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Provincial Department of Education - NWP

01 S I

Second Term Test - Grade 13 - 2018

Index No.: ....

Physics I

Two hours

- **This paper consists of 50 questions and Answer all the questions.**
- **Use of calculator is not allowed.**
- **Write your index number in the space provided in the answer sheet.**
- **In each of the questions 1 to 50 pick one of the alternatives from (1),(2),(3),(4),(5) which is correct or most appropriate and mark your response on the answer sheet with a cross (x) in the answer sheet.**

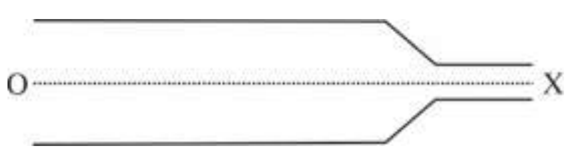
$(g = 10\ Nkg^{-1})$

01. The unit of moment of inertia is,

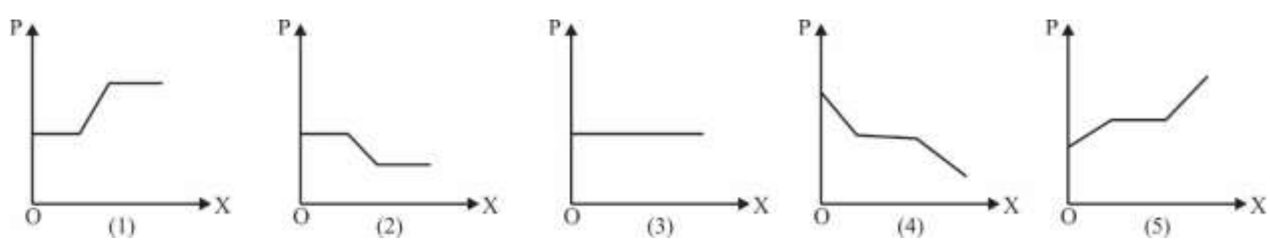
1. kgm 2. kgm^2 3. kg 4. m 5. $kgms^{-1}$

02. The sum of two forces acting at a point is $16N$. If the resultant force is $8N$ and its direction is perpendicular to the smaller force, then the force are,

1. $6N$ and $10N$ 2. $8N$ and $8N$ 3. $4N$ and $12N$
4. $2N$ and $14N$ 5. $6N$ and $2N$

03. 

A non-viscous, incompressible, steady, stream line flow of a liquid preceding through the above given tube. Which graph shows the correct variation [from o to x] in static pressure (P) of liquid flow.



04. The cylinder tube of a spray pump has a radius R, one end of which has n fine holes, each of radius r. If the speed of flow of the liquid in the tube is V, the speed of flow of the liquid through the holes is,

1. $\frac{V}{n}\left(\frac{R}{r}\right)^{\frac{1}{2}}$ 2. $\frac{V}{n}\left(\frac{R}{r}\right)$ 3. $\frac{V}{n}\left(\frac{R}{r}\right)^{3/2}$ 4. $\frac{V}{n}\left(\frac{R}{r}\right)^{2}$ 5. $\left(\frac{V}{n}.\frac{r}{R}\right)^{2}$

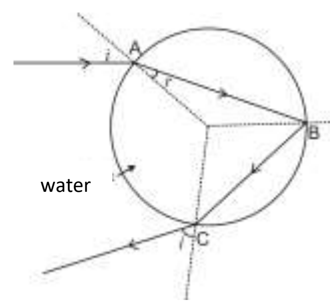
05. The end correction of an one end closed tube of length $58cm$ is $2cm$. The speed of sound in air was $300ms^{-1}$ in a say temperature 27^0C. Then frequency of fundamental mode of vibration of the air column. On another day with higher temperature the both ends of the tube was opened. Then the frequency of fundamental mode was observed as f_2 If the speed of sound in that the dry air was $310mS^{-1}$. f_1 and f_2 are respectively,

1. $125Hz, 250Hz$ 2. $500Hz, 1500Hz$ 3. $250Hz, 500Hz$
4. $1500Hz,\ 500Hz$ 5. $250Hz, 125Hz$

06. When monochromatic light ray travels from air to glass.
A – Intensity of light ray remains constant.
B – Frequency of light ray remains constant.
C – Color of light ray remains constant.

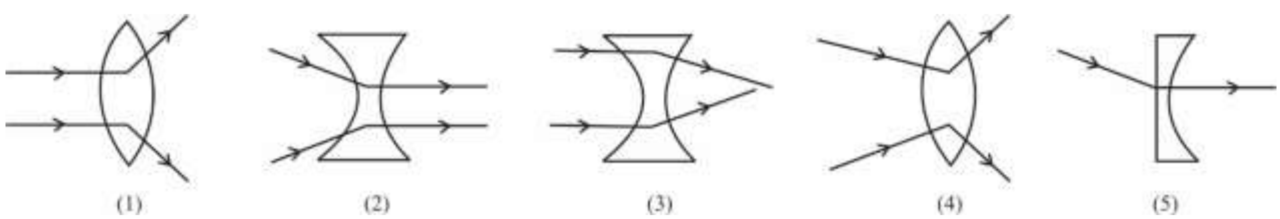
1. Only A 2. Only A and B 3. Only A and C 4. Only B and C 5. Only B

07. The figure shows the path of alight ray that incident on drop of water at the point A. The light ray partially reflected at point B, emerge to air from point C. The angle of incidence is 30^0 at point A, If the total deviation is 150^0. What should be the value of r.



1. 20^0 2. 44^0 3. 90
4. 180^0 5. 21^0

08. Which is the correct ray diagram for a glass lenses kept in air?



09 The period of time of simple pendulum is $4S$ and the amplitude of oscillation is $4cm$. The velocity of pendulum bob in CmS^{-1} is,

1. $\frac{\pi}{2}$ 2. $\frac{3\pi}{2}$ 3. 2π 4. 3π 5. 4π

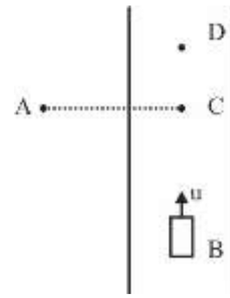
10. When a mass m_0 is suspended from a helical spring of spring constant k_0, the extension is Δl . That mass m_0 is pulled down by small distance x_0 and released to give S.H.M. What is the frequency of this motion?

1. $\frac{1}{2\pi}\sqrt{\frac{g}{x_0}}$ 2. $\frac{1}{2\pi}\sqrt{\frac{g}{\Delta l}}$ 3. $\frac{1}{\pi}\sqrt{\frac{g}{\Delta l}}$ 4. $2\pi\sqrt{\frac{g}{\Delta l}}$ 5. $\frac{1}{2\pi}\sqrt{\frac{\Delta l}{g}}$

11. A turning fork of frequency $260Hz$ vibrating with another turning fork (A) gave 10 beats with is $2S$. During the second time of vibration part of a prong of A was broken. So the number of beats became 18 with is $3S$. The frequency of the turning fork A should be,

1. 265 Hz 2. 256 Hz 3. 266Hz 4. 254Hz 5. 260Hz

12. When the vehicle B is passing point C, the frequency of sound emitted by B is observed as f_0 by the observer A. When B comes to D, the observed frequency is $\frac{4f_0}{5}$. The speed of sound in air is v What is the speed of the vehicle.



1. $\frac{V}{2}$ 2. $\frac{V}{3}$ 3. $\frac{V}{4}$
4. $\frac{V}{5}$ 5. $\frac{V}{6}$

13. A string of length $100cm$ and mass $20g$ is stretched to a tension T_0 and it is vibrated transversely by a vibrator. When its frequency was increased from OHZ to $100Hz$ the first resonance state was not observed but next two resonance states were observed at $40Hz$ and $60Hz$. What is the tension in the string.

1. $16N$ 2. 28N 3. $2N$ 4. $32N$ 5. 36N

14. The sound intensity level at a point $10m$ from a sound source is $50dB$. What is the sound intensity level of a point $100m$ away from the source ?

1. $50dB$ 2. $40dB$ 3. $30dB$ 4. $20dB$ 5. $10dB$

15. A telescope is constructed by using two convex lenses of focal lengths $100cm$ and $20\ cm$. When it is used to observed an object at infinity, its final image is formed at infinity, suddenly he adjusts the telescope to from the final image at his near point. (The least distance of distinct vision is $25\ cm$.) What is the separation between the lenses?

1. $\frac{1000}{9}\ cm$ 2. $\frac{100}{9}\ cm$ 3. $\frac{200}{9}\ cm$ 4. $\frac{9}{100}\ cm$ 5. $\frac{9}{1000}\ cm$

16. A compound microscope is used to observe a small object placed $2cm$ away from the objective of focal length$1cm$. When the final image formed at a point $25cm$ away is. Observed through the eyepiece of focal length f_2 . Its angular magnification is 6. What is the ratio between focal length of objective (f_1) and eyepiece (f_2) ?

1. $1:5$ 2. $5:1$ 3. $6:1$ 4. $1:6$ 5. $1:2$

17. The furthest point that can see by a person suffering from short sightness is placed $10m$ away from him. The lens he could use to overcome this defect is, (The least distance of distance vision is 25cm)

1. Convex lens of f = $10\ cm$
2. Concave lens of f = $10\ cm$
3. Convex lens of f = $5\ cm$
4. Convex lens of f = $25\ cm$
5. Concave lens of f = $25\ cm$

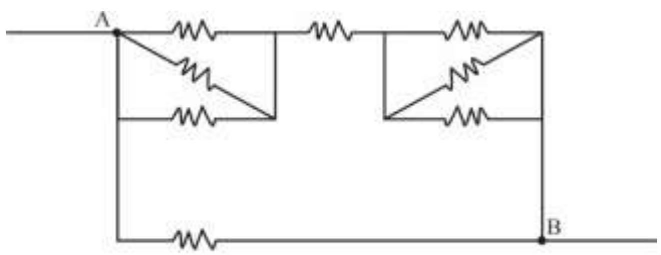
18. A projectile has the same range R when the maximum height attained by it is either h_1 or h_2 The R, h_1 and h_2 will be related as.

