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Provincial Department of Education - NWP

01 | E | I

Third Term Test - Grade 13 - 2018

Index No : ....

Physics I

2 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.**

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

1. If force F, displacement and time were considered as fundamental physical quantities and the dimensions are denoted by $[F], [L], [T]$ respectively, the dimensions of power will be

   1. $FL^{-1}T^{-1}$ 2. FLT^{-1} 3. $FL^{-1}T$ 4. FLT 5. $F^{-1}LT^{-1}$

2. Which of the following measurements cannot be obtained using metre ruler or usual Venire caliper in the lab?
   1. Diameter of a plastic tube of diameter 38.6 mm
   2. Length of a glass block of length 197 mm
   3. Width of a window of with 22.06 cm
   4. Depth of a cylindrical vessel of depth 8.35 cm
   5. Thickness of a book of thickness 1.9mm

3. Four masses m_1, m_2 m_3 and m_4 are placed at each corner of square of a side a. Then the gravitational potential at the canter of square is V. The gravitational potential energy of a mass m_5 placed at the centre of the square is,

   1. Vm_5 2. Vm_4 3. Vm_3 4. Vm_2 5. Vm_1

4. There is a mass W on an inclined plane of angle θ with the horizontal. In order to keep the mass from sliping down the plane a **horizontal** force of P is barely enough. Then the coefficient of friction between the object and the plane is,

   1. $\frac{wg\ sin\theta - Pcos\theta}{wg\ cos\theta + P\ sin\theta}$ 2. $tan\theta$ 3. $\frac{wg\ sin\theta + Pcos\theta}{wg\ cos\theta + P\ sin\theta}$

   4. $\frac{wg\ sin\theta - Pcos\theta}{w\ cos\theta + P\ sin\theta}$ 5. $P\ tan\theta$

5. Mass of the moon is $\frac{1}{64}$ of that of the earth. The distance between centers of the earth and the moon is 4.5×10^5 km . Then the distance to the point where the gravitational field intensity between the earth and moon is zero from the centre of the Moon is,

1. $4 \times 10^5\ km$ 2. $4 \times 10^4\ km$ 3. $5 \times 10^4\ m$ 4. $5 \times 10^4\ km$ 5. $4 \times 10^5\ m$

6. An object starts motion from rest with uniform acceleration. Its displacement during the first second is S_1 It is S_2 during the second second. Then the relationship between S_1 and S_2 is

1. $3S_2 = S_1$ 2. $S_2 = 3S_1$ 3. $S_2 = \frac{1}{3}S_1$ 4. $S_1 = \frac{1}{3}S_2$ 5. $S_1 = S_2$

7. An object P is released from rest from the top of a cliff of height 50 m and identical objects Q is thrown horizontally with a velocity 30 m s^{-1} at the same position at the same moment. Which of the following statement is correct regarding the motion of P and Q

(A) Acceleration of both P and Q is the same.
(B) Time taken by both P and Q to reach the ground is the same
(C) Both P and Q reach the ground with same velocity

(1) Only A (2) Only B (3) only A and B
(4) only B and C (5) all A, B and C

8. A man rotate the mass of 30 g attached to one end of a string in horizontal circle of radius 1.5 m by keeping the other end of the string fixed. If the maximum bearable tension of the string is 900 N the maximum possible angular velocity of the mass is

1. $\frac{10}{\sqrt{5}}\ rads^{-1}$ 2. $4\sqrt{5}\ rads^{-1}$ 3. $\frac{20}{\sqrt{5}}\ rads^{-1}$ 4. $10\sqrt{5}\ rads^{-1}$ 5. $20\sqrt{5}\ rads^{-1}$

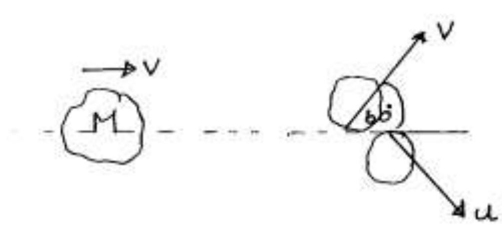
9. Mass and radius of a Merry Go Round which can be considered as a uniform circular disc are 50 kg and 2 m respectively. This merry-go-round is rotating with uniform angular velocity 2 rad s^{-1} at the beginning. Suddenly two children of mass 50 kg and 25 kg jump simultaneously and vertically onto the merry go round such that they are each At 1 m from the centre of the merry go round and they are on a diameter of merry go round. Then the new angular velocity of the merry go round will be nearly

1. 13 rpm 2. 12 rpm 3. 11 rpm 4. 10 rpm 5. 15 rpm

10. Momentum of mass *m* is *P*. If its kinetic energy is then became 4 times the initial its new velocity will be.

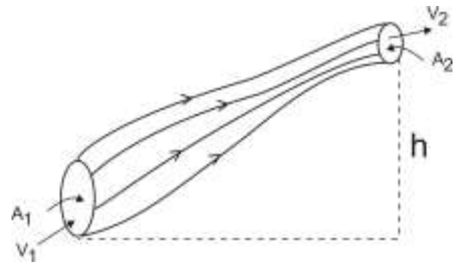
(1) Two times the initial (2) Half of the initial (3) Same as the initial
(4) four times the initial (5) quarter of the initial

11. An object of mass *M* while moving with a velocity *v* is exploded into two identical fragments and continues the motion as shown in the figure. Which of the followings represent the correct relationship between *u* and *v*?



1. $V = \sqrt{3}\,U$ 2. $\sqrt{3}\ V = U$ 3. $\frac{V}{\sqrt{3}} = U$
4. $V = \frac{U}{\sqrt{3}}$ 5. $V = U$

12. The speed of flow and cross sectional area at A_1 of the flow tube shown are V_1 and 2 cm^2 respectively and those at A_2 are V_2 and 0.5 cm^2 respectively. If the flow take place as a laminar flow with the rate of 300 $cm^3 s^{-1}$ values of V_1 and V_2 respectively are.



