FWC

G.C.E. A/L Examination March - 2020

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education, Northern Province.

Grade :-13 (2020)	Physics	Time:- 2.00 Hours

Part – I

01. SI unit of dielectric permitivity is

1) $C^2N^{-1}m^{-1}$ *2)* Nm^2C^{-2} *3)* $H\,m^{-1}$ *4)* $F\,m^{-1}$ *5)* $CN^{-1}m^{-2}$

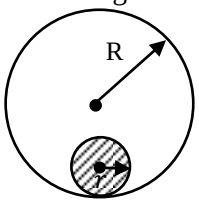
02. The phase difference between the wave source and the point which is at a distance $x$from the wave source, in a progressive wave of wavelength λ is

1) $\frac{x}{\lambda}$ *2)* $\frac{\pi x}{\lambda}$ *3)* $\frac{x}{2\pi}$ *4)* $\frac{2\pi x}{\lambda}$ *5)* $\frac{\lambda}{2\pi x}$

03. The fundamental frequencies of steel wires having same length and stretched by same force are $440\ Hz, 660\ Hz$ respectively. The ratio between the diameters of the wires.

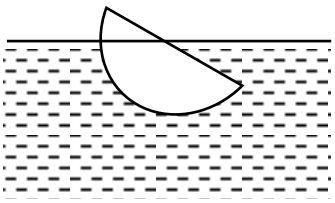
1) $2:3$ *2)* $3:2$ *3)* $\sqrt{3}:\sqrt{2}$ *4)* $9:4$ *5)* $4:3$

04. If the time taken for a circular disc of radius r to rotate around a fixed ring of radius R completely, without slipping and by rolling continuously inside the ring, is T, the instantaneous speed of the point which lies on the edge of disc which is directly opposite to the point of disc in contact of ring is.



1) $2\pi\,(R-r)/T$ *2)* $4\pi\,(R+r)/T$ *3)* $4\pi\,(R-2r)/T$
4) $2\pi\,(R-2r)/T$ *5)* $4\pi\,(R-r)/T$

05. A non – uniform solid hemisphere is partially immersed as shown in the figure. The equilibrium of hemisphere is.

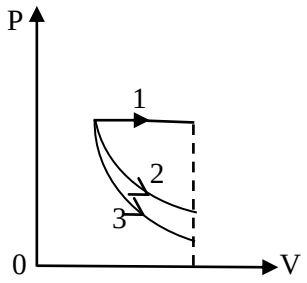


1) Stable equilibrium.
2) Unstable equilibrium.
3) Neutral equilibrium.
4) Neutral stable equilibrium.
5) Neutral, unstable equilibrium.

06. A generator produces a power of 22 kW in 220 V and current of 100 A. The energy is brought to a distance 100 km. The power dissipated (in kW) in this conductor of resistance 1 Ω is

1) 2 *2) 5* *3) 10* *4) 15* *5) 20*

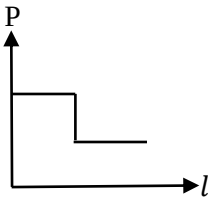
07. The P – V curve shows that an ideal gas is involved with thermodynamic processes denoted by 1, 2, 3. Each process is done from same initial state to same final volume. If 1, 2, 3 are involved to any one of adiabatic, constant volume, isothermal processes, the correct one is.

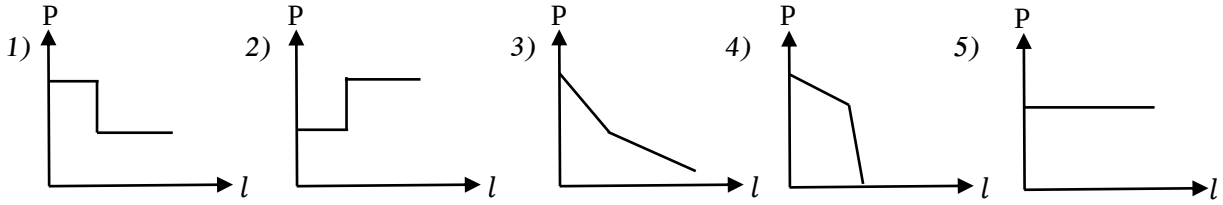


	Adiabatic process	Constant Volume process	Isothermal process
1)	1	2	3
2)	2	1	3
3)	2	3	1
4)	3	1	2
5)	3	2	1

08. The pressure change when an incompressible non-viscous liquid flows inside a tube in streamline flow is shown in the graph.

The pressure change when a viscous fluid flows under these conditions is.





09. Which of the following activities has/have systematic errors.

A. Taking reading using a incorrectly scaled meter ruler.

B. The error which can be reduced using finding the average of diameters measured in different places, when finding the diameter of a wire.

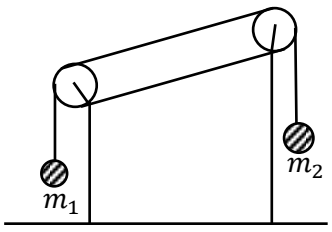
C. The error which can be reduced using finding the average if time of many osscillations, when measuring the period of oscillation of pendulum.

Form the above,

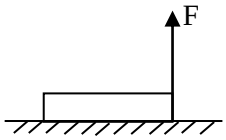
1) A is only True
2) A and B are only true
3) B and C are only true
4) A, B, C all are true
5) A, B, C all are false

10. The figure shows that the two masses are connected using a light string which goes above the pulleys which are on the ends of an inclined plane. All the contact surfaces are smooth. When the masses are released from rest, the inclined plane will,

1) Accelerate to the left if $m_1 < m_2$
2) Accelerate to the right if $m_1 < m_2$
3) Not move
4) Accelerate to the left whatever the masses are
5) Accelerate to the right whatever the masses are.



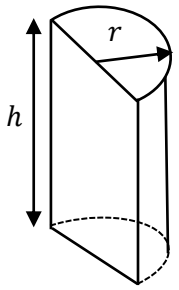
11. The figure shows a uniform rod with mass 'm' kepts on the horizontal floor. One end of the rod is tied with vertical string and pulls with a constant force of 'F' when the centre of mass of the rod begins to move upwards with accleration of 'a', which of the following correctly indicates the Normal reaction 'N' at the end of rod which is in contacts with horizontal floor (moment of inertia about the axis which passes through one end is $I = \frac{1}{3}m\ell^2$ when length of the rod isℓ)



1) $mg + \frac{ma}{3}$ *2)* $mg - \frac{2\,ma}{3}$ *3)* $\frac{mg}{2} + \frac{ma}{3}$

4) $mg - \frac{ma}{3}$ *5)* $\frac{mg}{2} + \frac{2\,ma}{3}$

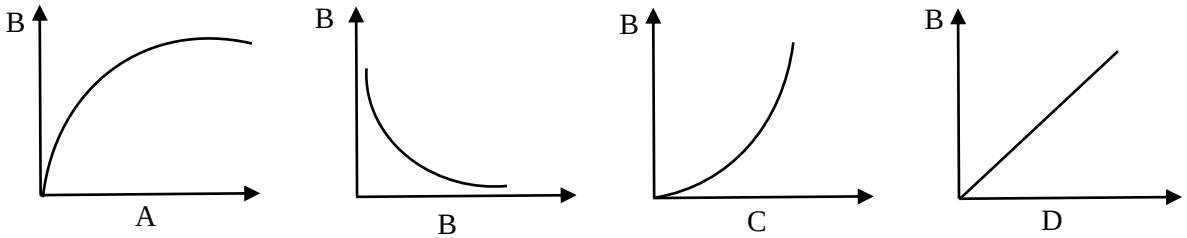
12. The figure shows a half-cylindrical vessel with radius 'r' and height 'h'. The cylindrical vessel is filled with a liquid of density 'ρ' which of the following correctly indicates the thrust on curved surface?



1) $h^2\,r\,\rho g$ *2)* $2h^2\,r\,\rho g$ *3)* $\pi\,r^2\,h\,\rho g$

4) $\pi\,rh^2\,\rho g$ *5)* $\frac{\pi\,rh^2\,\rho g}{2}$

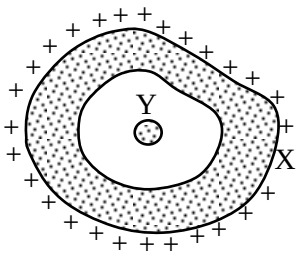
13. The wire with length$'\ell'$carries a constant current is made into a coil with radius R and have $'n'$ turns. Which of the following graph correctly indicates how the magnetic flux density at centre of coil 'O' varies with radius 'R' and number of turns 'n' ?