1. $R = \sqrt{h_1 h_2}$
2. $R = 2\sqrt{h_1 h_2}$
3. $R = 3\sqrt{h_1 h_2}$
4. $R = 4\sqrt{h_1 h_2}$
5. $R = 5\sqrt{h_1 h_2}$

19. Consider the statements given below about an ideal air system under thermodynamic process.
a) The final pressure under isothermal process is higher than that of the adiabatic process.
b) Whole quantity of heat is used to increase the internal energy of system when heat supplied under constant volume.
c) Work done by air under isothermal state is lower than work done by air under adiabatic state.
d) When heat is supplied to a processing system under constant pressure, part of it is wasted to increase internal energy of the air and the rest is used to work on the surrounding. True statements are,

1. Only a,b,c
2. Only b,c,d
3. Only a,c,d
4. Only a,b,d
5. Only a,b

20. The figure shows a network of identical resistors of resistance R. The resultant resistance of network is, ,

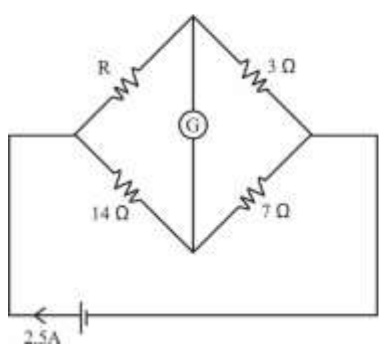


1. $\frac{5R}{8}$
2. $\frac{8R}{5}$
3. $\frac{5R}{16}$
4. $\frac{4R}{5}$
5. $\frac{8}{5R}$

21. The ratio between magnitudes of two resistors is 1:3. The ratios between rate of heat dissipation when the resistors connected parallel and when they are connected serially are respectively given by,

1. 1: 3 , 3: 1
2. 9: 1 , 3: 1
3. 1: 3 , 1: 9
4. 3: 1 , 1: 3
5. 1: 1 , 1: 1

22.



If current through the galvanometer in the given circuit in zero, The current through the R is,

1. 1.75 A
2. 0.75 A
3. 1.5 A
4. 2.5 A
5. 0 A

23. A car starting from rest has a constant acceleration a_1 for a time interval t_1. During that time it covers a distance S_1. In the next time interval t_2 the car has a constant retardation a_2 and comes to rest after covering a distance s_2 (in time t_2.) If the total distance covered by the car is S, the maximum speed attained by it will be.

1 $\left(2S \frac{a_1 a_2}{a_1 + a_2}\right)^{1/2}$
2. $\left(2S \frac{a_1 a_2}{a_1 - a_2}\right)^{1/2}$
3. $\left(\frac{S}{2} \frac{a_1 a_2}{a_1 + a_2}\right)^{1/2}$
4. $\left(\frac{S}{2} \frac{a_1 a_2}{a_1 - a_2}\right)^{1/2}$
5. $S \left(\frac{a_1 + a_2}{a_1 a_2}\right)$

24. The ratio of sides AC, AB and BC of a triangular shaped frame ABC is 4:3:5 and the linear expansively of materials of the rods are α_1, α_2 and α_3 . If this frame is heated, what should be the relationship between $\alpha_1, \alpha_2, \alpha_3$ to keep its shape same ?

1. $25\alpha_3^2 = 16\alpha_1^2 - 9\alpha_2^2$
2. $5\alpha_3^1 = 4\alpha_1 + 3\alpha_2$
3. $5\alpha_3 = 4\alpha_1 - 3\alpha_2$
4. $\alpha_3 = \alpha_1 + \alpha_2$
5. $25\alpha_3^2 = 16\alpha_1^2 + 9\alpha_2^2$

25. When a potential difference is maintained across the ends of a conductor,

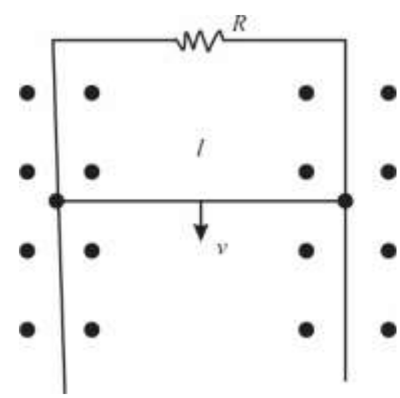
a) The free electrons are subjected to a set of forces acting opposite to the direction of the field.
b) Electric current flows from the point of high voltage to law voltage.
c) Free electrons drift to the direction of electric field.

True statements are,

1. only a 2. only b 3. only c 4. only a,b 5. a,b, c all

26. Which one of the following statements about lines of forces of a magnetic field is **not correct**?
1. The lines of forces emitted from north poles can reach to south poles.
2. The lines of forces never cross each other
3. There are flux lines in everywhere in the field other than the neutral points.
4. the direction of magnetic field at a point is perpendicular to the lines of forces passing the point.
5. The track of an imaginary north pole having unit magnitude released in the field is considered as a line of force.

27. A conducting wire is kept on a vertical couple of metal aids as shown below. The mass of the wire is m and length is l. The wire can slide on metal aids. The couple of aids are connected by a resistor R. A powerful uniform, horizontal magnetic field B acts perpendicularly out of the plane. The friction and resistance of conducting wire are negligible. The terminal velocity obtain under the gravitational acceleration is,



1. zero
2. $\frac{mg}{BlR}$
3. $\frac{\sqrt{2}\, mg}{B^2 l^2}$
4. $\frac{mgR}{B^2 l^2}$
5. $\frac{mgR}{Bl}$

28. Which of the following statements about meter bridge is correct?
1. Meter bridge can be used to compare any two resistors.
2. When the difference between resistances of two resistors used to compare is small the result is more accurate.
3. When the difference between resistances of the two resistors used to compare is large the result is more accurate.
4. The unknown resistors of the two resistors used to compare should be connected to the left gap of the meter bridge.
5. The unknown resistor of the two resistors used to compare should connected to the right gap of the meter bridge.

29. A wire of resistance 30Ω (length 15m) and a 10Ω resistor are connected with a battery of e.m.f. 5V in series. The internal resistance of the battery is negligible. What is the potential gradient along the wire?

1. 0.2 Vm^{-1} 2. 0.02 Vm^{-1} 3. 0.025 Vm^{-1} 4. 0.25 Vm^{-1} 5. 0.1 Vm^{-1}

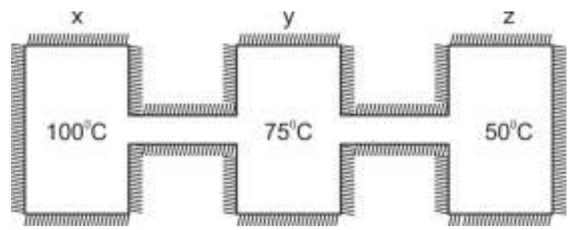
30. The supply voltage of a potentiometer is $2.0\ V$. It gives open circuit balanced length of $70\ cm$ for a cell of e.m.f. 1.5 V. When a $12\ \Omega$ resistor is connected parallel to the cell (1.5V) the balanced length becomes $60cm$. What is the internal resistance of the cell?

1. $1.5\ \Omega$ 2. $2\ \Omega$ 3. $2.5\ \Omega$ 4. $3\ \Omega$ 5. $3.5\ \Omega$

31. The speed of sound in air at $20\ C^0$ is $2V$. At what temperature that becomes $3V$?

1. $659.25^0\ C$ 2. $386.25^0\ C$ 3. $166.5^0\ C$ 4. $45^0\ C$ 5. $30^0\ C$

32. Three chambers x, y, z are connected by rods made up of same material as shown. The temperatures inside them are given in the figure. The length of the rod between XY is L and radius of the cross section is r. If the length of the rod between yz is 2L, what is the radius of the cross section of this rod?



1. $\sqrt{2}\,r$ 2. $\frac{r}{\sqrt{2}}$

3. $\sqrt{2r}$ 4. $2r$ 5. $\sqrt{\frac{r}{2}}$

33. When the temperature of a room of volume $50cm^3$ is at 27^0C its relative humidity is 60%. If its temperature is increased to $37^0\ C$ without adding or removing moisture, what will be the relative humidity in the room? The s.v.p P at $27^0\ C$ and 37^0C are P_{27} and P_{37} respectively.

1. $\frac{60\ P_{27}}{P_{37}}$ 2. $\frac{60\ P_{37}}{P_{27}}$ 3. $\frac{60\ P_{27}}{P_{37}}$ x $\frac{310}{300}$ 4. $\frac{60\ P_{27}}{P_{37}}$ x $\frac{300}{310}$ 5. $60\frac{P_{37}}{P_{27}}$ x $\frac{310}{300}$

34. A battery is constructed by connecting M number of rows of identical batteries of emf. E and internal resistance r. Each row contains N number of batteries. When a load resistor R is connected to the terminals of the battery the current through R is,

1. $\frac{NME}{Mr+NR}$ 2. $\frac{NME}{Mr+NR}$ 3. $\frac{NME}{M(R+r)}$ 4. $\frac{NME}{N(R+r)}$ 5. $\frac{(Mr+NR)}{NME}$

35. A boy of a mass m is sliding down a vertical pole by pressing it with a horizontal force f. If μ is the coefficient of friction between his palms and the pole. The acceleration with which he slides down will be,

1. g 2. $\frac{\mu f}{m}$ 3. $g+\frac{\mu f}{m}$ 4. $g-\frac{\mu f}{m}$ 5. $\frac{\mu f}{m}$

36. A potential difference of 600V is applied across the plates of a parallel plate capacitor. The separation between the plates is 3mm. An electron projected vertically, parallel to the plates, with a velocity of $2 \times 10^6 ms^{-1}$ moves without deflection between the plates. What is the magnitude of the magnetic field between the capacitor plates?

1. $0.1\ T$ 2. $0.2\ T$ 3. $0.3\ T$ 4. $0.4\ T$ 5. $0.5\ T$

37. Consider following statements.

a) Pure semiconductors have equal number of electrons and holes.

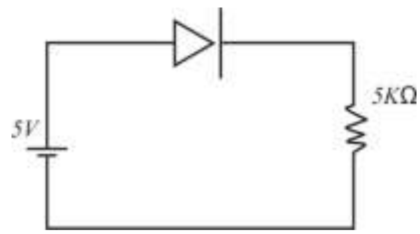
b) The rate of emission of electrons at a particular temperature in a pure semiconductor is equal to the rate of recombining.

c) The electrons are the only electric current carries in n – type extrinsic semiconductors.

of the above statements.