1. $1.5\ cms^{-1}, 6\ cms^{-1}$ 2. $150\ ms^{-1}, 600\ ms^{-1}$
3. $6\ ms^{-1}, 1.5\ ms^{-1}$ 4. $1.5\ ms^{-1}, 6\ ms^{-1}$
5. $6\ ms^{-1}, 1.5\ cms^{-1}$

13. Cube of ice of mass 48 g floats on concentrated salt solution in a measuring cylinder. Volume of the solt solution is 200 cm^3. The ratio of initial and final (after the ice cube is completely melt) volume of the measuring cylinder is (the density of water is 1000 kg m^{-3} and that of salt solution is 1200 kg m^{-3})

1. $15:16$ 2. $31:30$ 3. $30:31$ 4. 16:15 5. $6:5$

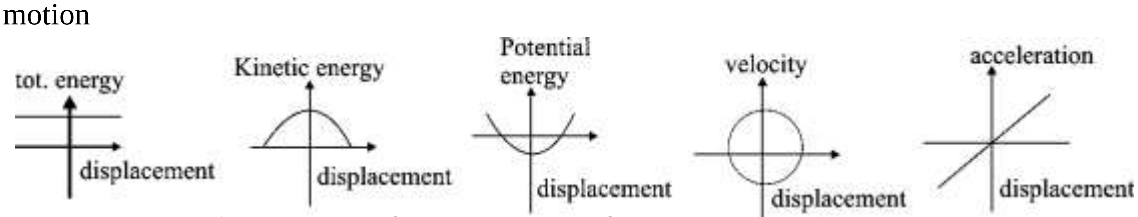
14. When there is a flow of fluid through a tube of non uniform cross section, the pressure is maximum at
(A) The place where the speed of flow is maximum
(B) The place where the speed of flow is minimum
(C) The place where the diameter of the tube is maximum
(D) The place where the diameter of the tube is minimum
(1) Only at B (2) only at A and C (3) only at B and D
(4) only at A and D (5) only at B and C

15. When electromagnetic waves are considered
(1) all the electromagnetic waves are transverse.
(2) All the electromagnetic waves are longitudinal.
(3) Energy is transformed only alone the direction of variation of electric field.
(4) Energy is transformed only along the direction of variation of magnetic field.
(5) The speed of electromagnetic waves is always 3×10^8 m s^{-1}

16. When there is a transverse wave along a string, the displacement of a particle is given by $y = 5 \sin(2t + \pi)$ then the frequency of vibration of particles on the string is,

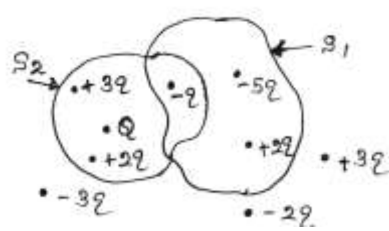
1. $\pi\ Hz$ 2. $\frac{1}{\pi}\ Hz$ 3. $2\pi\ \ Hz$ 4. $\frac{1}{2\pi}\ Hz$ 5. $5\ Hz$

17. Which of the following graph does not represent a graph that is not related to a particle at simple harmonic motion



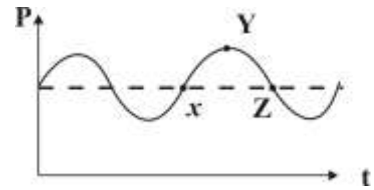
1. 2. 3. 4. 5.

18. A distribution of charges in the space is shown in the figure. Some of the charges are surrounded by two Gaussian surface S_1 and S_2. The ratio of electric flux through S_1 and S_2 is 2:1. Then the charge Q is,



1. $+6q$ 2. $+4q$ 3. $-6q$
4. $-12\ q$ 5. $-2.5q$

19. When there is a sound wave in air the variation of pressure P at a point with time t is shown in the graph. Consider the following statements



(A) There is a rarefaction at X
(B) There is a compression at Y
(C) There can be either compressor for affection at Z
Which of the the above is/are correct

(1) Only A (2) only B and C (3) Only B
(4) only A and C (5) all A, B and C are

20. A tube of length l_1 closed at one end has a fundamental frequency f_1. If the closed end of the tube is opened, its fundamental frequency is f_2. The speed of sound in air 330 m s^{-1}. The ratio $\frac{f_1}{f_2}$ is,

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

21. Which of the following help to distinguish two musical notes?
(1) Speed of the sound wave
(2) Wavelength of the sound wave
(3) Atmospheric temperature
(4) Amplitude of the wave
(5) The medium where the sound wave is propagating

22. When A tuning fork of frequency 256 Hz is sounded with another tuning fork of unknown frequency, 8 beats were heard in 2 seconds. When they were sounded for the second time, a small part of the arm of second tuning fork is broken. Then 10 beats were heard in 2 seconds. Then the actual frequency of second tuning fork.

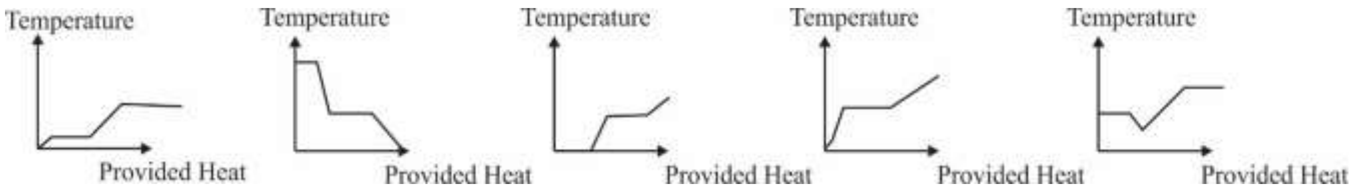
1. $260\ Hz$ 2. $252\ Hz$ 3. $256\ Hz$ 4. $264\ Hz$ 5. $248\ Hz$

23. In order to make the speed of transverse waves along a string 3 times, it's tension must make
(1) Two times (2) nine times (3) four times
(4) five times (5) three times

24. Block of copper of mass 2 kg is heated to 500 °C. Now if it is placed in a large block of ice at 0 °C the amount of ice that will melt will be
The specific heat capacity of copper is 400 J kg^{-1} °C^{-1}
The specific latent heat of fusion the specific latent heat of fusion of ice is 3.5 x 10^{5} J kg^{-1}
You may assume that no water is vaporized

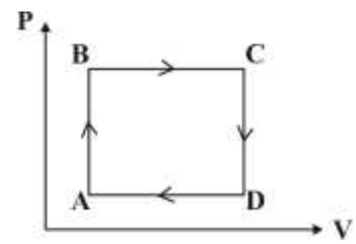
1. $\frac{3}{4}\ kg$ 2. $\frac{6}{5}\ kg$ 3. $\frac{8}{7}\ kg$ 4. $\frac{10}{9}\ kg$ 5. $\frac{12}{7}\ kg$

25. A block of ice at -10 Celsius is slowly heated until it is completely become steam at 100 °C. Which of the following graph best represent the above incident qualitatively



1. 2. 3. 4. 5.

