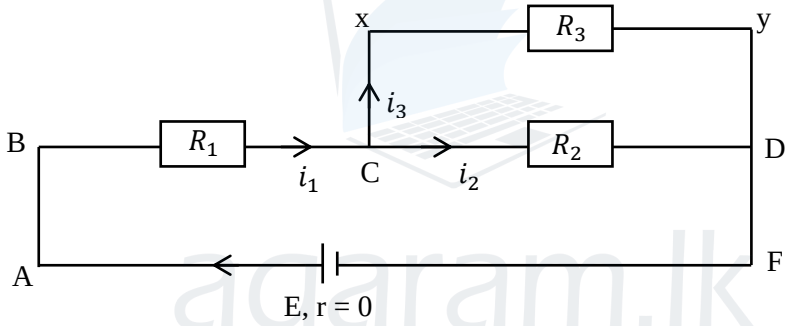

Figure – 1

i. Give two Kirchhoff's rules.

ii. Derive an expression relationship between the currents i_1, i_2, i_3 by applying Kirchhoff's first law at junction C.

iii. Obtain an expression for E by applying Kirchhoff's second law to the ABCDFA loop.

iv. Obtain an expression for $i_3\ R_3$ by applying Kirchhoff's second law to the CXYDC loop.

v. Magnitude of current i_1 is 2 A when $E = 30\ V,\ R_1 = R_2 = R_3 = 10\ \Omega$.

1. Determine the currents i_2, i_3.
2. Find the Potential difference between B and C, C and D.

b) Two identical head lamps H_1, H_2 and two identical side lamps L_1, L_2 of a car are connected in parallel with a source of emf $16\,V$ and internal resistance$2\,\Omega$. head lamps are rated at $24\,W, 12\,V$ and side lamps rated at $12\,W, 12\,V$. When only switch S_1 is working,

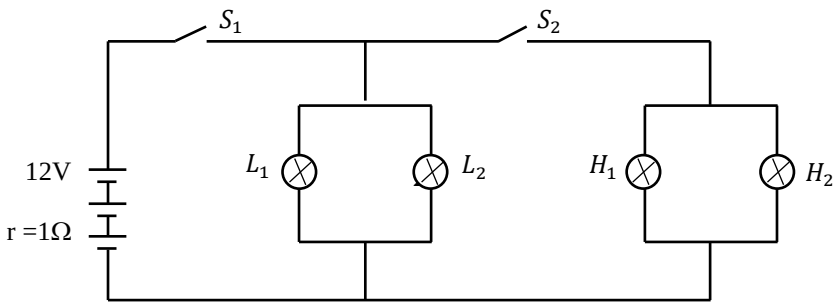

figure - 2

i. What is the voltage across L_1?

ii. What is the voltage across H_1 when the headlamps are on?

iii. What is the power generated by the battery when all four lamps are on?

iv. What happens to the brightness of L_1, L_2 when switch S_2 is operated?

v. What happens to the brightness of L_1, L_2 and H_1 if the lamp H_2 fails when the switches S_1, S_2 operate?

c) A hair dryer consists of a fan connected to an electric motor and resistance heating coils. As shown in figure 3, there are three switches A, B and C for working cold, warm and hot.

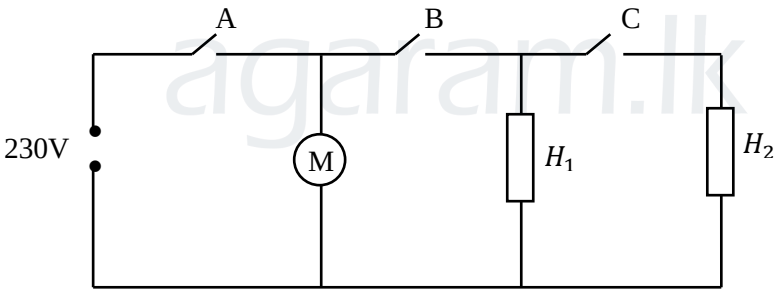

figure – 3

The electric motor works by obtained current of 3A from the power supply, while each resistance heating coil work by obtained current of 2A.

i. Which switches should work to get warm air from the hair dryer?

ii. Determine the current drawn from the power source to obtain the warm air.

iii. Which switches should work to get hot air from the hair dryer?

iv. Determine the current drawn from the power source to obtain the hot air.

v. What is the minimum current obtained from the power source to works hairdryer?

vi. What is the voltage across the electric motor when device is working?

(B)

Since by using only AND or NOR gates in circuits can be made other logic gates these gates are called universal logic gates.

a.

i. Obtain the output logic expressions Q_1, Q_2, Q_3, Q_4 in simplify format in terms of inputs (A, B) for given universal logic gates in figure 01 (P, Q, R, S). Identify the basic logic gates were made by each circuit from these results.