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

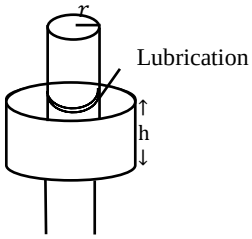
14. uncharged conducting ball 'Y' is kept inside the hollow charged conductor 'X'. Y is isolated from X. consider the following statements

A. Potential of ball 'Y' changes when it touches the conductor X.
B. Net charge in the hole of conductor is zero.
C. Potential of X and Y are same.



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

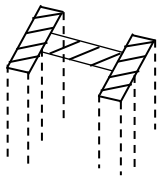
15. The axle with radius 'r' is rotates with angular velocity $'\omega'$ inside the fixed cylinder with height 'h' and internal radius $r + d$ $(d << r)$.Between the axle and cylinder lubrication oil with co-efficient of viscosity 'η' is applied. If 'F' is the viscous force, which of the following correctly indicates 'F'?



1) $F = 6\,\pi\,\eta\,\omega$ *2)* $F = 12\,\pi^2 h\,\eta\,\omega$ *3)* $F = \frac{2\pi r h \eta \omega}{d}$

4) $F = 2\,\pi^2\,h$ *5)* $F = \frac{2\pi r^2\,h\eta\omega}{d}$

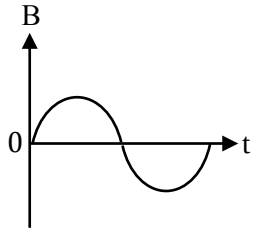
16. The roof with a mass of $500kg$ stands on the 4 steel rods with the cross-section of 'H' The height and area of cross-section of each steel rod is $8m$ and $25cm^2$. The young modulus of steel is $2 \times 10^{11}\,Nm^{-2}$consider that weight of the roof hold equally by 4 steel rods. For how much length, a steel rod contracts due to the weight of roof?

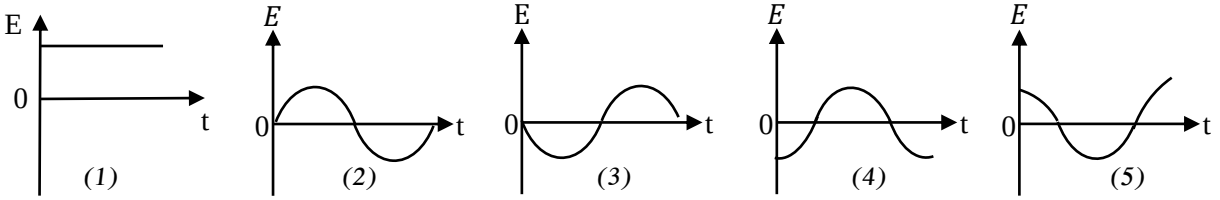


1) $1 \times 10^{-2}\,mm$ *2)* $2 \times 10^{-2}\,mm$ *3)* $2.5 \times 10^{-2}\,mm$

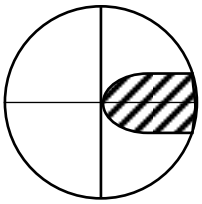
4) $5 \times 10^{-2}\,mm$ *5)* $8 \times 10^{-2}\,mm$

17. The graph shows how the magnetic flux density (B) across the closed loop varies with time which of the following graphs correctly indicates how the induced electromotive force (E) changes with time?



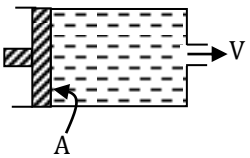


18. The figure shows how the reading is taken using Travelling microscope. Main scale of the travelling microscope scaled in mm. 50 vernier scale divisions coincides with 49 divisions of $\frac{1}{2}\,mm$. Which vernier scale division should be coincides with a division in main scale when the reading is $2.685cm$



1) 5 2) 15 3) 25 4) 35 5) 45

19. As shown in the figure when the constant force 'F' is applied by using the piston with area of cross-section 'A' in to the cylinder filled with liquid of density 'ρ', liquid flows out with a constant velocity 'V' through the hole with area of cross-section 'a' at the other end. Which of the following indicates pressure 'P' created due to the force applied in piston?



1) $P = \frac{1}{2}\,\rho\,V^2\frac{A^2}{a^2}$ *2)* $P < \frac{1}{2}\,\rho\,V^2\frac{A^2}{a^2}$ *3)* $P = \frac{1}{2}\,\rho\,V^3\frac{A^2}{a^2}$

4) $P > \frac{1}{2}\,\rho\,V^3\frac{A^2}{a^2}$ *5)* $P > \frac{1}{2}\,\rho\,V^2\frac{A^2}{a^2}$

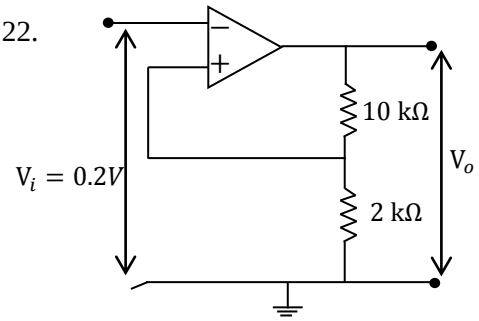
20. Water of mass $0.6\,kg$ at a temperature $30^{\circ}C$ is kept inside a thermally insulated vessel which has negligible heat capacity A light bulb of power $700\,W$ is completely immersed inside the water and switched on. If the temperature of the water is increased to $100^{\circ}C$ in 7 minutes, the thermal efficiency of this bulb is, (specific heat capacity of water is $4200\ \mathrm{J}kg^{-1}{}^{\circ}\mathrm{C}^{-1}$)

1) 70% 2) 60% 3) 49% 5) 42% 5) 40%

21. The electromotive force induced in a generator is 130 V. What is the resistance of Armature when the potential difference between the terminals of the Armature is 125 V and current through Armature is 25A.

1) 0.5 Ω *2)* 0.2 Ω *3)* 1 Ω *4)* 1.5 Ω *5)* 2.4 Ω

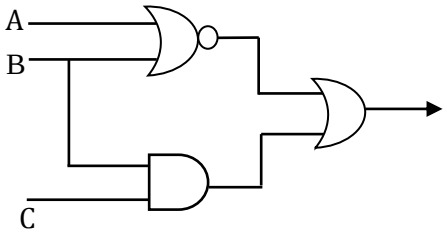
22.



An input voltage 0.2V is applied to an operational Amplifier. The output voltage V_o is.

1) 0.20 V 2) 1.0 V 3) 1.2 V
4) 0.08 V 5) 8.0 V

23. Which of the following Boolean expression shows the given logic gate.



1) $\left(\overline{A+B}\right)+(B+C)$ *2)* $(A+B)+(B.C)$

3) $\left(\overline{A+B}\right)+\left(\overline{B+C}\right)$ *4)* $\left(\overline{A.B}\right)+(B.C)$

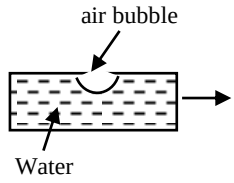
5) $\left(\overline{A+B}\right)+B.C$

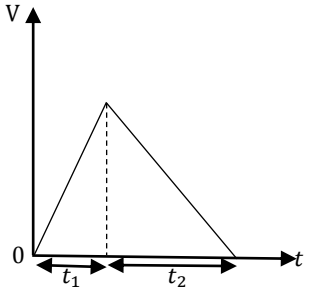
24. Which of the following statements about water and water vapour at same temperature, is / are correct.

A. Water vapour molecules have high speed and water molecules have low speed.
B. The potential energy between the water vapour molecules is greater than water molecules.
C. There would be a change in kinetic energy of water molecules during proper phase change.

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

25.





The velocity time graph of a sprit level moving in the direction shown in the figure is given which correctly shows the positions of air bubble during the time intervals t_1 , t_2.

1) 

2) 

3) 

4) 

5) 

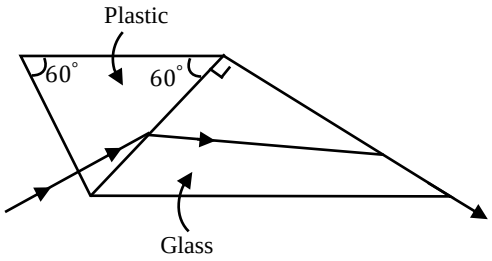
26.

Lens	Focal length f/mm	Diameter d/mm
1	50	20
2	100	10
3	200	30
4	200	50

The suitable selection to make a Astronomical telescope with high angular magnification and clear image is.