26. Following graph represent the PV diagram of a certain cyclic process. $P_A = 3 \text{ x } 10^4 \; Pa$, $V_A = 2 \text{ x } 10^{-3} m^3$, $P_B = 8\text{x } 10^4 Pa$, $V_D = 5 \text{ x } 10^{-3} m^3$ During the process AB 600 J is added to the system. During the process BC 200J is added to the system.



The change of internal energy during the process AC is,

1. $560\,J$ 2. $800\,J$ 3. $600\,J$ 4. $640\,J$ 5. $700\,J$

27. When the temperature of a gas is increased from 27 °C to 927 °C its root mean square velocity become

(1) Two times (2) Half (3) 4 time s (4) No change (5) 3times

28. Two ideal gases are at T' and T'' temperatures. They are then mixed together. If there is no energy loss during this process and amount of respective gases are n_1 and n_2 molls the final temperature of the mixture is ?

1. $\frac{n_1 T^{/} + n_2 T^{//}}{n_1 + n_2}$ 2. $\frac{n_2 T^{/} + n_1 T^{//}}{n_1 + n_2}$ 3. $T^{/} + \frac{n_2}{n_1} T^{//}$ 4. $T^{//} + \frac{n_1}{n_2} T^{/}$ 5. $\frac{n_1 n_2}{n_1 + n_2} T^1 + T^{//}$

29. Consider the following statements about amount of water vapor in certain volume of air at a certain temperature θ °C.

(A) $\frac{\text{Saturated vapour pressure at } 0\,°\text{C}}{\text{Saturated vapour pressure at the Dew Point}} \times 100\%$

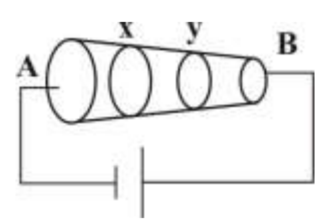
(B) $\frac{\text{partial vapour pressure at } \theta°\text{C}}{\text{Saturated vapour pressure at the } \theta°\text{C}} \times 100\%$

(C) $\frac{\text{mass of vapor at } \theta°\text{C}}{\text{Saturated vapour pressure at the } \theta°\text{C}} \times 100\%$

Which of the which of the above give the correct relative humidity of air

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

30. *AB* shown in the figure is tapering conductor. Radius of cross section at X and Y are 2*r* and *r* respectively. Potential difference is connected to *A* and *B*. If the drift velocity of electrons at *X* and *Y* are V_X and V_Y respectively , ratio $\frac{V_X}{V_Y}$ is



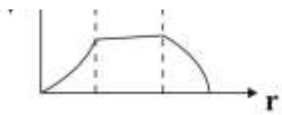
1. $\frac{1}{16}$ 2. $\frac{1}{4}$ 3. $\frac{1}{12}$ 4. $\frac{1}{6}$ 5. $\frac{1}{8}$

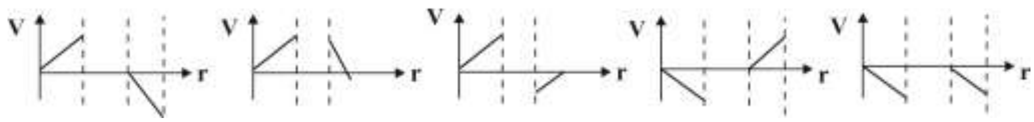
31. *ABCD* is a circular loop of wire and its Centre is *O* . There is a cell connected between *A* and *C* if the magnetic field intensity at *O* due to the current in *ABC* and *ADC* are B_1 and B_2 respectively, the ratio $\frac{B_1}{B_2}$ is,

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

32. The variation of electrostatic potential *V* with the distance *r* in a certain region is shown in the graph. The variation of electric field intensity *E* in this region is best represented by,

,

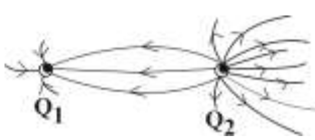




1. 2. 3. 4. 5.

33. Consider the following statements about the electrostatic induction.
(A) Only insulators can be charged with electrostatic induction
(B) When charge with electrostatic induction object must be grounded.
(C) The object must be grounded after the charge separation take place.
(D)
Of the above statements
(1) Only A is true. (2) Only B is true.
(3) only A and B are true (4) only B and C are true
(5) all A, B and C are true

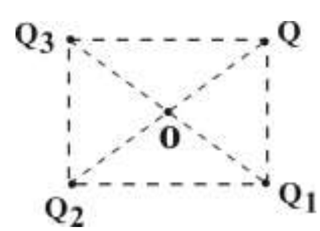
34. Following figure shows how electric field lines are spreaded between two charges Q_1 and Q_2. Then it can be concluded that



1. $Q_1 = Q_2$ 2. $2Q_1 = Q_2$ 3. $Q_1 = 2Q_2$
4. $Q_1 = Q_2^2$ 5. $Q_2 = Q_1^2$

35. Four charges are placed at the corners of rectangular wooden frame as shown in the figure,
$Q_1 = 2\,Q$, $Q_2 = 3\,Q$, $Q_3 = 4\,Q$,

If the electric field intensity at *O* due to *Q* charge is *E* , the resultant electric field intensity at *O* is?