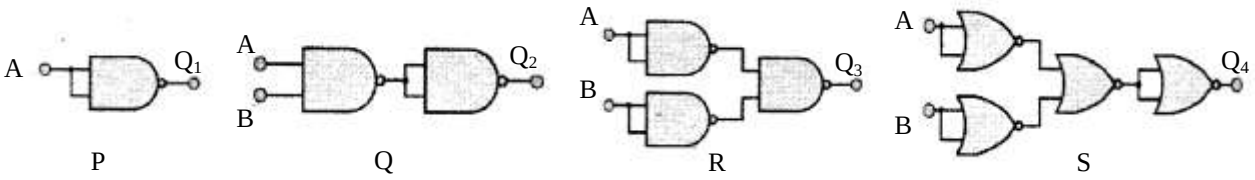

figure 01

ii. Copy and fill in the table given in figure 02 (b) on your paper by using logic gate circuit given in figure 02 (a). Identify the basic logic gate was made by circuit from this result.

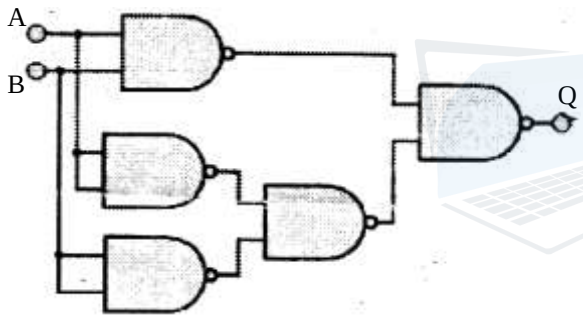

figure 02 (a)

A	B	Q
0	0	
0	1	
1	0	
1	1	

figure 02 (b)

iii. Draw the NAND universal logic gate circuit where output $(Q) = A.\bar{B} + \bar{A}.B$ Copy and fill in the table given in figure 02 (b) on your paper by using this logic gate circuit and identify the basic logic gate was made by circuit.

b. The circuit is given in figure 03 (a) which was made by two ideal diodes and suitable resistance R. Supply voltage V in the circuit is (+) 5 V.

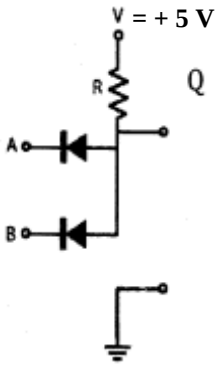

figure 03 (a)

A	B	Q
0V	0V	
0V	5V	
5V	0V	
5V	5V	

figure 03 (b)

i. Copy the table given in Fig. 03 (b) in your paper and fill in the output Q of the **voltage** obtained when 0V or 5V is supplied to the input terminals A, B of the circuit shown in Fig. 3 (a).

ii. Copy the table given in figure 03 (c) in your paper and using the result obtained in question b (i) above fill the output logic Q when logic 0 if the obtained voltage is 0V and logic 1 if the obtained voltage is 5V. Identify the basic logic gate was made by circuit from this result.

A	B	Q
0	0	
0	1	
1	0	
1	1	

figure 03 (c)

c.

i. Draw the SR flip flop circuit by using two NAND logic gates.

ii. Write the truth table of SR flip flop.

iii. Copy the signal diagram given in figure 04 and draw the output (Q) signals of the SR flip flop when the binary input signals change with time as shown in figure 04.

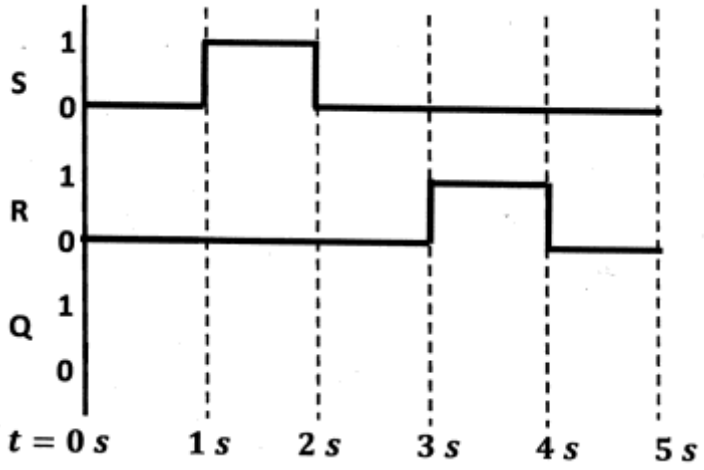

figure 04

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7)