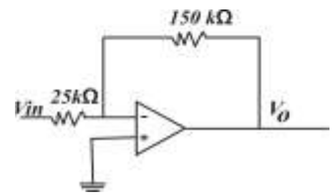
1. Only a is correct 2. Only b is correct 3. Only a and b are correct
4. Only a and c are correct 5. all a,b and c are correct.

38. Assuming the following diode as an ideal one. Select the current through the $5k\Omega$ resisor.

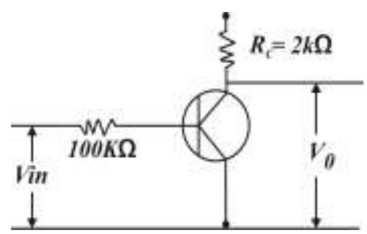


1. 1 mA 2. 2 mA 3. 1.5 mA
4. 0.5 mA 5. 0

39. When the input potential in the (V_{in}) following circuit is zero ($Vin =$ 0) the collector current and out put (V_{out}) potential are.



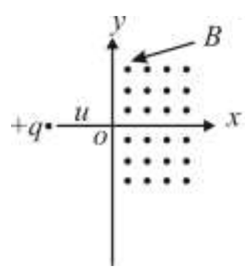
1. $2mA$ and 5V 2. $1mA$ and 5V 3. 0 and 2.5V
4. 0 and 5V 5. $5A$ and 5V



40. When $Vin = 1.5V$ in the operational amplifier circuit. V_0 is equal to.

1. 6V 2. $-6V$
3. 9 V 4. -9 V
5. 12V

41. A proton moving with a speed u along the positive x axis enters at $y = 0$ to a region of uniform magnetic field $B = B_0K$ which exists to the right of Y axis as shown in figure. If the proton leaves the region after some time with a speed V. Then the speed v and y co-ordinate should be.



1. $V > u, y < 0$ 2. $V = u,\ y > 0$
3. $V > u, y > 0$ 4. $V = u, y < 0$ 5. $V < u, y > 0$

42. A solid sphere rolls down from the top of a smooth inclined plane. It's velocity on reaching the bottom of the plane is v. When the same sphere slides down from the top of plane without rolling, it's velocity on reaching the bottom is V^1 the ratio $\frac{V^1}{V}$ is. .

1. $\sqrt{\frac{3}{5}}$ 2. 1 3. $\sqrt{\frac{7}{5}}$ 4. $\frac{3}{\sqrt{5}}$ 5. $\frac{9}{\sqrt{5}}$

43. Two long parallel wires P and Q are held perpendicular to the plane of the paper at a separation of $5m$. If P and Q carry currents of $2.5A$ and $5A$ respectively in the same direction. Then the magnetic field at a point mid-way between P and Q is,

1. $\frac{\mu_0}{\pi}$ 2. $\frac{\sqrt{3}\ \mu_0}{\pi}$ 3. $\frac{\mu_0}{2\pi}$ 4. $\frac{3\mu_0}{2\pi}$ 5. $\frac{4\mu_0}{\pi}$

44. A metal rod is heated to increase its temperature by θ from the room temperature and it is allowed to cool after clamping its two ends which one of the followings gives the force F in the rod? Where E is the young modulus of the material of the rod, A is the cross sectional area of the rod, α is the linear expansivity of the material of the rod.

1. $F = l\alpha\theta$ 2. $F = EA\alpha\theta$ 3. $F = EAl^2\alpha$ 4. $F = E\alpha^2\theta$ 5. $F = E\theta$

45. A small drop of oil falling in air, has the terminal velocity $4.0 \times 10^{-4}\ ms^{-1}$ What is the radius of the drop? The coefficient of viscosity of air is $= 18 \times 10^{-5}\ NSm^{-2}$ and density of oil is $= 900\ kgm^{-3}$ Neglect air resistance.

1. $1.8 \times 10^{-6}\ m$ 2. $1.9 \times 10^{-6}\ m$ 3. $6 \times 10^{-6}\ m$ 4. $1.9 \times 10^{-3}\ m$ 5. None of above

46. The apparent loss of weight of a metal block immersed completely in water at 30^0C is w_1 When the temperature is increased to 50^0C that reduction is w_2 The linear expansivity of the metal is α and volume expansivity of water is γ The ratio $\frac{w_1}{w_2}$ is equal to.

1. $\frac{1+20\gamma}{1+20\alpha}$ 2. $\frac{1+20\gamma}{1+60\alpha}$ 3. $\frac{1+60\alpha}{1+20\gamma}$ 4. $\frac{1+30\alpha}{1+30\gamma}$ 5. $\frac{1+50\alpha}{1+50\gamma}$

47. The surface area of bottom of legs of an animal is $0.005m^2$ and the legs have good thermal contact with ice at -10^0C. The blood vessels in the leg are placed $2mm$ above the ice. The temperature of the blood in these blood vessels is at a steady value of 35^0C The thermal conductivity of the legs is $0.006wm^{-1}k^{-1}$ The ratio of absorbing heat by ice through the legs is,

1. $0.575\ W$ 2. $0.675\ W$ 3. $0.775W$ 4. $0.765\ W$ 5. $0.525\ W$

48. The temperature of air inside a closed chamber of volume $1m^3$ is at 30^0C and its relative humidity is 60%. Reducing the temperature to 20^0C the excess moisture is removed by condensation. If the temperature again increased to 30^0C then what will be the new humidity in the chamber ? (Saturated vapor densities at 30^0C and 20^0C and $30\text{x}10^{-6}kgm^{-3}$ and $17.4\text{x}10^{-6}kgm^{-3}$ respectively.)

1. $\frac{174}{3}\ \%$ 2. 174% 3. 17.4% 4. 20% 5. 24%

49. If the speed of a transverse progressive wave propagating in a steal wire of density $8000kgm^{-3}$ is $500mS^{-1}$, what will be the stress in the wire ?

1. $2\text{x}10^9\ Nm^{-2}$ 2. $4\text{x}10^9\ Nm^{-2}$ 3. $8\text{x}10^9\ Nm^{-2}$
4. $3\text{x}10^9\ Nm^{-2}$ 5. $5\text{x}10^7\ Nm^{-2}$

50. The pressure difference between a horizontal flow tube of radius a and length l is ΔP What is the correct expression that gives the mean velocity of the steady stream lined flow of a fluid of viscosity η in that tube.

1. $\frac{a^2\Delta\rho}{8\eta l}$ 2. $\frac{\pi a^4\Delta\rho}{8\eta l}$ 3. $\frac{\Delta\rho}{l}$ 4. $\frac{\pi a^2\Delta\rho}{l}$ 5. $\frac{\pi a^4}{8\eta l}$

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Provincial Department of Education - NWP

01	S	II

Second Term Test - Grade 13 - 2018

Index No.: .... Physics II Three hours

- This paper consists of two parts A and B allowed time for both parts is 3 (three) hours.
- Answer all the questions of **part A** on this paper itself. You must use th given space to answer. No lengthy answers are expected.
- **Part B** consists of 6 questions. Answer only four of them. After the exam, attach part A and part B and hand over to the staff.
- Use of calculators is not allowed.

Part - A (Structured Essay)

01). (a) Mention the conditions to apply Bernoull's theorem.

(1) .... (2) ....

(3) ....

(b) Mention the Bernoulli's theorem.

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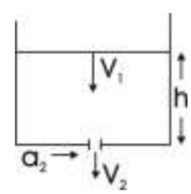
A cylindrical tank is open at the top and has cross sectional area a_1 . Water is filled in it up to height h. There is a hole of cross-sectional area a_2 at its bottom. Given $a_1 = 3a_2$



(c). Write an expression for the initial velocity with which the water falls in the tank.

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(d). Show that the initial velocity with which the water emerges from the hole is, $\frac{3}{2}\sqrt{gh}$

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(e). Find out the height with which the water level falls in the tank in a second. $a_1 = 9m^2$ and $v_2 = 1.5\ mS^{-1}$

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(f). Calculate the height of water level in tank to gain velocity of $1.5\ ms^{-1}$ to the water which emerges from the bottom hole.

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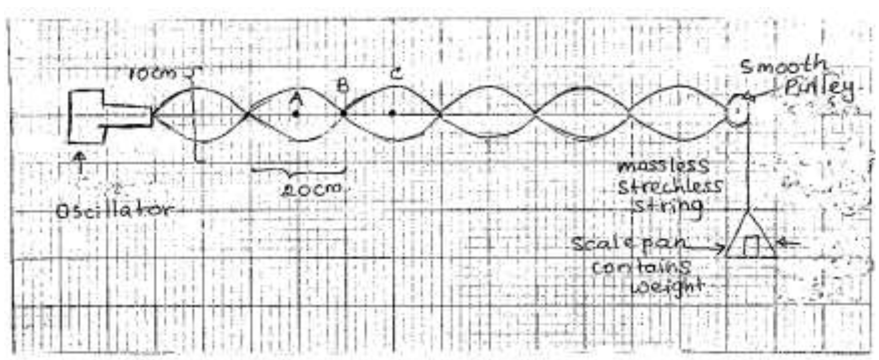
02). The figure shows a setup of apparatus which use to observe characteristics of stationary waves. One end of the uniform string is connected to an oscillator. The other end send through a pulley and connected to a scale pan containing weights. The length between smooth pulley and oscillator is l and the frequency f of the oscillator can be changed.



(1) Explain the motion of the particles at points A,B,C.

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(2) Determine the amplitude and the frequency of above stationary wave.

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(3) Calculate the velocity of above wave, if the frequency of oscillator is $300Hz$

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(4) Calculate the fundamental frequency of vibrating string when the length kept in constant.

(5) Write an expression by using m and M for the velocity of the transverse wave V in the string. The mass of scale pan and weight is M and the mass per unit length of the string is m.

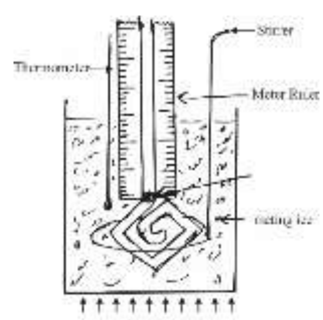
(6) If the value of M is $360\ g$ find m.

(7) If the frequency in part (3) is reduced to half, calculate the number of loops. M kept in constant.