1. $\sqrt{2}\,E$ 2. $\sqrt{3}\,E$ 3. $\sqrt{6}\,E$ 4. $\sqrt{8}\,E$ 5. E

36. Which of the following shows the correct spread of electric field lines?

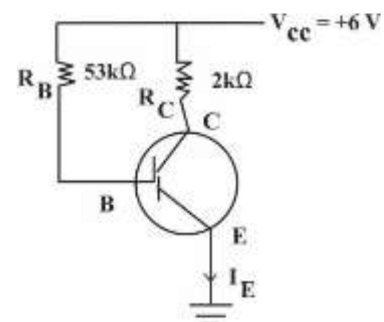
1. 2. 3. 4. 5.

37. X is a silicon diode if its potential barrier is 0.7 V the current through R_L is

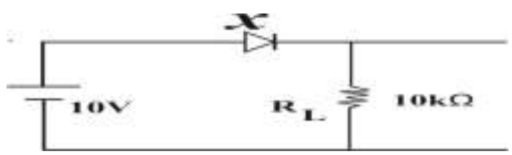
1. $9.3 \times 10^{-4} A$ 2. $93 \times 10^{-4} A$ 3. $9.3 \times 10^{4} A$
4. $93 \times 10^{4} A$ 5. $9.3 \times 10^{-3} A$

38. Following is a Si transistors in common emitter configuration. Its current gain is 100. V_{BE} = 0.7 V. Determine V_{CE}.

1. $2V$ 2. $4V$ 3. $6V$ 4. $8V$ 5. $5V$

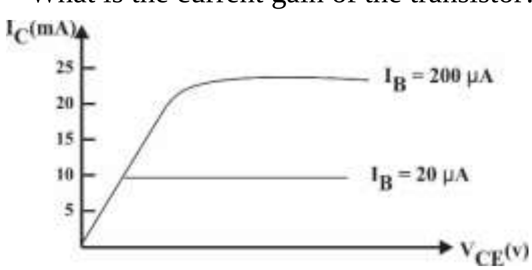


39. In the logic circuit shown below Q is the output. This circuit is analogous to which of the following gate?



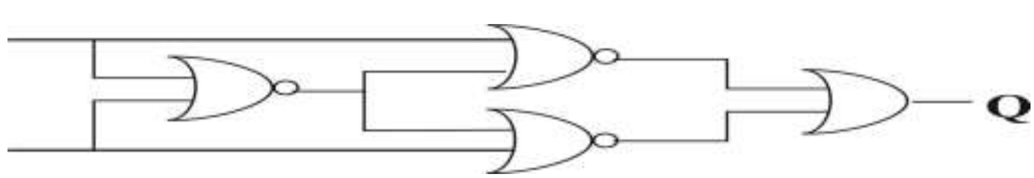
1. XOR 2. OR 3. $NAND$ 4. NOR 5. AND

40. Following graph indicate a characteristic curve of a silicon transistor in common emitter configuration. What is the current gain of the transistor?



1. 200 2. 300 3. 500
4. 50 5. 400

41. Which of the following graph best represent the variation of photo current I and voltage V of a photoelectric cell.



1. 2. 3. 4. 5.

42. The de Broglie wavelength of an electron of mass m and absolute Temperature T is (assume that electron behave as an ideal gas) (k Boltzmann's constant)

1. $\frac{h}{\sqrt{mkT}}$ 2. $\frac{h}{\sqrt{2mkT}}$ 3. $\frac{h}{\sqrt{3mkT}}$ 4. $\frac{h}{2\sqrt{mkT}}$ 5. $\frac{h}{2\sqrt{5mkT}}$

43. The shortest wavelength of X-Ray emitted from X ray tube is depend on

(1) The current in the tube (2) The voltage provided to produce X-rays
(3) The gas inside the tube (4) Atomic number of target metal
(5) None of the above

44. There is a viscous liquid flow in a tube of length l and diameter d. There is a pressure difference of ΔP and the rate of flow is V. If this tube is replaced by another tube of length $2l$ and diameter $\frac{d}{2}$, and keep the pressure difference unchanged, new rate of flow will become.

1. V 2. $V/4$ 3. $V/8$ 4. $V/16$ 5. $V/10$

45. It is required to make a soap bubble of radius $2r$ from a soap bubble of radius r under isothermal conditions. If the surface tension of soap solution is T, the amount of energy required for this process is.

1. $3\pi\ \sigma r^2$ 2. $6\pi\ \sigma r^2$ 3. $12\pi\ \sigma r^2$ 4. $24\pi\ \sigma r^2$ 5. $8\pi\ \sigma r^2$

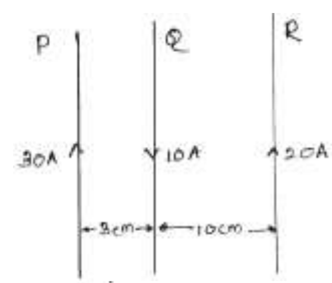
46. Young's modulus of a material is E. The strain of string made of this material is σ. Then the amount of energy stored per unit volume of the string is.

(1) $\frac{\sigma E}{2}$ (2) $\frac{\sigma^2 E}{2}$ (3) $\frac{\sigma^2}{2E}$ (4) $\frac{\sigma}{2E}$ (5) $\frac{\sigma^2 E^2}{2}$

47. When a conductor of length L carrying a current I is placed 60° inclined to a uniform magnetic field it experience a force F. Then magnitude of magnetic field intensity is.

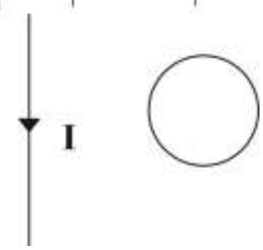
1. $\frac{2F}{IL}$ 2. $\frac{F}{\sqrt{3}\,IL}$ 3. $\frac{2\sqrt{3}\,F}{IL}$ 4. $\frac{IL}{\sqrt{3}\,F}$ 5. $\frac{IL}{2\sqrt{3}\,F}$

48. Three conducting wires P Q and R are shown in the figure. The direction of current flow in each wire is shown in the figure. Then the force acting on 25 cm length of the conductor Q is?