	Eyepiece	objective
1)	1	3
2)	1	4
3)	2	3
4)	2	4
5)	1	2

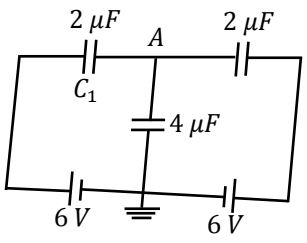
27. Isosceles right angled triangular glass prism and an equilateral triangular plastic prism were kept as shown in the figure. The light ray falls perpendicular on one side of the plastic prism and goes through as shown in the figure and emerges after grazing the face of glass prism what is the refractive index of plastic prism (Refractive index of glass is 1.5)



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

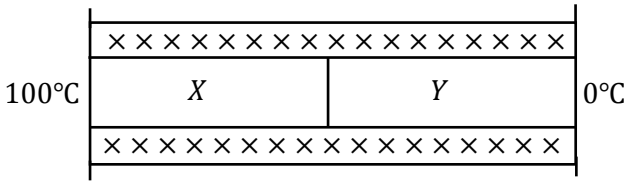
28. Consider the statements regarding the vibrating air column inside the one – end closed tube.
    A. Resonance frequencies are odd multiples of fundamental frequency.
    B. Low air pressure is at the closed end of the tube.
    C. The wave length of sound column changes with humidity.
    of the above statements.
    1) A is only True 2) A and B are only True 3) A and C are only True
    4) B and C are only True 5) A, B, C all are True

29. The charge in the capacitor C_1 in the circuit shown in the figure.



1) $6\ \mu C$ *2)* $12\ \mu C$ *3)* $18\ \mu C$
4) $24\ \mu C$ *5)* $30\ \mu C$

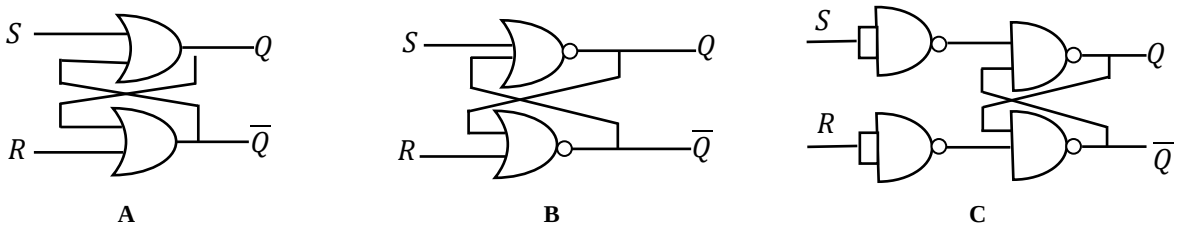
30.



An insulated compound conducting rod is made by connecting two conductors X, Y end to end. Rods X, Y have same cross sectional area of $1\,cm^2$, having lengths 1.8 m, 1.6 m and having thermal conductivities $300\,Wm^{-1}K^{-1}$, $400\,Wm^{-1}K^{-1}$ respectively. What is the rate of flow of heat through this conducting rod when their free ends are kept at $100^{\circ}C,\ O^{\circ}C$ respectively.

1) 0.5 W 2) 1 W 3) 1.5 W 4) 2 W 5) 2.5 W

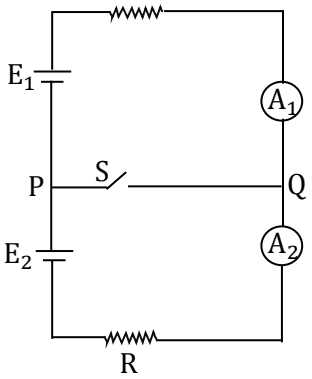
31. In which of the following gate circuits, S – R flip – flop can be obtained?



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

32. The internal resistance of cells and ammeters shown in the circuit is zero when the switch is closed and P and Q are made to short circuit, what will happen to the ammeter readings. ($E_1 > E_2$)

	Reading of A_1	**Reading of A_2**
1)	Increases	Increases
2)	Increases	Decreases
3)	Decreases	Decreases
4)	Decreases	Increases
5)	Equal to A_2	Equal to A_1



33. The maximum force a string of diameter 2cm can withstand is $1.5 \times 10^5\ N$. Themaximum force (breaking strength) a string of diameter 1 cm made of same material, can with stand is

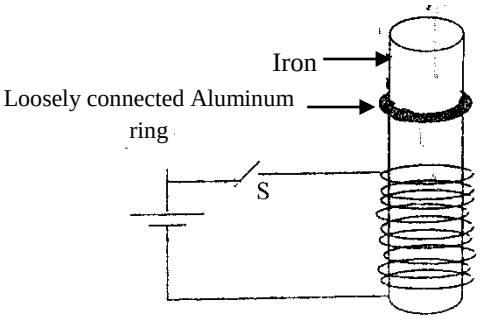
1) $0.375 \times 10^5\ N$ *2)* $2 \times 10^5\ N$ *3)* $6 \times 10^5\ N$
4) $9 \times 10^4\ N$ *5)* $12 \times 10^4\ N$

34. In the following setup, the Aluminum ring is thrown upwardly when the switch S is closed.

A. Because Aluminum changes as magnet.

B. Because, a charge is induced on Aluminum ring.

C. Because a current is induced on the Aluminum ring.

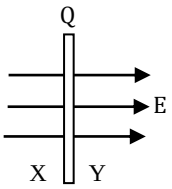


Of the above, the correct statement/s is/are

1) A, B, C all 2) A and B only

3) B and C only 4) A only 5) C only

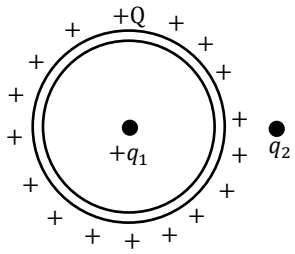
35. A conducting plate of area A is isolated and given a charge Q. This plate is kept perpendicular to the electric field intensity in a uniform electric field E. The whole plate is kept inside the field. The charges on the surfaces X, Y are.



1) $\frac{Q}{2}, \frac{Q}{2}$ *2)* $\frac{Q}{2}+EA\varepsilon_0, \frac{Q}{2}+EA\varepsilon_0$ *3)* $\frac{Q}{2}-EA\varepsilon_0, \frac{Q}{2}-EA\varepsilon_0$

4) $\frac{Q}{2}+EA\varepsilon_0, \frac{Q}{2}-EA\varepsilon_0$ *5)* $\frac{Q}{2}-EA\varepsilon_0, \frac{Q}{2}+EA\varepsilon_0$

36. Thin hollow conducting sphere has a charge of Q on its surface charge $q_1$is placed in centre and q_2 is placed outside of the conducting sphere. All the charges are positive. Which of the following statement is true?



1) Force acts on the charge q_1 towards right.

2) Force acts on the charge q_1 towards left.

3) Force acts on the charge q_1 is zero.

4) Electric field intensity is inside the hollow conducting sphere is zero.

5) Electric potential inside the hollow conducting sphere is zero.

37. Some people are inside the closed room. They felt discomfort due to sweating after sometime. To avoid this discomfort,

A. Allow the fan inside the room to rotate fatly.

B. Allow the refrigerator inside the room to operate with door open.

C. Open the door of the room

Which of the above is / are wrong?

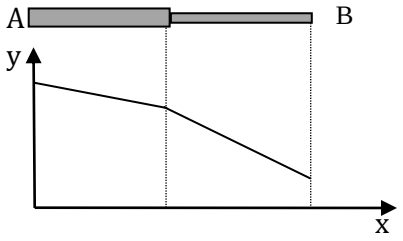
1) A only 2) Only C 3) Only A and B

4) Only A and C 5) Only B and C

38. Magnetic flux changes by $\Delta\phi$ in Δttime across the circuit with resistance R. If 'Q' is the charge passed through any point of the circuit.

1) $Q=\frac{1}{R}\frac{\Delta\phi}{\Delta t}$ *2)* $Q=\frac{\Delta\phi}{R}$ *3)* $Q=\frac{\Delta\phi}{\Delta t}$ *4)* $Q=\frac{R\Delta\phi}{\Delta t}$ *5)* $Q=\frac{\Delta\phi\Delta t}{R}$

39. The graph shows how the quantity 'y' changes with the distance 'x' which is measured from 'A' in the combination of AB. So what quantity 'y' be.



A. y is the temperature when combining rod AB is made of same material and lagged without any loss of heat.

B. If AB is a combined tube, Quantity 'y' is the pressure of the viscous fluid in a steady flow.

C. 'y' is electric potential when AB is a combining conductor made of same material

which of the above statement/s is/are true?