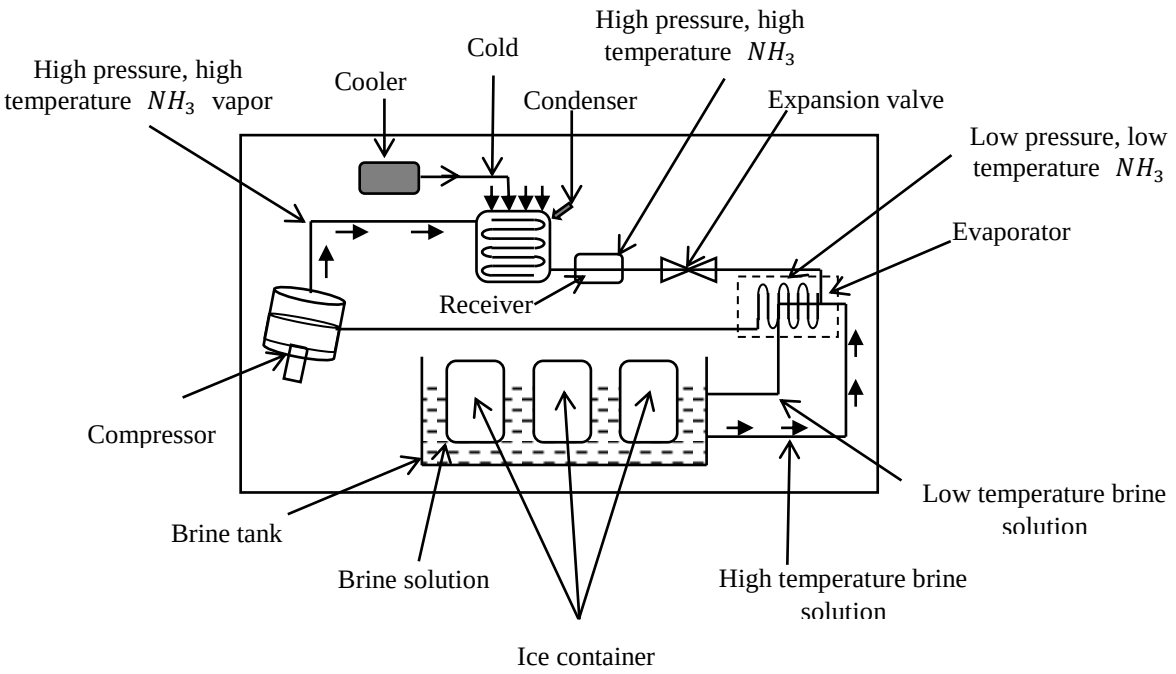

Figure 1

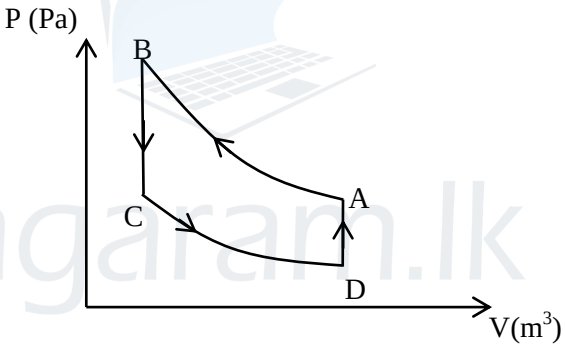

Figure 2

Figure 1 shows a model block diagram of an ice factory. Here $NH_{3(g)}$ and Brine are used as primary refrigerant and secondary refrigerant. Here $NH_{3(g)}$ is rapidly compressed by compressor, then cooled down by condenser, and suddenly is being expanded by the expansion valve. The primary refrigerant then receives heat in the evaporator and returns to the compressor. This process continues as a cyclic process. Figure 2 shows the P versus V graph for this cyclic process.

At the same time the secondary refrigerant goes from the brine tank to the evaporator and back to the tank. Ignore the heat lost to the environment when calculating for the secondary refrigerant.

Specific heat capacity of water is $4200\ J\ kg^{-1}K^{-1}$

Latent heat of fusion of ice is $3.36\ 10^5\ J\ kg^{-1}$

Specific heat capacity of ice is $2100\ J\ kg^{-1}K^{-1}$

Specific heat capacity of brine is $4000\ J\ kg^{-1}K^{-1}$

a.

i. State the first law of thermodynamics.

ii. Write the equation for this law of thermodynamics and identify each quantity.

iii. Define adiabatic process.

b.

i. Identify the process $A \rightarrow B, B \rightarrow C, C \rightarrow D$ and $D \rightarrow A$, Also tabulate the names of the parts where they take place.

ii. Find the change in internal energy. if the work done on the gas is $5000\,J$ when one time compressed by the compressor.

iii. Find the amount of heat gained or lost by the evaporator, if the change in internal energy in the evaporator is $3950\,J$.

iv. Where is heat gained or lost?

c. $600\,kg$ of water at 30^0C in a brine tank takes one hour to turn into ice at -6^0C. Also assume that the circulating brine enters at -16^0C and leaves at -6^0C.

i. What is the amount of heat must be taken from the water that turns into ice at 1second?

ii. What is the number of cyclic processes required to absorb the heat in question c(i) above?

iii. Find the mass flow rate for the brine tank.

iv. What is the purpose of using brine, without using pure water for the process?