1. $4\ \text{x}\ 10^{-5}N$ 2. $4\ \text{x}\ 10^{-4}N$ 3. $4\ \text{x}\ 10^{-3}N$
4. $4\ \text{x}\ 10^{-2}N$ 5. $4\ \text{x}\ 10^{-1}N$

49. There is a loop of conductor with n number of turns near a straight conductor carrying a current I as shown in the figure. Then in the loop



(1) there is a current in anticlockwise direction.
(2) There is a current in clockwise direction.
(3) There is no current
(4) First there is safe clockwise current and then there is anticlockwise current.
(5) First there is anticlockwise current and then there is a clockwise current.

50. When there is a current through a long solenoid, a magnetic field of intensity B is build up along the axis of the solenoid. If the solenoid is unwinded and the same wire is used to wind another solenoid of radius half of the first and send a current quarter of the first, then new magnetic field intensity on the axis will be.

1. $4B$ 2. B 3. $2B$ 4. $\frac{B}{2}$ 5. $\frac{B}{4}$

වයඹ පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව

Provincial Department of Education - NWP

01	E	II

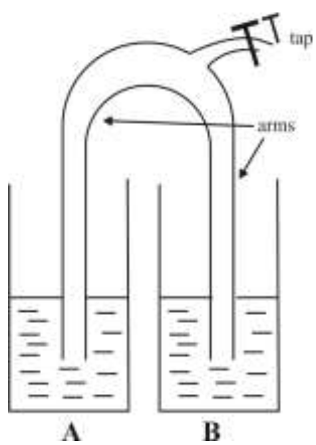
Third Term Test - Grade 13 - 2018

Index No : .... **Physics II** 3 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. Hare's apparatus is used to compare densities of two liquids



i. This instrument is specially designed to compare densities of one type of liquids. What is that type?

....

ii. Explain how do you insert liquid columns into the arms and describe how do you keep them there?

....

....

....

iii. Above apparatus is used to compare two liquids A and B . The densities of them are d_A and d_B respectively. The corresponding heights of the liquid columns are h_A and h_B respectively. The corresponding heights of the liquid columns are h_A and h_B. If $d_B > d_A$, mark the heights h_A and h_B on the above figure.

iv. Write an expression for d_B in terms of d_A, d_B, h_A . The atmospheric pressure is P_0

....

....

v. If the above mentioned A is water and B is coconut oil, rearrange above expression to represent variation of h_A with h_B to plot a graph.

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vi. Sketch the expected graph and label its axis.

vii. If the gradient of the graph is 1.25, determine density of coconut oil. Density of water is $1000\ kgm^{-3}$

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viii. while measuring heights of liquid columns, how do you minimize effect of fractional errors and avoid effect of capillary rise experimentally.

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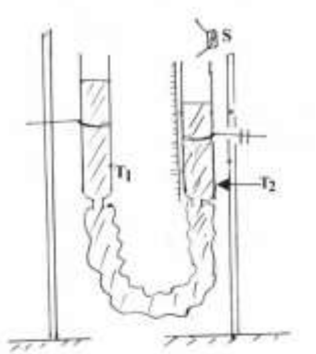
02). 

A set up used to find speed of sound in air is shown below. S is a sound source of frequency f placed above the open end of the tube T_2. The water level in the tube T_2 can be changed by lowering the tube T_1

i. How do you move the tube T_1 . Up or down, to increase water level in the tube T_2

....

ii. Explain how do you find initial resonance state experimentally.

....

....

....

iii. Draw the pattern of the fundamental mode of vibration in the above tube T_2. Clearly indicate the end correction.

iv. When the water level in the tube T_2 is $1m$ below the open end the fundamental resonance state is observed. Find the frequency of sound. Neglect end correction. The speed of sound in air is $360\ ms^{-1}$

....

....

v. Derive and expression for the speed of sound in air V interms of frequency of n^{th} overtone (f), resonance length (l) and end correction (e).

....

vi. If you are following a graphical method to find v, rearrange the above expression for that,

....

vii. Sketch the graph and label axis clearly.

viii. During the experiment surrounding temperature is dropped to a lower value. Then sketch the expected graph on the above axes and label it as B.

....

ix. If you used another tube having narrow cross section instead, of T_2. What change do you expect from the experimental value of V. Explain your answer.

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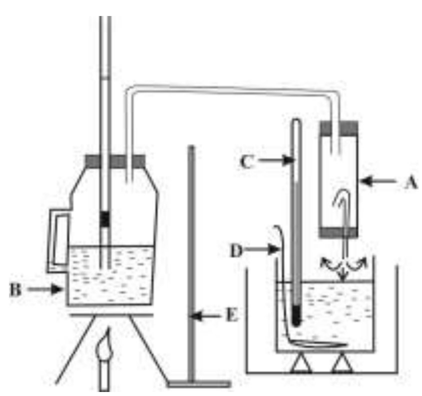
03.



i. Above setup is used to find specific latent heat of vaporization of water. Label parts A, B, C, D and E

A .... B ....

C .... D ....

E ....

ii. What is the specific latent heat of vaporization of water?

....

iii. What is the method used to minimize heat loss in this experiment.

....

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....

iv. (a) What is the suitable initial temperature of water in the calorimeter.

....

(b) While selecting above temperature, what is the environmental condition that should be considered.

....

v. (a) What should be the most accurate measurement in this experiment?

....

(b) Explain the reason for above answer.

....

vi. What is the reason to use E here ?

....

vii. The steam at 150^0C is generated from the boiler and that steam is passed through a copper tube to increase temperature of $10\ kg$ of water from 20^0C to 90^0C during one hour. Then steam is condensed to water 95^0C and returns to the boiler.

(a) If the required mass of steam for one hour for the above process is m, what is the heat gained by water to heat for one hour ?.

....

(b) Using M write an expression for the heat given by steam during one hour.

....

....