1) Only A 2) Only B 3) Only A and B

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

40. Gravitational field intensity at the surface and radius of the planet are 'g'and 'R' respectively. Boltzman's constant is 'k' and mass of H_2 gas molecule is 'm' At which of the following temperature that the root mean square speed of H_2 gas molecules and escape velocity at the surface of the planet becomes equals to each other?

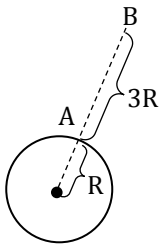
1) $\frac{2\,mg\,R}{3K}$ *2)* $\frac{mg\,R}{2K}$ *3)* $\frac{3\,mg\,R}{2K}$ *4)* $\frac{2\,mg\,R}{K}$ *5)* $\frac{mg\,R}{K}$

41. Hydrogen (H_2) gas molecules move towards the observer at the speed of $3 \times 10^3\ ms^{-1}$by releasing light at the frequency of 4.57×10^{14}Hz at the 700K temperature what is the change in the frequency of light observed by the observer approximately (speed of light in air is $3 \times 10^8\ ms^{-1}$)

1) $4.57 \times 10^6\ Hz$ *2)* $4.57 \times 10^9\ Hz$ *3)* $1.52 \times 10^{11} Hz$

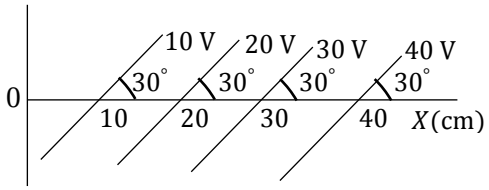
4) $1.52 \times 10^9\ Hz$ *5)* $4.57 \times 10^{11} Hz$

42. The gravitational potential energy at the point 'B' which is at the height of '3R' from the surface of the earth with radius 'R' is $-16/3$ kJ what the minimum energy is needed to move the object from A to B.



1) – 8kJ 2) 16 kJ 3) 32 kJ 4) – 16 kJ 5) – 32 kJ

43. The figure shows the equi-potential surfaces which of the following correctly indicates the magnitude and direction of electric field intensity?



1) $100\ V\ m^{-1}$, along 'X' axis.

2) $100\ V\ m^{-1}$, along the direction which makes 60° with 'X' axis

3) $200\ V\ m^{-1}$, along the direction which makes 60° with 'X' axis.

4) $200\ V\ m^{-1}$, along the direction which makes 120° with 'X' axis.

5) $200\ Vm^{-1}$, along the 'X' axis.

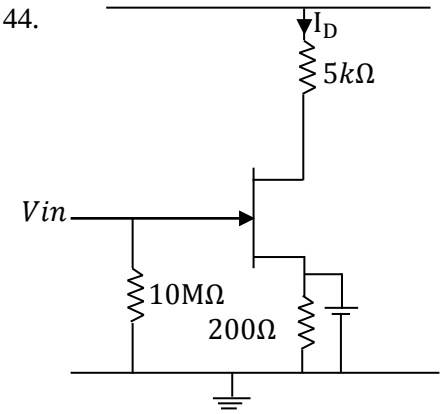
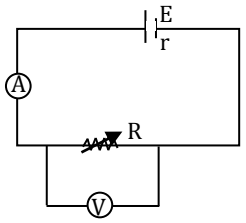
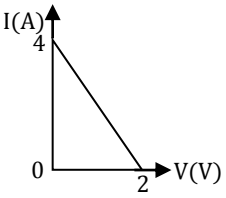
44. 

Figure shows the circuit of field effect transistor. If $I_D = 2.5\ mA\ V_{DS} = ?$

1) 12 V
2) 15 V
3) 17 V
4) 20 V
5) 24 V

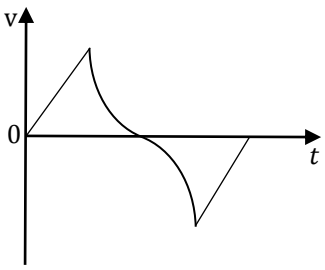
45. The graph shows how the ammeter reading varies with voltmeter reading when changing the resistance 'R' electromotive force of cell and its internal resistance respectively are.



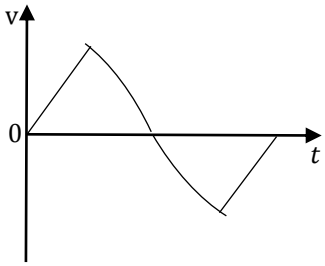


1) $2\ V, 0.5\ \Omega$ *2)* $2\ V, 1\ \Omega$ *3)* $2\ V, 2\ \Omega$ *4)* $4\ V, 1\ \Omega$ *5)* $2\ V, 2\ \Omega$

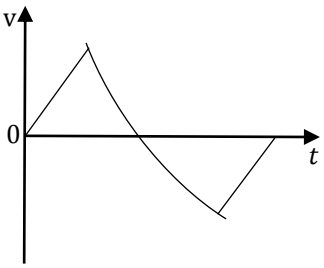
46. One end of a light elastic string is fitted to a fixed point and a mass hangs on the other end. The mass is allowed to fall after it lifted up to the fixed point consider that there is no loss of energy and string can't exceed proportional limit which of the following correctly indicates velocity (V) time (t) graph for the motion of the object until the object momentarily rest at the initial position



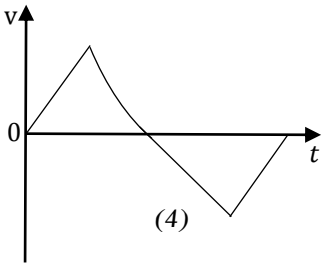
(1)



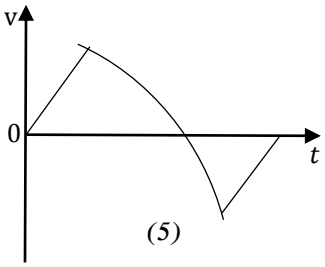
(2)



(3)



(4)



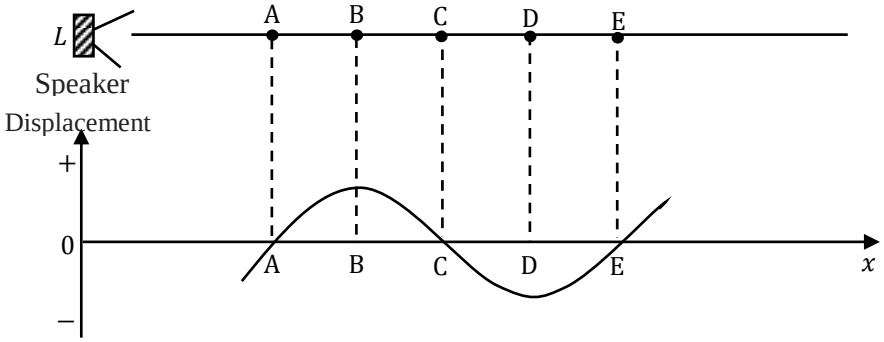
(5)

47. Focal length of lens in simple microscope is 10cm. If near point of eye is 30 cm, what is the object distance needed to get the maximum angular magnification?

1) 5 cm 2) 6 cm 3) 7 cm 4) 7.5 cm 5) 9 cm

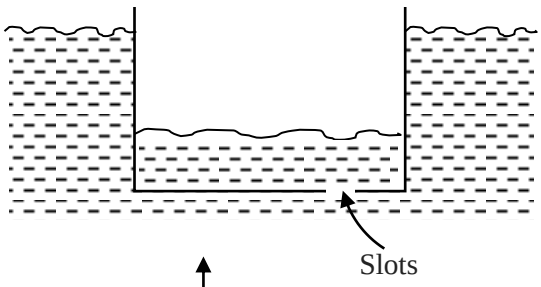
48. From which of the following methods, sensitivity of the moving coil galvanometer can be increased.
    A. By increase the number of turns in the coil.
    B. By decrease the strength in the poles of magnet.
    C. By winding coil at the frame which can rotate about soft iron cylinder.
    D. Using the Hair spring with higher torsion constant.
    Which of the above is/are true?
    1) Only A and B 2) Only A and D 3) Only A and C
    4) Only A, B and C 5) Only B, C and D

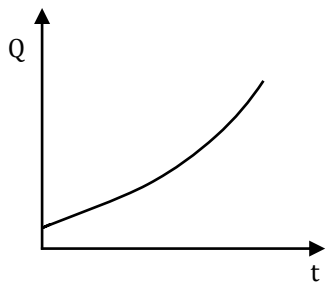
49. The figure below shows the speaker 'L' emitting sound continuously at frequency 400 Hz in the positive direction 'x' axis. And also shows displacement from the resting point versus time graph of air particles along 'x' axis (consider that displacement of air particles in along the positive direction of 'x' axis as +)