(8) i. If the cross-sectional area of the string is A and the density is ρ write an expression for the velocity of transverse wave V using A, ρ and M.

ii. Find the density of material of the string if the cross – sectional area of string is $3.6\ mm^2$, the mass of scale pan and weight is 360g, and velocity of transverse wave is $60ms^{-1}$

03). To determine the variation between temperature and volume of a constant mass of air under a constant pressure experimentally, a constant mass of air has trapped in a thin glass tube which kept in melting ice. The increased volume will be measured by increasing the temperature.



a. Mention the formula which shows the variation between temperature in Celsius and expansion of volume under constant pressure of a constant mass of air. Introduce the terms.

b. When the temperature increases it is essential to stir the water bath. What is the reason for that?

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c. Mention the steps in brief when measuring the length l. l is the rising length of mercury drop.

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d. i. If the initial length of circulated part of the tube at $0^0\,C$ is L and the rising length of mercury drop at $\theta^0\,C$ is l derive the relationship between above terms and the coefficient of volume expansivity (r_P) under constant pressure. Mention the independent and dependent variables separately that use to find (r_P) by a graphical method.

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ii. Sketch the expected graph.

e. Calculate the coefficient of volume expansivity under constant pressure if gradient of the graph is $\frac{1}{5}\ cm^0C^{-1}$ and the length of the circulated part of tube is $50\ cm$.

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f. Mention the correct value of coefficient of volume expansivity under constant pressure of a constant mass of air. Give two experimental errors that causes for the difference of above obtained value and correct value.
Assume that, the experimental steps are correctly done.

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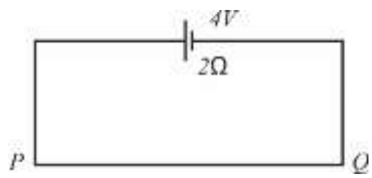
04). The figure shows a potentiometer with a cell and a potentiometer wire. The electromotive force of the cell is $4V$ and its internal resistance is 2Ω. The wire has resistance of 6Ω and its length is 600cm.



i. What is the maximum potential difference that can be measure by using this potentiometer?

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ii. Find out the minimum potential difference if the minimum balancing length which can be measured by the potentiometer accurately is 2cm.

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iii. If you want to measure about $10\mu v$ voltages by this potentiometer, how do you prepare this set up. If you are using a resistor, find the value of it.

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- Assume that you are going to use a thermocouple to measure temperature. You are supposed to use above potentiometer to measure the e.m.f between the terminals of the thermocouple following equation shows the relationship between voltage and temperature (t)
$E = a + bt + ct^2$ Here, $b = 0.02, c = 0.01$

iv. When measuring the temperature the balancing length is 300cm and potential gradient in potentiometer is $k = 1mvcm^{-1}$ Calculate the thermal electromotive for the considered temperature.

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v. Calculate the value of constant a if the temperature of the liquid is $2^0\ C.$

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vi. Why it is suitable to use potentiometer than using a voltmeter to measure this e.m.f?

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vii. When measuring the balanced, length the jokey (contact key) should not drag along the potentiometer wire, Give reasons for that?

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viii. Give reasons, why the thermocouple is more suitable than other thermometers to measure temperature of a liquid.

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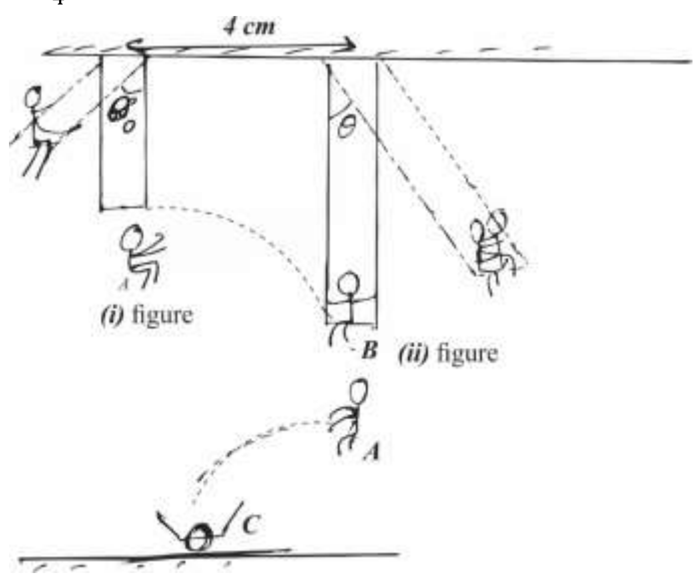
Second Term Test - 2018
Physics Part II - Grade 12
Part - B (Essay)

❖ **Answer four questions only.**

05). The figure shows that a player jumps between swings in a circus pacifia. The mass of player in the swing is 40kg. As shown in figure (i) the swing releases with an angle θ_0 from a place. The length of swing is 3.2m. At the lowest point in path of swing, the player A releases, from the swing. Then another player B with mass of 40kg catches him. The horizontal length between A and B initially is 4m. While the swing is swinging and when it comes back, at the lowest point of path, once again the player (A) releases from second swing and jumps in to a cart C of mass 60kg. Which is on the ground. Assume that swings are stretcless and massless. $(Cos\ \theta_0 = \frac{3}{4})$



i. What is the velocity of player A when he releases from first swing?
ii. What should be the length of swing to catch A by B.
iii. After catching A by B calculate the angle of swinging of the swing?
iv. What is the velocity of player A just after releasing the second swing?
v. After releasing from the swing, A should jump in to a cart C. What is the horizontal distance from the cart to the point right below the lowest position of the swing on the ground? The high from the swing to the ground is 13.2m.
vi. What is the initial velocity of the cart just after, A fell in to the cart?
vii. What is the distance travelled by the cart before stopping. The coefficient of friction between ground and tyres of the cart is 0.08.
viii. Find the reaction on A by the cart at the instance of striking the cart.

06). a). According to the electromagnetic spectrum the frequency of white light is in the order of $10^{14}\ Hz$ and wave length is in the range from about 400nm to 700nm. The white light consists of seven colours. These colours have different wavelengths in a medium. A mercury vapour lamp emits red and blue colors having wave lengths 450nm and 650 nm.

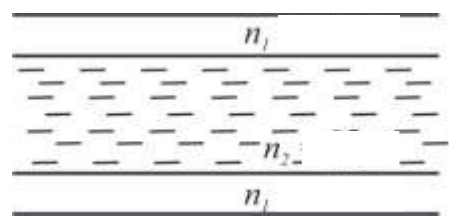
i. What is the wave length of red color?

ii. The refractive indies of glass for red and blue colors emitted from mercury lamp are 1.50 and 1.52 respectively. This light emitted from the lamp incident at a point on a rectangular block of glass making an angle of incidence 60^0. Draw the paths of refracted rays of red and blue colors in the glass box. Calculate angles of refraction.

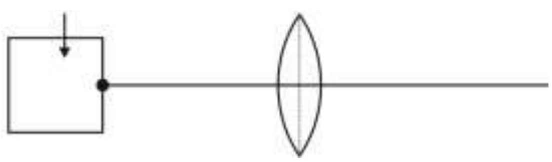
iii. Find the angle between refracted rays of blue and red.

iv. The internal section of the fiber shown below is made up of a transparent material of refractive index n_2 and the outer layer is made up of another transparent material of refractive index n_1. An incident ray consisting red and blue colors propagating in the air, enters to one end of the fiber with an angle of incidence 30^0. Draw paths of these colours for two reflections.

$n_1 > n_2$



b). **Light Source**

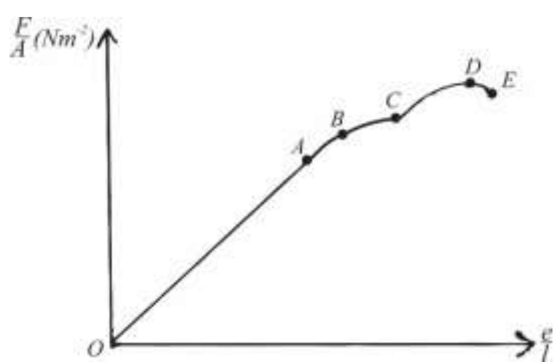


i. A convex lens of focal length 30cm is placed in front of a light source emitting light spot as shown. The distance between light spot and lens is 50cm. What is the position and nature of the image of the light spot formed by the lens?

ii. Now a concave lens of focal length 30cm is placed co-axially, 50 cm away the convex lens. What is the position and nature of the final image formed by the combined lens.

iii. If a block of glass of thickness $6\ cm$ and reflective index $3/2$ is placed in between the light source and the convex lens, how the position of the final image formed by the above lens combination will change ?

07). The extension of a metal wire is due to the displacement of molecules from their mean positions. According to the Hook's law the restoring force is proportional to these displacements. Until the elastic limit, the energy stored in a stretched string or metal wire is molecular potential energy. So after removing the force that energy is regained. If the load applied on soft steel or iron exceeds the elastic limit, their molecular layers slip over the other. When the load is removed, the total energy is not regained. When the load is increased further and further the wire becomes narrow and brakes. The braking stress is the perpendicular force per unit area on



the smallest cross section in the wire. The materials which show these properties are called ductile materials. The brittle materials do not show these properties they will brake quickly when exceeding the elastic limit. The stress – strain curve of a ductile material is shown below.

a) i. Explain briefly why it is possible to conclude that the molecules in an elastic wire or string are doing simple harmonic oscillations with in the elastic limit?

ii. Explain what is the plastic behavior inside the metal wire.

iii. After gaining the plastic behavior state three changes appearing in physical properties of the wire.

iv. After showing the plastic behavior when the force is removed the wire shows permanent extension. What is the reason for this?

b) Introduce parts of the graph OL and BC and point D.

c) A large lift used to move things from lower to upper position, consists of metal wires and pulleys. A motor is used to move the lift up and down. The mass of the fully loaded lift is 10000kg. The braking stress of the connected cables is $5 \mathrm{x} 10^{7}\ Pa$ This set of cables can hold maximum rest mass 75000kg. The length of a cable is 350m. The young modulus $2 \mathrm{~x}\ 10^{11}\ Nm^{-2}$

i. Find the total cross sectional area of the cables connected to the lift.

ii. If the cross sectional area of a cable is $5 \mathrm{~x}\ 10^{-4} m^{2}$ find the number of cables connected to the lift.

iii. What is the extension of a cable when the above loaded lift is at rest near the ground?

iv. What is the power of the motor when the lift is moving up with uniform velocity $4\ ms^{-1}$?

v. Give your suggestions to improve this system to minimize the power requirement.