(c) Hence find M

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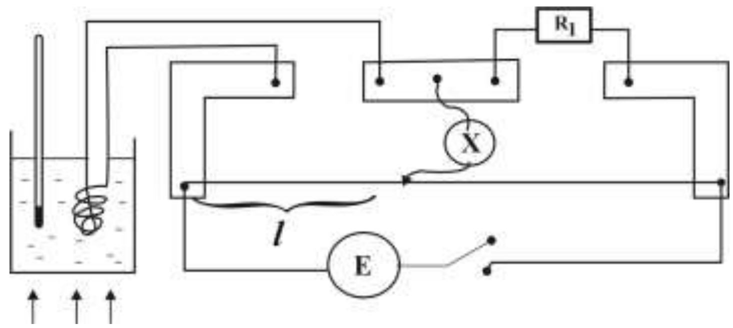
Specific latent heat of vaporization of water $= 2.27\ x\ 10^6 JKg^{-1}$
Specific heat capacity of water $= 4200\ JKg^{-1}C^{0\ -1}$
Specific heat capacity of steam $= 2000\ JKg^{-1}C^{0\ -1}$

04). A metre bridge can be used to find temperature coefficient of resistance of a material in the form of wire. A known resistance (R_1) Can be connected to one gap and the coiled wire can be connected to the other gap. The coil is immersed in water bathe as shown.



i. What are the items x and E

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....

....

ii. How do you protect item ?

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iii. Graphical method is used to determine temperature coefficient of resistivity, then what should be the item used as R_1 Give a reason for that.

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iv. The balanced length for a certain temperature θ is l. Write an expression for the resistance of the coil R_2 in terms of l and R_1

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v. Write an expression for R_2 in terms of R_0, α , and θ. R_0 - resistance of O^0C, α - temperature coefficient of resistance.

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vi. Rearrange above expression to find α using a graphical method.

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vii. What are the independent and dependent variables?

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viii. Sketch the expected shape of the graph and label the axes.

vii. How do you find α from the graph?

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....

x. Above experiment was used to find temperature coefficient of copper. Then the gradient and intercept of the plotted graph were $0.00408\,\Omega C^{0-1}$ and 1.02Ω respectively. Determine temperature coefficient of resistance of copper.

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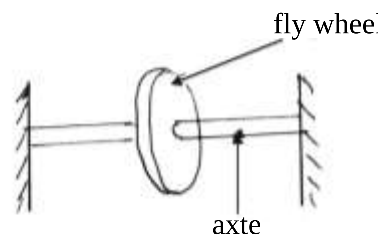
Second Term Test - 2018
Physics Part II - Grade 13
Part - B (Essay)

- **Answer four questions only.**

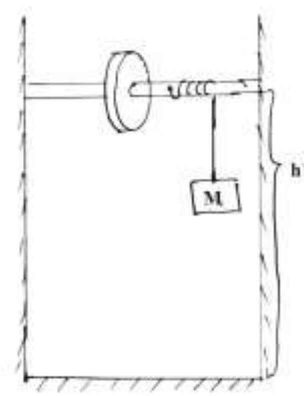
05).(a) Write down an expression for the moment of inertia, I of a circular disc of mass M and radius a.



(b) A flywheel (uniform circular disc) of mass 10 kg and radius 0.15m is mounted on a horizontal cylindrical axle of radius 0.015m and negligible mass. Neglecting frictional losses in the bearings, calculate,

(a) The moment of inertia of the flywheel.
(b) the angular velocity acquired from rest by the application, for 10 seconds of a force of 20N tangential to the axle.
(c) The kinetic energy of the disc at the end of this period.
(d) The time required to bring the disc to rest if a constant braking force of 1N were applied tangentially to its rim.

(C) The moment of inertia of a flywheel about a horizontal axle can be determined by passing one end of some string through a hole in the axle, winding the string round the axle, and attaching a mass M to the other end of the string. The length of the string is such that M reaches the floor, when released, at the same instant as the string is completely unwound from the axle. M is released and the number of revolutions, n, made by the wheel up to the occation when M strikes the ground is noted. The further number of revolutions, n_1 made by the wheel until it comes finally to rest, and the time t taken are also observed.



Now the loss in potential energy of M = gain in kinetic energy of M + gain in kinetic energy of flywheel + work done against friction.

$$Mgh = \frac{1}{2} Mr^2\omega^2 + \frac{1}{2} I\omega^2 + nf$$

Where M is the mass of M, h is the distance M has fallen, r is the radius of the axle, ω is the angular velocity, I is the moment inertia, and f is the energy per turn expended against friction. Since the energy of rotation of the flywheel. When the mass M reaches the ground = work done against friction in n_1 revolutions, then

$$\frac{1}{2} Iw^2 = n_1 f$$

$$f = \frac{\frac{1}{2}I\omega^2}{n_1}$$

Since the angular velocity of the wheel when M reaches the ground is ω, and the final angular velocity of the wheel is zero after a time t, the average angular velocity = $\frac{\omega}{2} = \frac{2\pi n_1}{t}$. The readings obtained from the experiment are given below. Calculate the moment of inertia of the flywheel taking $(\pi = 3)$

$n = 6$ $M = 500g$ $n_1 = 10$ $h = 50\ cm$

$t \;=\; 2S \qquad r = 0.015m$

06). Passenger standing close to the platform at a station observes an express train which is travelling with a constant velocity of $60\ ms^{-1}$ sounding its horn producing a note of $500\ Hz$. Velocity of sound $360ms^{-1}$

i. What is meant by the Doppler effect? Give two examples for the applications of Doppler effect.

ii. What is the apparent frequency heard by the passenger when the train approaches him the passenger at rest.

iii. What is the apparent frequency heard by the passenger when the train passes the passenger at rest.

iv. Draw a rough sketch of the graph to represent the variation of the frequency heard by the passenger with the location (distance) of the train.

v. When the above train is passing the platform while continuously sounding its horn, the passenger observes another train coming from the opposite direction at a constant velocity of $60\ ms^{-1}$ sounding its horn with a frequency of 350 Hz.

(a) How many beats per second will be heard by the passenger when the second train is coming towards the flatform.

(b) What is the beat frequency heard by the passenger when the second train is passing the platform.

07). i. Explain the differences between the elastic limit and the proportional limit of a metal wire.

ii. (a) A uniform cylindrical rod made of soft steel has a cross sectional area of $4 \text{ x } 10^{-4}m^2$ Find the tensile stress on the rod when a tensile force of $6.5 \text{ x } 10^2N$ is applied on it.