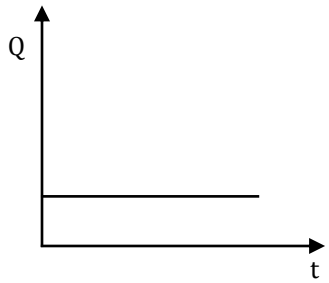
    Points which has/have instantaneous higher pressure?
    1) A 2) B 3) C 4) A, C 5) B, D

50. The figure shows a rectangular cross sectional shaped boat with a small hole in its bottom part begins to immerse by allowing the water to flow through the hole which of the following graph correctly indicates how flow rate of water varies with time. (Consider that boat is in horizontal position until immersed in water)

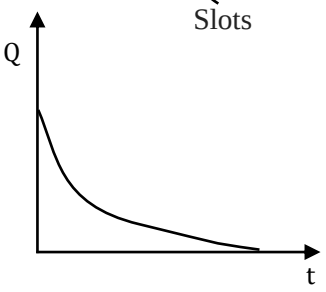




(1)



(2)



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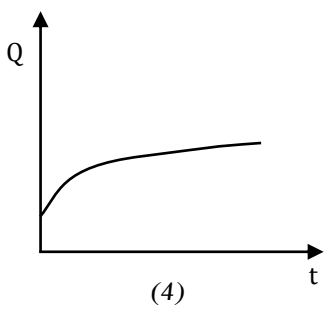

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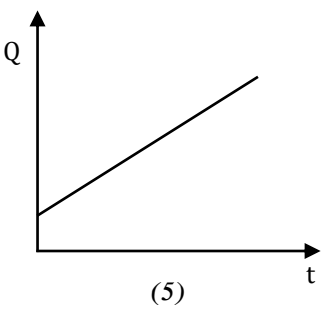


(5)

FWC

G.C.E. A/L Examination March - 2020

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education, Northern Province.

Grade:-13 (2020)	Physics II A	Time:- 3.00 Hours 10 minutes

Part – II A

❖ **Answer all four questions in this paper.**

01. a) i) State Archimedes' principle.

……

……

……

ii) State two applications of Archimedes' principle.

……

……....

b) The relative density of a solid and liquid to be determined using Archimedes' principle. For this purpose, a student has set up an apparatus as shown below.

Figure I

c) The figure below shows the reading obtained when the stone was weighed.

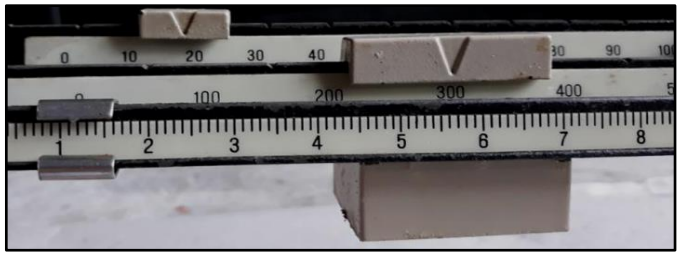
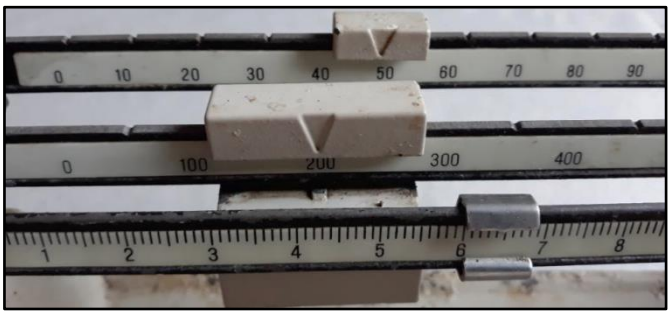


Figure II

What is the mass of the stone? (say w_1)

……

d) The figure below shows the reading obtained when the stone was weighed in water. What is the reading of the balance? (say w_2)



உரு III

……

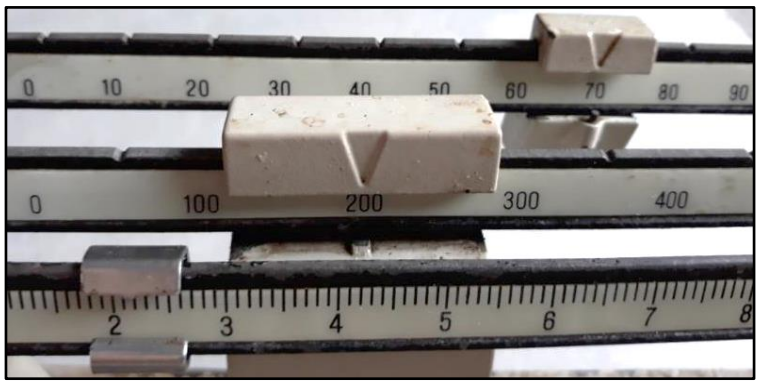
e) Give the expression for the determination of relative density of the stone, interms of $(w_1$ **and** $w_2)$

……

f) Find the relative density of the stone.

……

g) The following reading was obtained when the stone was weighed inside a liquid



உரு IV

What is the weight of the stone in the liquid? (Say w_3)

……

h) Give the expression for the determination of the relative density of the liquid in terms of w_1 , w_2 and w_3

……

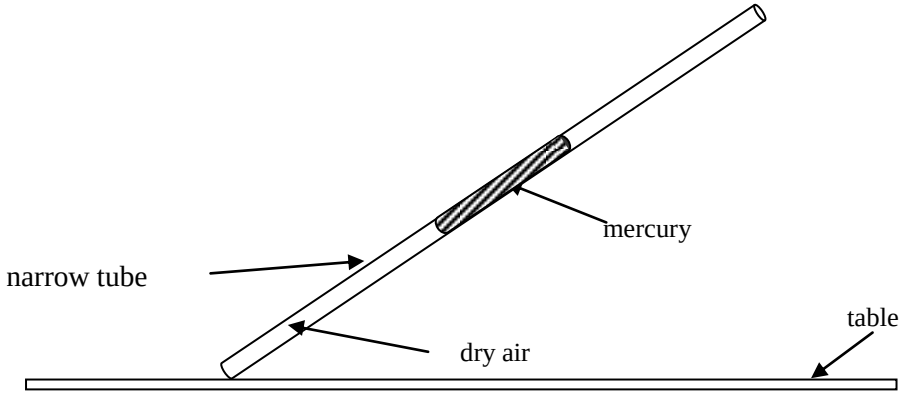
i) Find the relative density of the liquid

……..

j) What are the errors which can come up in this experiment?

……..

02.



The figure above shows an experimental set up for the determination of atmospheric pressure using a narrow tube closed at one end. In this, a dry air column of length ℓ cm is trapped by a mercury thread of length $x\ cm$. The tube has length L, area of cross – section a and its upper end is at a height h above the table.

a) In this experiment two quantities, in relation to trapped air, will be kept constant. What are these two quantities?

……..

b) when changing the inclination of the tube, should it be done very quickly or slowly? GIve reason for it.

……

……

c) Given that the atmospheric pressure is H (cm Hg) and the density of mercury is ρ. Write down the expressions for the volume (V) and the pressure (P) of the trapped air interms of quantities given above and previously stated.

……

……

d) Briefly state the procedure of this experiment and mention the measurements you would take.

……

……

……

……..……..

e) By making use of expressions you wrote in section(C), write the relationship between P and V and hence identify the additional quantities appearing in the relationship

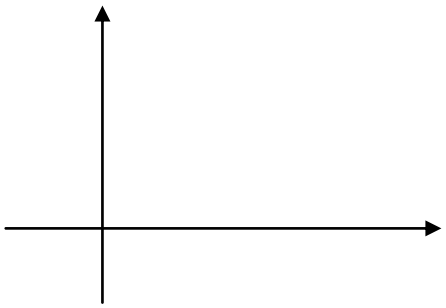
……

……

f) Rearrange the expression you wrote in section (e), to give a straight line graph with independent variable in the x - axis.

……
……
…….

g) i) Sketch the expected graph and label the axes clearly.



ii) How would you find out the atmospheric pressure from the graph?

……..
……..

iii) If x = 10 cm, L = 40 cm gradient = $1.64 \times 10^{-4}\text{cm}^{-2}$, and intercept = $0.05\ \text{cm}^{-1}$, find the value of the atmospheric pressure H. Take $1.64 \simeq \frac{1}{0.61}$

……
……
……

iv) What would be the length of the trapped air when the tube is held horizontally?