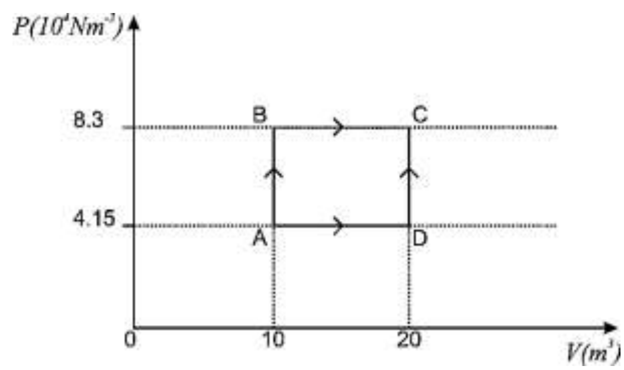
08). (a) i. State the first law of thermodynamics.

ii. Write it as an equation and define all the symbols.

iii. What is the relevant sign convention for the above law?

iv. What is the difference between isothermal process and adiabatic process.

(b) A sample of 2kg of monoatomic Helium gas is subjected to the process ABC as below. (assume He is an ideal gas). Another 2 kg of the same gas is subjected to another process ADC as shown. The molar mass of He is 4g and $R = 8.3\ Jk^{-1} mol^{-1}$



i. Find the temperatures at $A, B, C \text{ and } D$

ii. What is the work done during the process ABC ?

ii. Find the energy provided during the process ADC ? The internal energy for one mole is $3200 J$

❖ **Answer part A or B**

09). (A) Write an expression for the electric field intensity at a point P, which is r away from a charge +Q placed in a medium of dielectric constant K. The permeability of free space is ε_0

A charge Q is given to a solid uniform non conducting sphere of radius R and it is placed in above medium.

Derive expressions for the electric field intensities using gauss theorem for the points given below.

a) i. Point S which is at a distance r_0 from the centre of the sphere ($r_0 > R$)

ii. Point T, on the surface of the sphere.

iii. Point N, which is at a distance r_2 from the centre ($r_2 < R$)

iv. Sketch a graph to represent variation of electric field intensity with distance from the centre of the sphere.

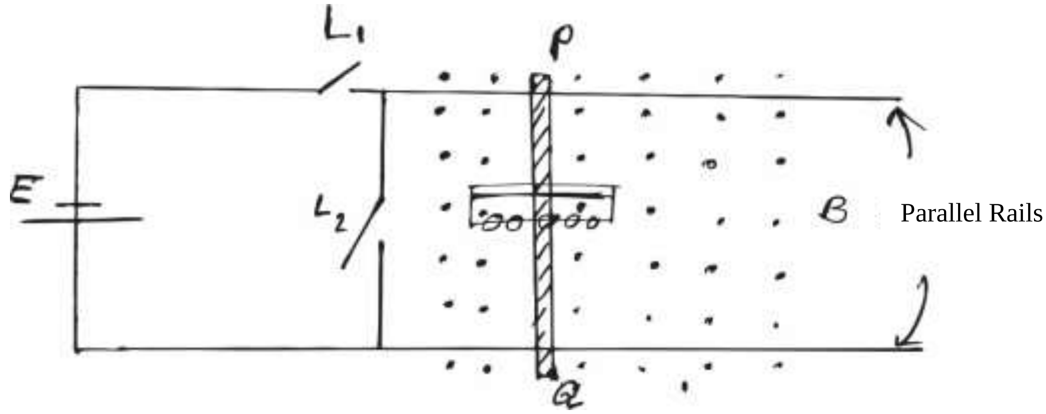
b) i. Write expressions for the electric potentials at points S and T.

ii. If $r_0 = 10cm,\ R = 4cm$ find the potential difference between points S and T.

($\frac{1}{4\varepsilon_0\pi} = 9x10^9\ Nm^2C^{-2}$ dielectric constant $k = 3,\ Q = 2C$)

iii. What is the colliding speed of a charge (q = -2C) released from the point T with this sphere ? Mass of q is $10^{-8}\ kg$

(B)



A model of rails of a toy electric train planned to control by a remote controller is shown in the above figure. The train is mounted on a conductor PQ of length l_0 The mass of train with conductor is m_0 The resistance of PQ is R_0. There is a magnetic field of uniform flux density B pointing out the plane of the paper perpendicular to the rails in the region of the rails. The cell connected to rails has no internal resistance. Its electromotive force is E_0 The cell provides a current to the conducting rod PQ. The switches L_1 and L_2 controlled by the remote controller. There is no any resistance in the rails.

i. When only L_1 is switched on by the remote controller, write an expression for the force on the rod PQ due to the magnetic field.

ii. If the maximum speed of the train is V_0 and the rails are frictionless then.

a. Write an expression for the induced back e.m.f. on the rod PQ, when the train is moving with speed u.

b. Derive expressions for the current on PQ and for the power for this instance.

c. When the train is mowing with maximum speed what is the current through PQ. Derive an expression for V_0.

iii. The moving train is stopped by the controller by opening L_1 and closing L_2 . Explain this process of stopping the train.

iv. The mass of the train with rod PQ is 200g and separation of the rails is 10 cm. The magnetic flux density B is 0.02T and resistance of rod PQ is 1Ω

a. If the train can gain maximum speed of $10\ ms^{-1}$ what will be the electromotive force of the cell?

b. Hence find the initial acceleration of the train.

v. If the above cell has an internal resistance of 1 Ω find the maximum speed of the train.

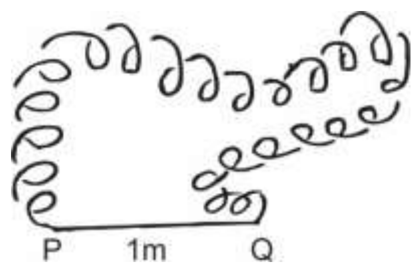
Answer part A or B only.

10). (A) a i. Write an expression for the resistance R of a copper wire of length L and cross sectional area a. The resistivity of copper is ρ .

ii. Sketch Wheatstone bridge circuit use to find unknown resistance. When the bridge is balanced the readings of the resistance boxes are $R_1, R_2, R_3 and\ R_4$. Derive the relationship between them. Write two assumptions you made here. Why the sensitive of the centre zero galvanometer is important? Give reasons.

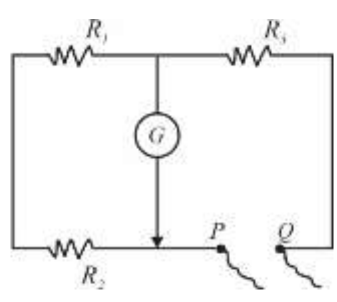
b i. A conducting wire of total length L has been entangled. About $1m$ of its length has been straightened and the ends are clipped by the fixed clips P and Q.

The density of the material of the wire is d and mean cross sectional area a. The total mass of the coil is m. Write an expression for the total length L in terms of above symbols.



ii. If the resistance between P and Q is R_l write an expression for R_l in terms of ρ, a, m, d and ρ is the resistivity of materials of the wire.

c One resistance box in the bridge circuit in part a (II) is replaced by the conductor PQ. After balancing when the galvanometer reads zero the values of R_1 ,R_2 and R_3 are $800\Omega, 80\Omega$ and 600Ω.



I. Determine resistance of the wire PQ.

II. If the mass of the total wire is 1.6kg and density of the material is $1.2\ x\ 10^4\ kgm^{-3}$ and cross sectional area is $10^{-6}\ m^2$ Calculate resistivity of the material.

(d) When the coil is placed in water at 70^0C the resistances are measured as in part $(C - I)$ Then their values are $R_1 = 700\Omega$, $R_2 = 70\Omega$ and $R_3 = 700\Omega$. Find the temperature coefficient of resistance for the material. Room temperature is 30^0C

(e) Explain briefly the reason for the variation of resistance of a metal wire with temperature.

(B) 1) i. What are the characteristics of an ideal operational amplifier?

ii. Mention the golden rules.

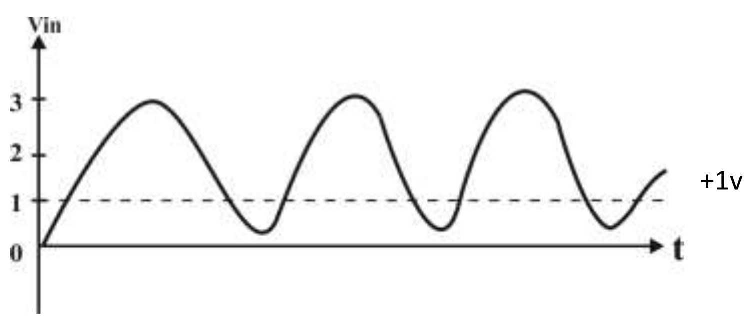
2) An operational amplifier $(op - amp)$ used in the comparator cicuit is given below.

a) i. Show that the potential at the inverting input of the op-amp is $+1.0V$.

ii. Explain the reasons for following observations.

- When $V_{in} > 1.0\ V$ the voltage across R is $+5V$
- When $V_{in} < 1.0\ V$ the voltage across R is zero.

b) i.



The variation of V_{in} is given by the above graph. Sketch variation of V_{out} with time for this input signal. Mention the corresponding values on the graph. Assume this is an ideal (OP-amp)

i. What is the advantage of this type of circuit.

Second Term Test Grade - 13
Physics I

(1)	2	(11)	1	(21)	4	(31)	2	(41)	4
(2)	1	(12)	3	(22)	1	(32)	1	(42)	3
(3)	2	(13)	4	(23)	1	(33)	3	(43)	3
(4)	4	(14)	3	(24)	5	(34)	2	(44)	2
(5)	1	(15)	21	(25)	3	(35)	4	(45)	3
(6)	4	(16)	1	(26)	4	(36)	1	(46)	2
(7)	5	(17)	2	(27)	4	(37)	1	(47)	2
(8)	2	(18)	4	(28)	2	(38)	1	(481	1
(9)	3	(19)	4	(29)	4	(39)	4	(49)	1
(10)	2	(20)	1	(30)	2	(40)	4	(50)	1

Second Term Test Grade - 13
Physics II

Part - A (Structured Essay)

01). (a) Mention the conditions to apply Bernoull's theorem.