(b) find the tensile strain of the rod if the young's modulus of soft steel is $2.0 \text{ x } 10^{11}Nm^{-2}$

ii. The figure shows a flower pot placed on a supporting column, the weight of it exerts a compressive force on the column.

The cuboid shaped column with solid walls has a internal cylindrical hollow of radius 3cm and uniform square cross section of side 15 cm. A flower pot of weight 40kg is placed on the column of height 50 cm, made of soft steel. (Take $\pi = 3$)

(a) Find the compressive stress exerted on the column.

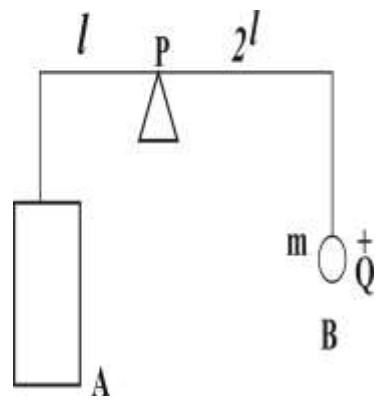
(b) Find the compressive strain.

(c) What is the compression of the column due to the flower pot placed on it ?

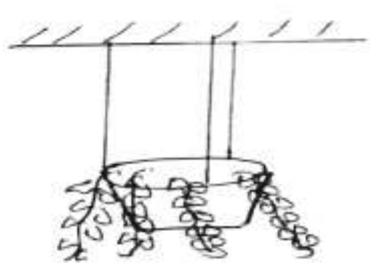
(d) The compressive of the breaking stress of steel is $1.5x10^5\ Nm^{-2}$

What is the maximum mass the flower pot should have to be placed on the above column ?

iv. The figure shows a flower pot hanging from a fixed support using 3 vertical soft steel wires. The wires are identical and each has a diameter of 2cm. If the tensile value of breaking stress is $1.6x10^5 Nm^{-2}$, show that the flower pot placed on the above column can not be hung from the 3 identical wires.



08). A structure of a scales (balance) working according to the principle of moment is shown in the figure. The scale pan A of the scales with different arms is used to keep the mass to be measured. B is a metal sphere with a mass m and a charge $+Q$. There is an electric field applied around the sphere. Although the mass m can be moved along the arm, this type of scales is normally balanced by keeping a mass on the plan A and the magnitude of the electric field around the sphere is varied. Using a digital screen the magnitude of the mass on the pan A is accurately read. Initially the scales is in balanced.



i. To which direction should the sphere be moved in order to balance the scales when a mass m_0 is placed on the scale pan A? Now an electrostatic field is not applied around the sphere. Obtain an expression for the distance of B that should be moved along the arm. The gravitational itational field intensity is g.

ii. If the scales should be balanced without moving m , what is the direction of the applied electric field? Obtain an expression for the electric field intensity E in terms of M_0, g, Q and m

iii. If $m_0 = 100g,\ m = 20\ g$ හා $Q = 5C$ find the magnitude of the applied electrostatic field.

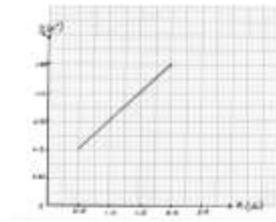
iv. A gold metal sphere of mass $m_1 = 50\ g$ is placed on the scale pan A to find the mass of it. Due to the positively charge mass m the gold sphere is charged under the electrostatic induction. If the whole scale is now affected by an electric field applied vertically downwards, To which direction should the mass m be moved in order to balance the scales .
Obtain an expression for the distance of m that should be moved along the arm in terms of l, m_1, Q, E and m

v. If the magnitude of E is same as the value calculated in III above and $l = 30\ m\ \ \Delta l$
Calculate the distance Δl moved by m.

❖ **<u>Answer part A or B</u>**

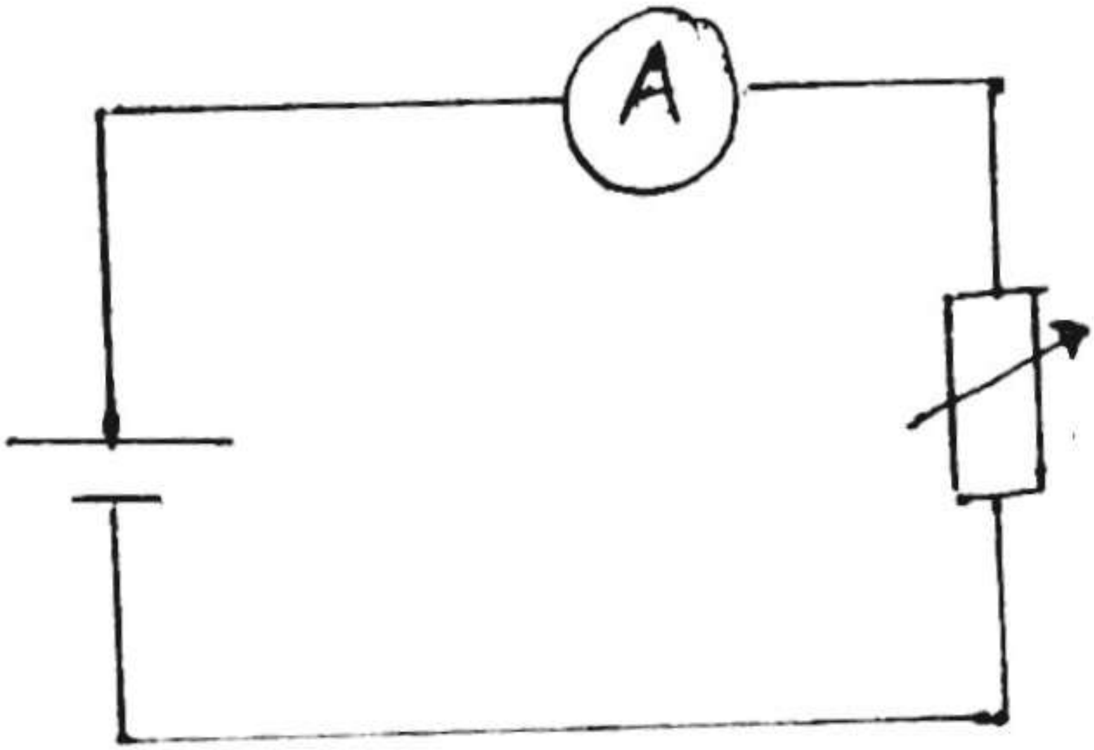
09). (A). following circuit is usual to find the electromotive force and internal resistance of a cell experimentally.

i. The $E.M.F$ and internal resistance of cell "E " and "r" respectively when the external resistance is R, Write down expression for the current I flowing through the circuit in terms of $E, R \; and \; r$



Resistance Box

i. In the experiment the readings for I are taken by the changing the value of resistance box. The graph is drawn by using the above readings.