……
……..

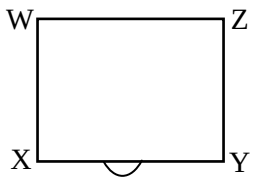
v) Could it be possible to carry out this experiment successfully by using a short length $(< 2cm)$ of mercury thread? Explain your answer.

……
……..

03. a) State the conditions under which total internal reflection can occur

……..
…….

b) The figure below shows a cubical glass block placed on a small coin. (The critical angle for glass – air is 42°)



i) A student makes an attempt to view the coin through the vertical face of the cube, will it appear to him? Explain with the help of a ray diagram originating from the coin

……

……

……

……

……

ii) Another student after placing a small quantity of water in between the coin and block attempts to view through the vertical forces of the block. Will the coin appear to him? Explain with a ray diagram originating from the coin.

……

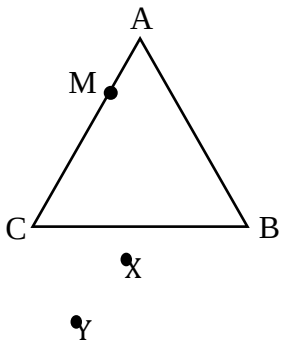
……

……

……

……

c) The refractive index of the material of a prism is to be determined. As shown in the figure, the prism is placed on a white sheet of paper and a pin M is errected to be in contact with face AC of the prism. The boundary of the prism is drawn on the paper.



i) In this experiment the pin M should be placed in contact with the face AC. Give reason for this.

……

……

ii) As you view AB through BC and move your eye from B to C, what do you expect to happen to the image of the pin M?

……

……

iii) How would you find out the required emerging ray experimentally be using two pins?

……

……

……

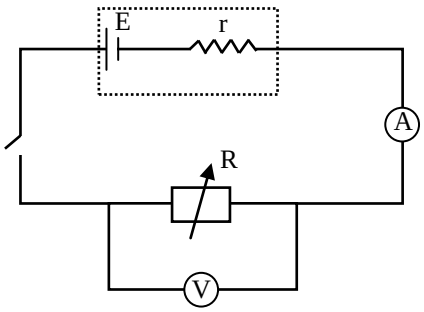
……

iv) The position of the two pins are marked by X and Y in the above figure. Construct the path of the ray.

v) What measurement you would obtain from your ray diagram? Mark this clearly in the diagram.

……

04. The figure below shows a circuit set up by a student to determine the electromotive force E, and the internal resistance r of a cell.



a) i) Mark the positive and negative terminals of the ammeter (A) of negligible internal resistance, and the digital voltmeter(V) of high internal resistance, shown in the figure by + and – signs.

ii) What electrical component can be used for the variable resistance R?

……

iii) When the graph is drawn with ammeter reading I along X – axis and the voltmeter reading V along Y – axis, the gradient of the graph is 0.5Ω and its intercept is 1.5 V.

Based on this, e. m. f. E ……

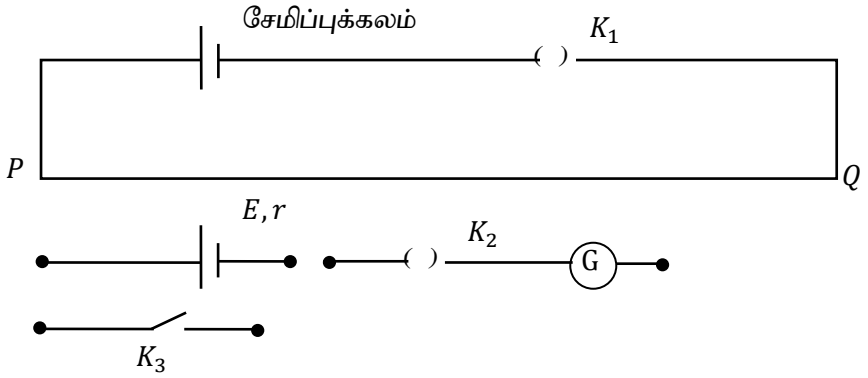
internal resistance r ……...

iv) The accuracy of this experiment depends on how accurately the potential drop across the terminals of the cell can be measured. To measure the potential drop, it is better to use a potentiometer rather than using a digital voltmeter. What is the reason for this?

……..…

……

b) Now, the student decided to use potentiometer in order to determine E and r accurately. The figure shows the incomplete setup of the arrangement used for this experiment. In this set up, the variable resistor (X), high resistance 5kΩ resistance box (Y), and sliding contact key are not shown. Sufficient number of connecting wires are provided.



i) Mark X and Y at the appropriate places and complete the circuit.

ii) Identify the suitable electrical component that can be used for X.

……

iii) When the value of X is R, balance lengths ℓ_0 and ℓ were obtained when key K_3 was open and closed respectively. Relate R and r with ℓ_0 and ℓ

……

.....

.....

iv) If the intension is to determin the value of r by drawing a suitable graph, then rearrange the expression obtained in b(iii) for this purpose

……

v) When the measured lengths ℓ and ℓ_0 are comparatively large, the accuracy of the measurement increases. Consider the following changes, the student may make it in the circuit in order to increase the accuracy. Put tick (√) sign against any one which is correct.

1) Connecting high resistance in series with PQ ( )

2) Choosing high value for X ( )

3) Choosing low value for X ( )

4) Reducing the value of Y ( )

G.C.E. A/L Examination March - 2020

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education, Northern Province.

FWC

Grade :-13 (2020)	Physics II B	

Part-II B

Essay Question

05. a) A car ,A, of total weight 1.2×10^4 N is travelling up an inclined road of length 4.8 km and of vertical height 0.3 km with a uniform speed of 16 ms^{-1}. The average frictional force acting on the car is 5.0×10^2 N.

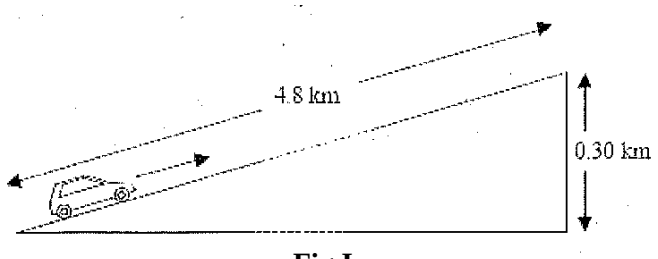


Fig I

i) What is the time taken by the car, A, to reach the top of the inclined road.

ii) Calculate the work done by the car, A, against the gravity.

iii) From your answer for a(i) and a(ii) , find the minimum power delivered by the car, A, to reach the top of the inclined road.

b) The car, A, after reaching the top of the inclined road it is brought to rest. It then continue its journey, down an inclined road of length 6.4 km as shown in the figure below. For the sake of saving fuel, the engine is shutdown and the car is allowed to travel down the road. The average value of resistance on the car during this motion is $5.0 \times 10^2\ N$.

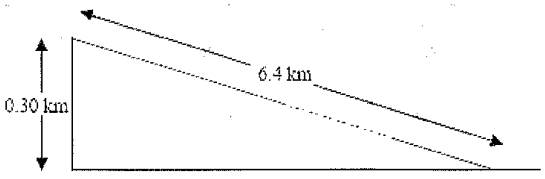


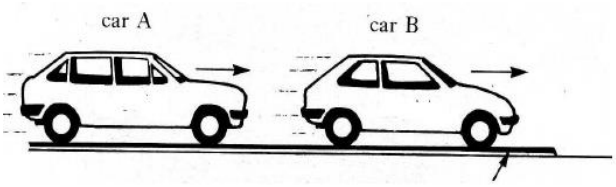
Fig II

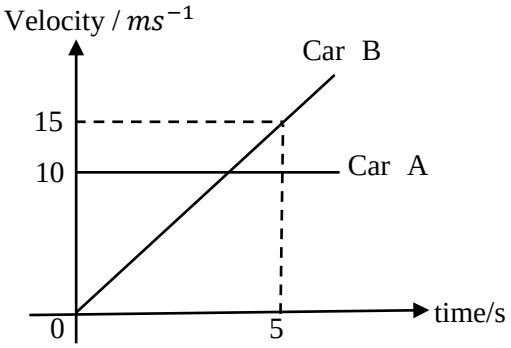
i) What is the acceleration of the car?

ii) What will be the speed of the car when it reaches the bottom of the road?

iii) In fact, the car is moving through the last 100 m down the inclined road with uniform speed. Calculate the frictional force acting on the car at this stage.

c) The car A, is travelling on a straight level road with uniform speed. It passes another car B parked by the side of the road. At the moment the car A, passes the car B, the car B start moving in the same direction as car A. The velocity – time graph given here shows the motion of car A and car B, right from the time car A is passing the car B





i) Find the initial acceleration of the car B.

ii) Find the distance between the car A and the car B at the end of 5.0 s

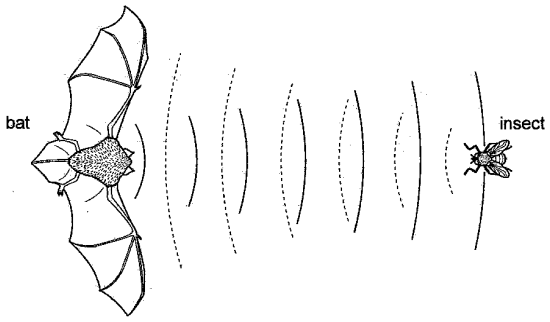
iii) The total weight of the car B is 1500 kg. At time 2.0 s, the tractive force exerted by the car B is 9000N

1) What is the frictional force acting on car B at this moment?