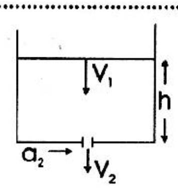
(1) incompressible (2) non viscous — (01)

(3) streamlined flow

(b) Mention the Bernoulli's theorem.

Along a streamline, the sum of PE, KE and pressure energy of unit volume of a steady streamlined flow of incompressible non viscous fluid is constant. — (01)

A cylindrical tank is open at the top and has cross sectional area a_1 . Water is filled in it up to height h. There is a hole of cross-sectional area a_2 at its bottom. Given $a_1 = 3a_2$



(c). Write an expression for the initial velocity with which the water falls in the tank.

$a_1 V_1 = a_2 V_2$ — (01)

$V_1 = \frac{a_2}{a_1} V_2$ $\quad V_1 = \frac{V_2}{3}$ — (01)

(d). Show that the initial velocity with which the water emerges from the hole is, $\frac{3}{2}\sqrt{gh}$

$P_0 + \rho g h + \frac{1}{2}\rho V_1^2 = P_0 + \frac{1}{2}\rho V_2^2$ — (01)

$V_1^2 = V_2^2 - 2gh$

$\because V_1 = \frac{V_2}{3}$, $\left(\frac{V_2}{3}\right)^2 = V_2^2 - 2gh$ — (01)

$\frac{8}{9} V_2^2 = 2gh$ — (01)

$V_2 = \frac{3}{2}\sqrt{gh}$

(e). Find out the height with which the water level falls in the tank in a second. $a_1 = 9m^2$ and $v_2 = 1.5\ mS^{-1}$

$a_1 V_1 = a_2 V_2$

$9 V_1 = \frac{a_1}{3} \times 1.5$ — (01)

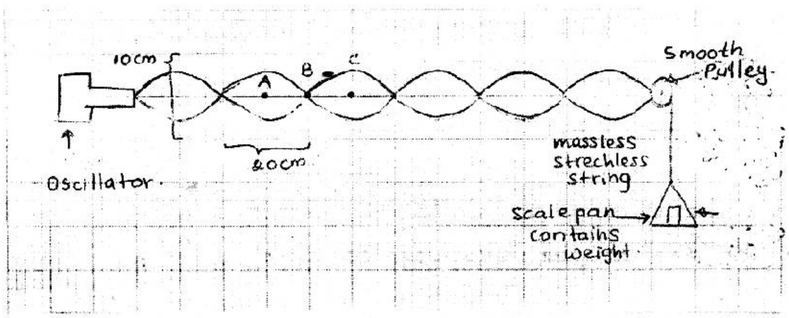
$V_1 = 0.5\ m s^{-1}$ — (01)

(f). Calculate the height of water level in tank to gain velocity of $1.5\ ms^{-1}$ to the water which emerges from the bottom hole.

$V_1 = \frac{3}{2}\sqrt{gh}$

$1.5 = \frac{3}{2}\sqrt{gh}$ $h = 0.1\ m$ — (01)

02). The figure shows a setup of apparatus which use to observe characteristics of stationary waves. One end of the uniform string is connected to an oscillator. The other end send through a pulley and connected to a scale pan containing weights. The length between smooth pulley and oscillator is l and the frequency f of the oscillator can be changed.



(1) Explain the motion of the particles at points A,B,C.

particles at A & C move up and down (opposite phase)

" at B are at rest — 01

(2) Determine the amplitude and the frequency of above stationary wave.

wave length = 40 cm & Amplitude = 6 cm — 01

(3) Calculate the velocity of above wave, if the frequency of oscillator is $300Hz$

$v = f\lambda = 300 \times 40 \times 10^{-2}$

$= 120\ ms^{-1}$ — 01

(4) Calculate the fundamental frequency of vibrating string when the length kept in constant.

$\lambda = 2l = 120 \times 2 = 240$ cm

$f = V/\lambda = \frac{120}{240 \times 10^{-2}} = 50$ Hz — 01

(5) Write an expression by using m and M for the velocity of the transverse wave V in the string. The mass of scale pan and weight is M and the mass per unit length of the string is m.

$V = \sqrt{\frac{Mg}{m}}$ —01

(6) If the value of M is 360 g find m.

$120 = \sqrt{\frac{360 \times 10^{-3} \times 10}{m}}$ —01

$m = 2.5 \times 10^{-4}$ kg —01

(7) If the frequency in part (3) is reduced to half, calculate the number of loops. M kept in constant.

$V = f\lambda$ $\lambda/2 = 40$ cm

$\lambda = \frac{120}{150} = 0.8$ m $= 80$ cm $\therefore$ No. of loops $= \frac{120}{40} = 3$ —01

(8) i. If the cross-sectional area of the string is A and the density is ρ write an expression for the velocity of transverse wave V using A, ρ and M.

$m = A\rho$

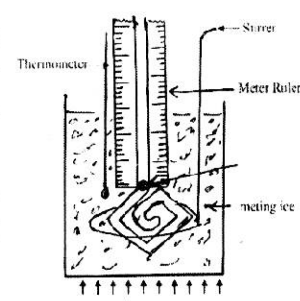
$V = \sqrt{\frac{Mg}{m}} = \sqrt{\frac{Mg}{A\rho}}$ —01

ii. Find the density of material of the string if the cross – sectional area of string is $3.6\, mm^2$, the mass of scale pan and weight is 360g, and velocity of transverse wave is $60 ms^{-1}$

$60 = \sqrt{\frac{360 \times 10^{-3} \times 10}{3.6 \times 10^{-6} \rho}}$

$3600 = \frac{10^6}{\rho}$ $\rho = 277.77$ kg m^{-3} — 01

03). To determine the variation between temperature and volume of a constant mass of air under a constant pressure experimentally, a constant mass of air has trapped in a thin glass tube which kept in melting ice. The increased volume will be measured by increasing the temperature.



a. Mention the formula which shows the variation between temperature in Celsius and expansion of volume under constant pressure of a constant mass of air. Introduce the terms.

$V_\theta = V_0(1 + \gamma\theta)$ —01

V_θ = volume at θ °C

V_0 = volume at 0°C

θ = temperature difference.

γ = volume expansivity under constant pressure

01

3

b. When the temperature increases it is essential to stir the water bath. What is the reason for that?

To maintain constant temperature in the whole liquid and then there is a uniform expansion —01

c. Mention the steps in brief when measuring the length l. l is the rising length of mercury drop.

Measure l by increasing and decreasing temperature from the required temperature. Calculate mean value of l. Stir well while taking readings. First heat it to a temp. few degrees above the relavant temp and stir well and measure l at after reaching lower value of the temp. —01

d. i. If the initial length of circulated part of the tube at $0^0\,C$ is L and the rising length of mercury drop at $\theta^0\,C$ is l derive the relationship between above terms and the coefficient of volume expansivity (r_P) under constant pressure. Mention the independent and dependent variables separately that use to find (r_P) by a graphical method.

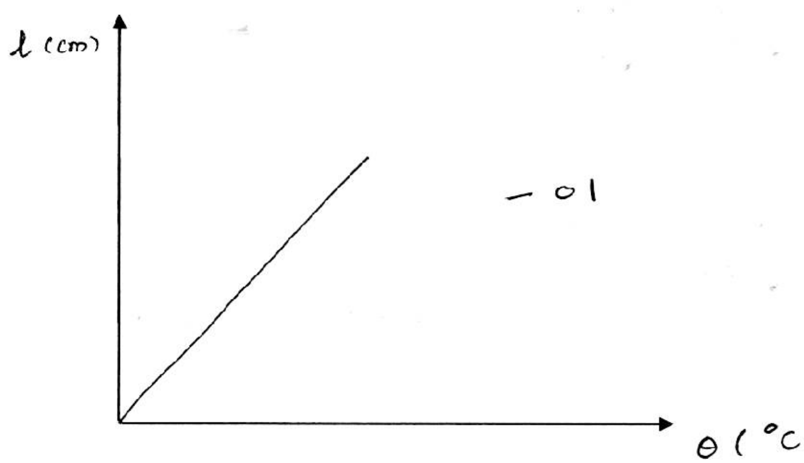
$(L+l)\,a = La\,(1+\gamma\theta)$ —01

$L + l = L + L\gamma\theta$

$l = L\gamma\theta$ —01

(dy = l, m = $L\gamma$, x = θ)

ii. Sketch the expected graph.



e. Calculate the coefficient of volume expansivity under constant pressure if gradient of the graph is $\frac{1}{5}\ cm^0C^{-1}$ and the length of the circulated part of tube is $50\ cm$.

$\frac{1}{5} = \gamma \times 50$

$\gamma = \frac{1}{250}\ {}^\circ C^{-1}$ — 01

f. Mention the correct value of coefficient of volume expansivity under constant pressure of a constant mass of air. Give two experimental errors that causes for the difference of above obtained value and correct value.

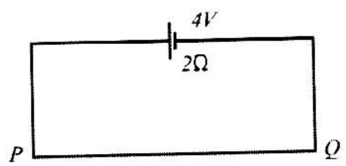
Assume that, the experimental steps are correctly done.

$\frac{1}{273}$ °C^{-1}

I. The temp. of the gas is not equal to temp of water because of the thickness of the tube (01)

II. Part of expansion of the gas is left due to expansion of glass tube (01)

04). The figure shows a potentiometer with a cell and a potentiometer wire. The electromotive force of the cell is $4V$ and its internal resistance is 2Ω. The wire has resistance of 6Ω and its length is 600cm.



i. What is the maximum potential difference that can be measured by using this potentiometer?

$E = IR + Ir$ $\quad V = IR$

$4 = I \times 8$ $\quad = 0.5 \times 6$

$I = 0.5$ A $\quad = 3$ V (01)

ii. Find out the minimum potential difference if the minimum balancing length which can be measured by the potentiometer accurately is 2cm.

minimum Potential difference $= \frac{3}{600} \times 2 = \frac{1}{100}$

$= 0.01$ V (01)

iii. If you want to measure about $10\mu v$ voltages by this potentiometer, how do you prepare this set up. If you are using a resistor, find the value of it.