Electromotive Farce and internal resistance of cell are calculated by using the graph.

a. Rearrange the expression that is taken in part (I) to satisfy the condition of drawn graph.

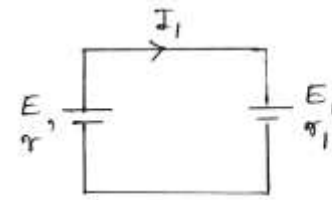
b. When the cell is short circuit, Find the maximum current passing through it.

c. Calculate the Electromotive force (E) and internal resistance (r) of the cell.

d. Write down the relationship between R and r to given maximum power to the external circuit calculate the maximum power.

e. Find the efficiency of a cell when it generate the maximum power.

v. After removing the resistance, another cell of electromotive force E_1 and internal resistance r_1 connect to the circuit as shown in the fiqure. In the circuit $E > E_1$ and the current is I_1

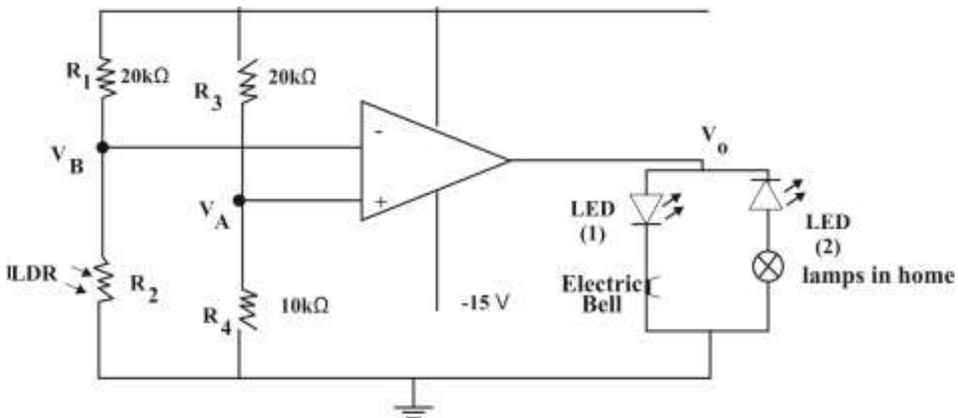


(a) Build up the expression for I_1

(b) Show that $EI_1 - I^2r = E_1 I_1 + I_1^2 r_1$

(c) Write down the physical quantity represent for the terms EI_1 and E_1I_1

(B). A circuit mate by using a LDR ($Light\ Dependent\ resistor$) and opamph to automatically switch on the lights at night and to ring the bell when the sunlight falls is given below. The resistance of LDR at night is $130\ k\Omega$ and its value is 200Ω day time. LED is a (Light Emitting Diode) The maximum voltage of op-amp $V_0\ (sat) = \pm 13\ V$



i. Find the voltage of V_A

ii. When the light falls on to the LDR find the V_B

iii. When the darkness falls on the LDR find the value of V_B

iv. When the LDR at darkness and light. Find the value of V_0 Explain the answer.

v. Explain the mechanism of light on at the home at the night.

vi. Explain the mechanism of ring the bell when the sunlight falls.

vii. Given a change of circuit to operate the LED (1) at darkness without changing the position of LED at circuit.

viii. Find the value of V_B at light and at dark and after doing the above change.

❖ **<u>Answer part A or B</u>**

10). (A). a. What is the different between real and apparent expansion of liquid in vessel.

b. Write down the relations among the coefficient of expansions.

c. A liquid of volume $60\ cm^3$ and temperature 28^0C (Room temperature) is added to a metal container of height $30\ cm$ and base $5\ cm^2$ ant heated up to 58^0C. The linear expansivity of metal is $2\ x\ 10^{-5}C^0$ and volume expansivity is $2\ x\ 10^{-4}\ C^{0-1}$.

I. What is the real expansion of liquid?

II. What is the apparent expansion of liquid?

III. What is the volume expansion of vessel

IV. What is the height of liquid column is vessel.

d. After the liquid is cooled up to 0^0C the sphere of mass $2737g$ and radius $7\ cm$ is floated on the liquid. When the temperature of the liquid is increased gradually. The sphere is started to immerse in liquid at 35^0C

I. Find the density of liquid at 35^0C

II. Using above, Find the density of liquid at 0^0C

(B). a. Introduce photo electric effect.

b. The nuclide of ^{128}I I is used often in medicine to measure the rate of absorption of iodine in thyroid organ. The following table shows the few measurement of rate decay of sample of ^{128}I. The relation between R and t is given by $R = R_0e^{-\lambda t}$

Time (min)	R $(Count/S)$	lnR
4	392.2	5.97
36	161.4	5.08
68	65.5	4.18
100	26.8	3.28
132	10.9	2.38
164	4.56	1.52
196	1.86	0.62
218	1.00	0

i. To obtain the liner graph for above table, Draw rough sketch using an equation in $\ln R = \ln R_0 \ - \lambda t$ (Clearly mark the independent and dependent variable)

ii. Find the disintegration constant λ

iii. Find the half lite time.

C. The light of wavelength of $300\ nm$ is incident on the surface of the optical cathode of sodium (Na). The work function of Na is 2.46 ev

I. Find the maximum kinetic energy of photo electrons emitted by the surface.

II. Find the stopping voltage for above light

III. Find the threshold wave length of Na