2) To maintain a constant acceleration, the tractive force exerted should be increased with time. Explain the reason behind this.

3) At the end of 6.0 s, the tractive force exerted by the car B reaches its maximum value and then it maintains it. Draw the velocity – time graph for the car B.

06. Bat emits high frequency sound. This sound is reflected by objects such as insects, fruits and obstacles and echo returns the bat. It locates the position of the objects using this echo. It is explained by the figure shown here.



a) Sound waves are longitudinal waves.

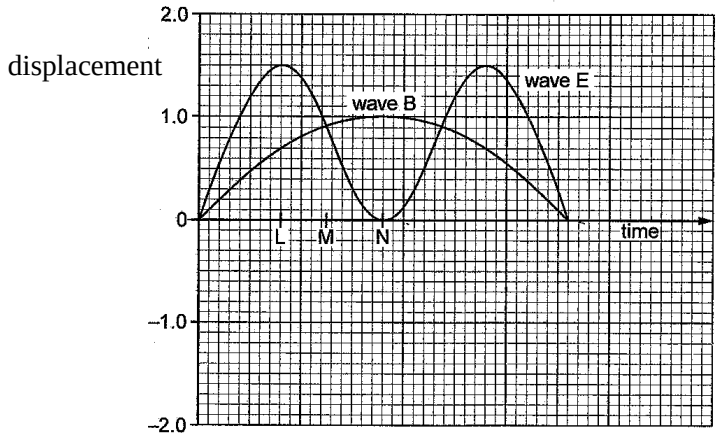
i) Explain the term, longitudinal waves, using molecular movement.

ii) In your answer sheet, mark the equilibrium positions of the molecules and their displaced position at any particular instant, hence draw the corresponding wave.

b) The sound emitted by a bat travels with a speed of $340\ ms^{-1}$. If the frequency of the sound emitted by the bat ranges from 20kHz to 80kHz, find the corresponding range of the wavelength.

c) Bat emits two wave forms, wave B and wave P, which superpose to form a wave E.

- Wave B gives information about the environment.
- Wave P helps to find the prey (food) [NOT SHOWN IN THE GRAPH]
- Wave E is the wave formed by the superposition of wave B and wave P.



i) Using the principle of superposition, calculate the displacement of wave P corresponding to time denoted by the points L, M and N on the time axis.

ii) Redraw the waves B and E on your answer sheet and on it draw the wave P.

d) The speed (V) of the reflecting body (prey) can be obtained by applying Doppler principle for the change in frequency of the wave. When wave P is reflected by the prey, the difference in frequency, Δf, between the incident wave and reflected wave can be proved to be given by the relationship given below.

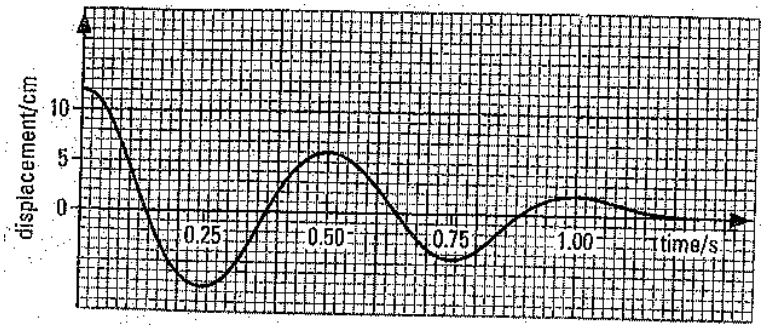
$$\frac{\Delta f}{f} = \frac{2v}{c}$$

Where, C is the speed $340\ ms^{-1}$ of the sound wave emitted by the bat.

i) The frequency of wave P is $50.80\ kHz$, and when it is reflected, the apparent frequency of the wave sensed by the bat is 51.25 kHz Calculate the speed of the prey.

ii) The bat best identify, even a small prey precisely when the wavelength of P is roughly same as the size of the prey. State the property of the which explain this.

e) The suspension of a car is tested by dropping the car from a low height on to a rigid concrete surface. The displacement – time graph for the resulting vertical oscillations of the car is shown in figure.

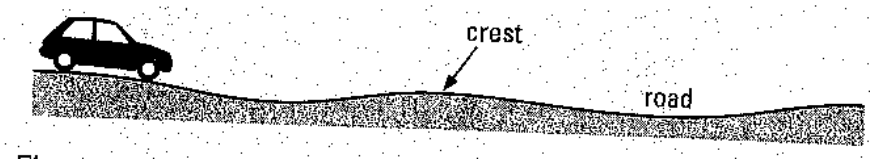


i) What is the frequency of the oscillation of the car?

ii) State how the results show that oscillations are damped.

iii) The effective oscillating mass of the car is 750 kg. The car has an identical spring at each of the four wheels. Determine the spring constant, in N m^{-1}, of each spring.

iv) As a warning for speeding drivers approaching a round about, it is suggested that the road be made so that it rises and falls as shown in figure.



Resonant oscillations are produced when the speed of the car is $110\ kmh^{-1}$

1) State the condition for resonant oscillations to occur.

2) Estimate the distance required between successive crests to produce resonance.

3) Sketch a graph showing how you would expect the amplitude of oscillation of the car to vary with speed of approach to the roundabout.

07. a) The figure 1 shows stress – strain behaviour of a uniform metal wire. Identify the points labelled A, B and C. What is the difference between the points A and B.

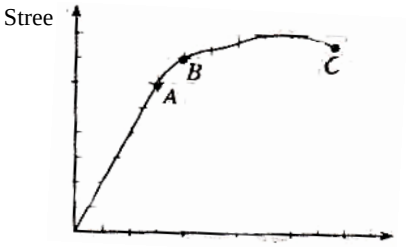


Figure I

b) The figure 2 shows the stress – strain behaviour of steel and copper wires having uniform cross - section.

i) Find the young's modulus for steel and copper.

ii) These two wires have equal lengths of 2 m and equal cross – sections of $0.8\ mm^2$. Find the highest loads that can be suspended individually to these wires without exceeding their proportional limit.

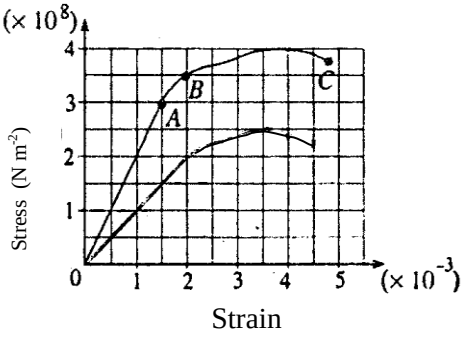


Figure 2

iii) Find the highest load that can be suspended to the compound wire, made by joining the above two wires end to end, without each wire not exceeding their proportional limit.

c) Assume that you are provided with four identical steel wires having same dimensions as stated in section (b). Using these wires, a uniform circular disc of negligible mass and of diameter 15 cm is hanged from a horizontal ceiling as shown in figure 3. The ends of the wires are attached to points P, Q, R and S at the circumference of the disc symmetrically and forms a square PQRS. The plan view of the disc is shown in figure (4). Calculate the mass to be placed at the centre of the disc such that it will be lowered by 1 mm to a horizontal position.