Connecting a large resistor R_o in series with potentiometer wire (01)

$E = I(R + r + R_o)$ $\quad$ p.d. $= \frac{10^{-6}}{2} \times 600 \times 0.2 \times 3 \times 10^{-3}$ V (01) for the wire $V = IR$ $\quad 6 \times I = 3 \times 10^{-3} \Rightarrow I = 5 \times 10^{-4}$ A

$4 = I(6 + 2 + R_o)$ $\quad 4 = 5 \times 10^{-4}(8 + R_o)$ $\quad R_o = 7992\ \Omega$ (01)

- Assume that you are going to use a thermocouple to measure temperature. You are supposed to use above potentiometer to measure the e.m.f between the terminals of the thermocouple following equation shows the relationship between voltage and temperature (t)

  $E = a + bt + ct^2$ Here, $b = 0.02, c = 0.01$

iv. When measuring the temperature the balancing length is 300cm and potential gradient in potentiometer is $k = 1mvcm^{-1}$ Calculate the thermal electromotive for the considered temperature.

$E = 1 \times 300$ mV

$= 0.3$ V (01)

v. Calculate the value of constant a if the temperature of the liquid is $2^0\ C$.

$E = a + bt + ct^2$

$0.3 = a + 0.02 \times 2 + 0.01 \times 4$

$0.3 = a + 0.04 + 0.04$

$a = 0.22$ —— (01)

vi. Why it is suitable to use potentiometer than using a voltmeter to measure this e.m.f?

Because potential difference can be measured without absorbing a current from the main circuit. —(01)

vii. When measuring the balanced, length the jokey (contact key) should not drag along the potentiometer wire, Give reasons for that? - then wire will be damaged therefore

i) uniformity will be changed
ii) Potential gradient may be changed

} for both (01)

viii. Give reasons, why the thermocouple is more suitable than other thermometers to measure temperature of a liquid.

- More accurate and sensitive.
- Can measure temperature at a point —(01)

(for any one)

part B

5) (i) loss of potential energy = Gain of kinetic energy — (01)

$mgh = \frac{1}{2}mv^2$

$v^2 = 2gh$

$v^2 = 2\times10\,(3.2 - 3.2\cos\theta_0)$

$v^2 = 2\times10\,(3.2 - 3.2\times\frac{3}{4})$

$= 2\times10\times0.8 = 16$

$= 4\ ms^{-1}$ ———— (01)

(ii) time taken to move between two swings is t

$\rightarrow s = ut$

$4 = 4\times t$

$t = 1\ s$

If the distance travelled down by the man within 1 s is S

$\downarrow s = ut + \frac{1}{2}at^2$

$S = 0 + \frac{1}{2}\times10\times1^2$

$S = 5\ m$ ———— (01)

∴ length of the second swing = 3.2 + S =

$= 8.2\ m$ —— (01)

(iii) If the initial velocity of the swing with two persons is V_0

Initial momentum = final momentum,

$40\times4 = 80\times V_0$

$V_0 = 2\ ms^{-1}$ ———— (01)

If the distance oscillated up is h_0

loss of K.E = Gain of P.E

$\frac{1}{2}m_2V_0^2 = m_2gh_0$

$\frac{1}{2}\times2^2 = 10\,h_0$

$h_0 = 2\ m$ ———— (01)

$\therefore \cos\theta = \frac{8.2 - 0.2}{8.2} = \frac{8}{8.2}$

$\cos\theta = \frac{80}{82}$ $\quad \theta = \cos^{-1}(40/41) = \cos^{-1}(0.9756)$ ———— (01)

$\theta = 12^\circ 40'$

(iv) When jumping from the second swing $2\ ms^{-1}$ ———— (01)

(v) time taken to fall on to the ground is to

$\downarrow s = ut + \frac{1}{2}at^2 \quad = 0 + \frac{1}{2}\times10\times t^2$

$t = 1\ s$

9

Horizontal distance to the cart.

$\leftarrow$ $s = ut$

$s = 2 \times 1$

$= 2\ m$ // —— (01)

(vi) Initial momentum of A = final momentum of the cart and A

$40 \times 2 = 100 \times v_1$

$v_1 = 0.8\ ms^{-1}$ —— (01)

(vii) frictional force on wheels

$f = \mu R$

$= 0.08 \times 1000$

$= 80\ N$ —— (01)

for the cart $f = ma$

$80 = 100a$

$a = 0.8\ ms^{-2}$

$v^2 = u^2 + 2as$

$= 0.8^2 - 2 \times 0.8 \times s$

$s = 0.4\ M$ —— (01)

distance travelled by the cart $= 0.4\ m$.

(viii) the falling speed of the man to the cart

$\downarrow$ $v = u + at$

$0 + 10 \times 1$

$= 10\ ms^{-1}$ //

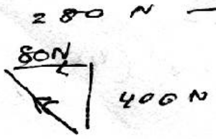
$\uparrow$ Reaction $= 40 \times 10$

$= 400\ N$ —— (01)

$\leftarrow$ Reaction $= 40 \times 2$

$= 80\ N$ —— (01)

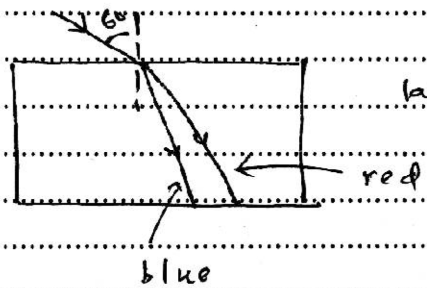
Resultant



$R = \sqrt{400^2 + 80^2}$

$= \sqrt{160000 + 6400}$

(6) a (i) λ for the red colour $= 650$ nm —(01)



labelled two rays —(01)

for red colour

$n = \frac{\sin i}{\sin r}$

$1.5 = \frac{\sin 60}{\sin r}$

$\sin r = \frac{0.8660}{1.5}$

$= 35^\circ 15'$ —(01)

for blue colour

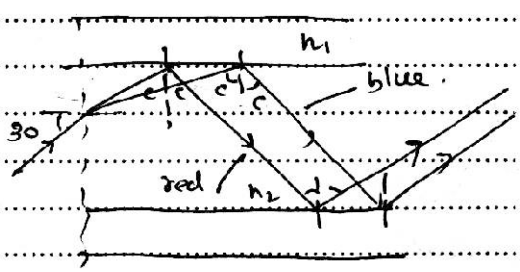
$1.52 = \frac{\sin 60^\circ}{\sin r}$

$\sin r = \frac{0.8660}{1.52}$

$r = 34^\circ 43'$ —(01)

iii $35^\circ 15' - 34^\circ 43' = 0^\circ 32'$ —(01)

iv



correctly labeled ray diagram —(02)

(b) (i) for convex lens

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Applying sign convension

$\frac{1}{v} - \frac{1}{50} = \frac{1}{-30}$ —(01)

$\frac{1}{v} = \frac{1}{50} - \frac{1}{30}$

$v = -\frac{150}{2} = -75$ cm —(01)

Real ~~vertical~~ image formed 75 cm behind the lens. —(01)

(ii) for the concave lens

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{v} + \frac{1}{25} = \frac{1}{30}$

$\frac{1}{v} = \frac{1}{30} - \frac{1}{25}$

$v = -150$ cm — (01)

vertual image formed 150 cm behind the concave lens —(01)

(iii) for the glase block.

$d = t(1 - 1/n)$

$= t(1 - 2/3)$

$d = 2$ cm — (01)

for the convex lens

$\frac{1}{v} - \frac{1}{48} = -\frac{1}{30}$

$\frac{1}{v} = \frac{30-48}{30 \times 48}$

$v = -80$ cm —(01)

object distance for the concave lens is 30 cm

∴ image formed at infinity. —(01)

(7) (i) Because the restoring force is directly proportional to the extension. —(01)

II when the force is increased, ~~one~~ the tendency of the molecules to slides over the ~~others~~ another. —(01)

III • narrowing the wire
• heating the wire.
• getting permanent extension. —(02)

IV After reaching the plastic behaviour, It has to be done work against the friction between the sliding layers of molecules. That energy removes ~~appears~~ as heat.

b) OL — Elastic deformation
BC — plastic deformation
D — braking point. } (02)

c) I $\frac{75000}{A} = 5\times10^{7}$ — (01)

$A = 0.015\ m^{2}$ — (01)

II No of cables $= \frac{0.015}{5\times10^{-4}} = 30$ — (01)

III $\frac{F}{A} = Y\frac{e}{l}$ — (01)

$\frac{1000}{0.015} = 2\times10^{11} \times \frac{e}{350}$ — (01)

$e = 1.16\times10^{-3}\ m$ — (01)

IV applied force = 10000 N
power = 40000 W — (01)

V Preparing a mechanism to restore the decreasing potential energy due to the downward movement of the lift.

apply lubricant oil to ~~axis of~~ the pullyes — (01)

(8) a (i) The heat energy given to a closed system (ΔQ) is equal to the sum of increased amount of internal energy (ΔU) and work done by the system (ΔW). — (01)

(ii) $\Delta Q = \Delta W + \Delta U$ — (01)

(iii) given. — (01)

(iii) Energy given to the system ( ) (+)

" removing by " " ( ) : (−)

work done by the system (+)

" " on " " (−) — (01)

(b) No of moles of Helium $= n$

$$n = \frac{\text{mass}}{\text{atomic mass}} = \frac{2000}{4} = 500$$ — (01)

for A

$PV = nRT$

$P_A V_A = nRT_A$

$$T_A = \frac{P_A V_A}{nR}$$

$$= \frac{4.15 \times 10^4 \times 10}{500 \times 8.3} = 100\ K.$$ — (01)

for B

$A \rightarrow B$ (process under constant volume)

$$\frac{T_A}{T_B} = \frac{P_B}{P_A} = \frac{8.3 \times 10^4}{4.15 \times 10^4} = 2$$

$T_B = 2T_A = 200\ K.$ — (01)

for C (process under constant pressure)

$B \rightarrow C$

$$\frac{T_C}{T_B} = \frac{V_C}{V_B} = \frac{20}{10} = 2$$

$T_C = 2T_B = 400\ K.$ — (01)

for D

$A \rightarrow D$ $$\frac{T_D}{T_A} = \frac{P_D}{P_A} = \frac{20}{10} = 2$$

$T_D = 200\ K$ — (01)

(ii) work done by ABC

$W = W_{AB} + W_{BC}$ $\quad W = P\Delta V$

$= 0 + P_B (V_C - V_B)$ — (01)

$= 8.3 \times 10^4 (20-10)$

$= 8.3 \times 10^3 J$ — (01)

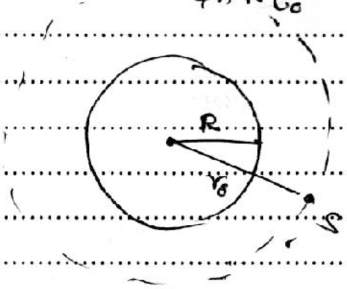
(iii) $\Delta Q = (\Delta U)_{ADC} + (\Delta W)_{ADC}$ — (01)

$\Delta Q = n \times 3200 + P_A (V_D - V_A)$ — (01)

$= 16 \times 10^5 + 4.15 \times 10^4 (20-10)$ — (01)

$= 20.15 \times 10^5 J$ — (01)

(9) (A) $E_P = \frac{1}{4\pi K \varepsilon_0} \cdot \frac{Q}{r^2}$ — (01)



a) (i) construct a gaussian surface having radices r_0 & it is passing through S — (01)

$\phi = EA$

$\phi = Q/\varepsilon$

$EA = Q/\varepsilon$ — (01)

$E \times 4\pi r_0^2 = \frac{Q}{k\varepsilon_0}$

$E_S = \frac{1}{4\pi k\varepsilon_0} \cdot \frac{Q}{r_0^2}$ — (01)

(ii) $E \times 4\pi r_1^2 = \frac{Q}{K\varepsilon_0}$

$\because r_1 = R$

$E_N = \frac{1}{4\pi K\varepsilon_0} \cdot \frac{Q}{R^2}$ — (01)

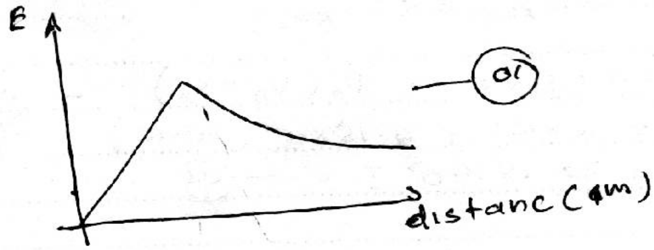
(iii) $E_T \times A = \frac{Q_1}{k\varepsilon_0}$

$Q_1 = \frac{Q}{\frac{4}{3}\pi R^3} \times \frac{4}{3}\pi r_2^3$ — (01)

$Q_1 = \frac{Q}{R^3} \times r_2^2$ — (01)

$E_T \times 4\pi r_2^2 = \frac{Q r_2^3}{R^3 k\varepsilon_0}$ — (01)

(iv)



— (01)

(b) i. $V_S = \frac{1}{4\pi k\varepsilon_0} \cdot \frac{Q}{r}$ — (01)

$V_T = \frac{1}{4\pi k\varepsilon_0} \cdot \frac{Q}{R}$ — (01)

(ii) $V_{ST} = V_S - V_T$

$V_{ST} = \frac{Q}{4\pi k\varepsilon_0}\left(\frac{1}{R} - \frac{1}{r}\right)$

$V_{ST} = \frac{9\times10^9}{3} \times 2\left(\frac{100}{4} - \frac{100}{10}\right)$ — (01)

$V_{ST} = 6\times10^9\ (25-10)$

$= 6\times15\times10^9 = 9\times10^{10}$ — (01)

(iii) $W = QV = \frac{1}{2}mu^2$

$2\times9\times10^{10} = \frac{1}{2}\times10^{-8}u^2$ — (01)

$36\times10^{18} = u^2$

$u = 6\times10^9\ ms^{-1}$ — (01)

(9)(B)

(i) $F = BIl_0$

$E = I \times R_0$

$\therefore I = \frac{E}{R_0}$ — (01)

$\therefore F = \frac{BEl_0}{R_0}$ — (01)

→ to right — (0.1)

(ii) $E = Bl_0 V_0$

$V_0 = \frac{E}{Bl_0}$

a) back e.m.f $= E_0$

$E_0 = Bl_0 u$ — (01)

b) $E - E_0 = IR_0$

$\frac{E - Bl_0 u}{R_0} = I$ — (01)

$P = I^2 R_0$

$= \left(\frac{E - Bl_0 u}{R_0}\right)^2 \times R_0$

$P = \frac{(E - Bl_0 u)^2}{R_0}$ — (01) //

c) $E = Bl_0 V_0$

$I = 0$ — (01)

$V_0 = \frac{E}{Bl_0}$ — (01)

(iii) when L_1 is open, the current through the conducter PQ to the direction QP ~~stop~~ is stopped, then PQ is a conducter moving in an external magnetic field. then an electromotive force is induced in it. Then ~~there~~ is a developed current to the direction PQ. According to Fleming's left hand rule, a force is created ~~acting~~ in the opposite direction to the ~~of~~ motion. Therefore the rod is subjected to a deceleration. — (02)

IV a) $E = Blv$

$E = 0.02 \times 10 \times 10^{-2} \times 10$

$= 0.02\ V$ — (01)

b) $f = ma$

$f = BIl$

$BIl = ma$

$I = E/R$

$\therefore B \cdot \frac{E}{R} \cdot l = ma$ — (01)

$0.02 \times \frac{0.02}{1} \times 10^{-1} = 200 \times 10^{-3}\ a$ — (01) Substitution.

$4 \times 10^{-5} = 200 \times 10^{-3}\ a$

$a = 2 \times 10^{-4}\ ms^{-2}$ — (01)

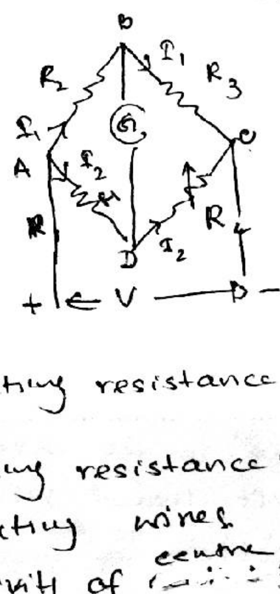
V $E_0 = Bl V_{max}$

E_0 is ~~not~~ constant

$V_{max} = 10\ ms^{-1}$ — (01)

(10) (A) I $R = \rho \frac{l}{a}$ $\rho = \frac{Ra}{l}$ — (01)

(01) →



After balancing

$V_{AB} = V_{AD}$

$I_1 R_2 = I_2 R_1$ — (1)

$V_{BC} = V_{DC}$

$I_1 R_3 = I_2 R_4$ — (2)

$I_1 R_3 = I_2 R_4$ — (2) — (01)

$\frac{I_1 R_2}{I_1 R_3} = \frac{I_2 R_1}{I_2 R_4}$

$\frac{R_2}{R_3} = \frac{R_1}{R_4}$

* neglecting resistance of

* neglecting resistance of connecting wires

* Sensitivity of centre zero galvanometer.

When only the galvanometer is sensitive, a balanced point is obtained. — (01)

(b) (i) $m = aL \times d$

$L = \dfrac{m}{ad}$ — (01)

(ii) Resistance of PQ $R_1 = \dfrac{\rho}{a}$

Rest part $R_2 = \dfrac{\rho}{a}(L-1)$

$$\frac{\frac{\rho}{a} \times \frac{\rho}{a}(L-1)}{\frac{\rho}{a}(L-1) + \frac{\rho}{a}}$$ — (01)

$$= \frac{\frac{\rho}{a}(L-1)}{L} = \frac{\rho}{a}\left(\frac{m - ad}{m}\right)$$ — (01)

(c) I $\dfrac{800}{80} = \dfrac{600}{x}$

$x = 60\ \Omega$ — (01)

II $60 = \dfrac{\rho}{a}\left(\dfrac{m - ad}{m}\right)$

$60 = \dfrac{\rho}{10^{-6}}\left(\dfrac{1.6 - 10^{-6} \times 1.2 \times 10^{4}}{1.6}\right)$ — (01)

$1.6 \times 60 \times 10^{-6} = \rho(1.6 - 0.012)$

$\rho = 6 \times 10^{-5}\ \Omega m$ — (01)

(d) $\dfrac{700}{70} = \dfrac{700}{x'}$

$x' = 70\ \Omega$

$R_\theta = R_0(1 + \alpha\theta)$

$60 = R_0(1 + 30\alpha)$ — (01)

$70 = R_0(1 + 70\alpha)$ — (01)

$\dfrac{6}{7} = \dfrac{1 + 30\alpha}{1 + 70\alpha}$

$\alpha = \dfrac{1}{210}\ {}^\circ C^{-1}$ — (01)

c) when temperature is increased, the random speed of free e^n is increased therefore there is a resistance to the flow of e^n under a potential difference — (01)

(10) (B)

(i) (i) input impedance is infinite.

output " is zero

open loop voltage gain is infinite

band ~~width~~ width is infinite. — (02)

Goldan rules

I. voltage law.

~~The~~ voltage difference between input ~~and~~ terminals of an ideal op-amp is zero. — (01)

II current law.

Since the input impedance of an ideal op-amp is very large $> 10^2 \Omega$, the current ~~through the input~~ flowing to the amplifier through the input terminals becomes zero. — (01)

(a) (i) potential $= \frac{1.2}{(1.2 + 4.2)} \times 4.5 = +1.0\ V$ — (01) (01) (01)

Simplification — (01)

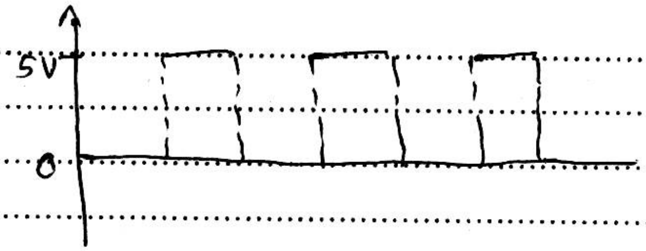
input resistance is infinite and ~~out~~ output resistance is zero

(ii) V_{in} ~~>~~ 1.0 V then $V^+ > V^-$

the output of the op-amp is +5 V or the + of the diode, ~~through~~ current flows to produce +5 across R — (01)
Then $V_{out} = +5\ V$.

when $V_{in} < 1.0\ V$ output becomes $-5\ V$ since - direction, there is no current through the diode. voltage across R is 0 V. $V_{out} = 0$. — (01)

(b) (i)



curve is rectangular. — (01)
maximum value +5 — (01)
minimum value 0 — (01)
are in same phase — (01)

(ii) Creating digital signals.
As a regenerating amplifier
re-creating signals.
for one answer — (01)