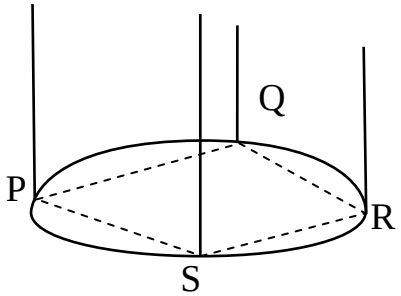


Figure *3*

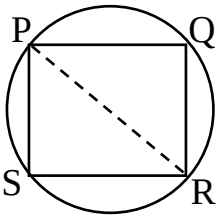


Figure *4*

d) Now, one of the wires (let it be P) being replaced with a copper wire of identical length and of cross – sectional area $2.4mm^2$ The disc should be made to continue at the lowered horizontal position by 1mm

i) Find the ratio of the tensions in the copper and steel wires.

ii) What is the magnitude of the load required to make this lowering?

iii) Copy the figure (4) in your answer sheet and mark the place, where the load you calculated in d (ii) to be placed, with letter X.

iv) Find the distance of the point X from the point P.

08. i) State Faraday's law of electromagnetic induction in words.

ii) State Lenz's law of electromagnetic induction in words.

iii) What is meant by magnetic flux?

iv) What is meant by magnetic flux density?

v) To which quantity, the electromotive force induced in a moving conductor, is directly proportional?

vi) How eddy currents are created in a conductor?

vii) State two applications of eddy currents.

Copy the figure 1 in your answer sheet and draw the eddy currents in the circular disc which is rotating with angular velocity ω as shown in the figure.

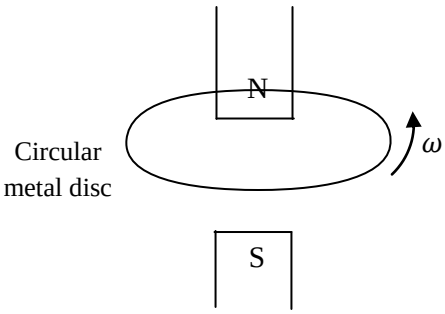


Figure *1*

viii) Copy the figure 2 in your answer sheet and mark the direction of the current in the rectangular conductor PQRS when the magnetic flux through the conductor increases with time.

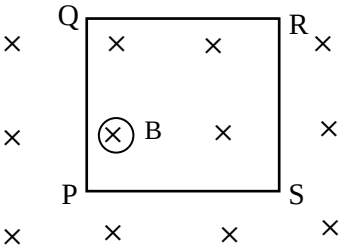
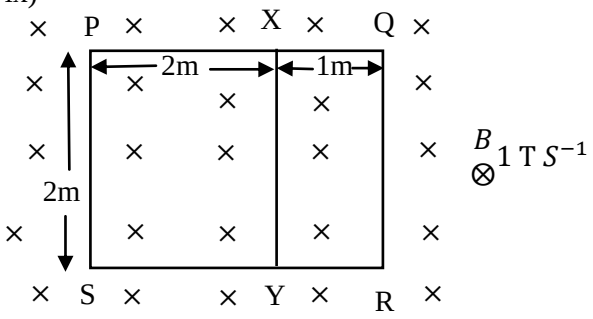


Figure *2*

ix)



PQRS is formed with a thin metal wires. The points X and Y are connected with the same kind of wire. PXYS is a square of side 2m. XQ = YR = 1m. It is placed in a uniformly increasing magnetic field at the rate of 1 T s^{-1}. If unit length of the wire has a resistance of $1\Omega m^{-1}$, calculate the current through PX, QX and XY.

09. **Answer either part (A) or part (B) only.**

A)

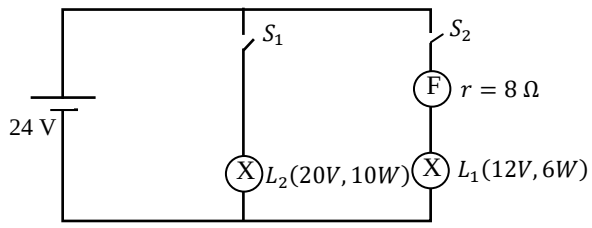
a) The electromotive force of an electric source is defined as the work done by the source on a unit charge. Using this definition of electromotive force (emf), find

i) the unit of $e.m.f$

ii) an expression for the power delivered by an electric source interms of its $e.m.f.E$ and the current I through it.

b) An electric source having e. m. f. E and internal resistance r is connected to an external resistor of resistance R. Obtain an expression for the energy dissipated in the circuit, in time t, in terms of E, r, R and t.

c)



The figure shows an electric bulb L_1 rated 12 V, 6 W and an electric fan (F) having internal resistance $8\ \Omega$ connected in series, is connected to a cell having internal resistance and of e. m. f. 24 V. Another electric bulb labelled as L_2 and rated 20 V, 10 W is connected in parallel across F and L_1

i) If the electric bulb L_2 glows with normal brightness when the key S_1 is closed, find

1) The current through electric bulb L_2

2) The internal resistance of the cell.

3) The power supplied by the cell to the circuit.

ii) Find the following at the instant the key S_2 is closed while key S_1 is kept open.

1) the resistance of electric bulb L_1

2) the current through the electric fan

3) the power supplied by the cell to the circuit.

iii) When only S_2 is closed the electric fan accelerates and reach a steady velocity after a short time and then L_1 glows as rated.

1) At this stage, find the current through the electric bulb.

2) Explain why the current presently in the circuit is less than the current at the instant of closing the key S_2

3) Calculate the induced back e. m. f by the fan when it is working at a steady state.

d) A student decided to use cells each having e. m. f. 6 V and internal resistance $4\ \Omega$. What is the minimum number of cells required for this purpose and illustrate with a diagram how they must be connected.

B) A logic gate is one which consists of high speed operating switch circuit. These logic gates are largely used in the operation of computers, calculators, robots and communication appliances.

a) i) State the three fundamental logic gates.

ii) Draw the symbols for the three fundamental logic gates and mark the inputs A and B and output F.

iii) For each fundamental logic gate give the truth table.

iv) State two benefits of digital technology

b) A student wishes to make a digital circuit which can automatically switch on a battery operated lamp when there is power failure in the night. Further, it must have facility to operate at any time by pressing a key. The student has the procedures to make three inputs P, Q and R using logic values(0, 1)

$P = 0$ When the switch is not pressed.

$P = 1$ When the switch is pressed.

$Q = 0$ at day

$Q = 1$ at night

$R = 0$ when there is power failure

$R = 1$ when there is power supply

If the student has designed and made the circuit using the three inputs P, Q and R such that when the output X = 1, the lamp lights up, and for the output X = 0, the lamp is put off. Based on this data answer the questions given below.

i) Give the truth table

ii) Give the expression for the outcome X of the truth table.

iii) Using Boolean algebra show that the X can be considered as $X = P + Q.\overline{R}$

iv) Draw the logic circuit that can give the outcome X.

10. a) i) State three methods by which an unsaturated vapour can be changed to saturated vapour.

ii) What do you understand from the term "dew point"?

iii) Define relative humidity in terms of dewpoint.

b)

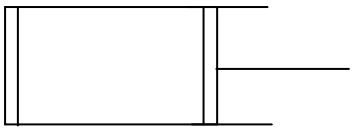


Figure I

Temperature (θ)°C	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Saturated vapour pressurė $(mm\ Hg)$	*5.5*	*6.3*	*7.2*	*8.2*	*9.3*	*10.5*	*12.8*	*14.0*	*15.1*	*16.2*	*17.5*

Figure II

The figure I shows a cylinder containing air of volume $1\,m^3$, at $20^{\circ}C$, having relative humidity of 60%. The fig II shows the variation of saturated vapour pressure (s. v. p) of water vapour with temperature. The molar mass of water $= 18g$. Gas constant $= 8.31\text{J mol}^{-1}K^{-1}$. Density of mercury $= 13000\ kg\ m^{-3}$. Use the data given and answer the following questions.

1) i) What is the dew point of the air inside the cylinder.

ii) What is the absolute humidity of the air inside the cylinder.

2) Find the new absolute humidity, relative humidity, and dew point when the volume of air inside the cylinder is changed to $0.6\,m^3$ without altering its temperature. (Assume that the air inside the cylinder has not become saturated due to this volume change)

3) What is the mass of water condensed when the volume of the air is changed to $0.25\,m^3$ without changing its temperature? Assume that the water vapour behaves like an ideal gas.

4) Presently, the condenced water vapour is removed from the cylinder and the volume is changed to its initial value. Find the present value of absolute humidity and the relative humidity of the air.

5) Explain, using the principle of thermodynamics, what would happen to the temperature of the gas in the cylinder when its volume is changed.

(a) Slowly

(b) rapidly