Royal College, Colombo 07
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Grade 13 13 ශ්‍රේණිය	***Final Term Test*** අවසාන වාර පරීක්ෂණය	***July 2010*** 2010 ජූලි
Physics I භෞතික විද්‍යාව I		***Two Hours*** පැය දෙකයි

Important :

- *This question paper consists of* **60** *questions in pages.*
- *Answer* ***all*** *the questions.*
- *Write your* ***Index Number*** *in the space provided in the answer sheet.*
- *Instructions are given on the back of the answer sheet. Follow those carefully.*
- *In each of the questions* **1** *to* **60**, *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*** *(×) in accordance with the instructions given in the back of the answer sheet.*

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

01) Which of the followings do not represent energy?

1. force x volume
2. electric charge x potential difference
3. pressure x volume
4. electromotive force x electric current
5. Plank's constant x frequency

02) The expression $V = K\sqrt{\frac{F}{\mu}}$ is a standard equation used in physics. Where V *and F are the* velocity and force. *K is* a dimensionless constant. The dimensions of μ are,

1. ML^{-2}
2. MLT^{-2}
3. ML^{-1}
4. LT^{-1}
5. $ML^{2}T^{-2}$

03) The rate of emission of thermal radiation from a hot body depends on,

1. temperature and the atmospheric pressure
2. temperature and the surface area
3. the nature of the surface and the pressure
4. surface area and the humidity
5. temperature and the nature of the surface

04) If full break is applied on a moving bus with no passengers it moves a distance S before coming to rest. When the passengers are on board its mass increases by 40%. Now the bus is moving with the same velocity and full break is applied again. The distance it moves before coming to rest is,

1. 1.4 s
2. $\sqrt{1.4}$ s
3. $(1.4)^2$ s
4. 1.2 s
5. s

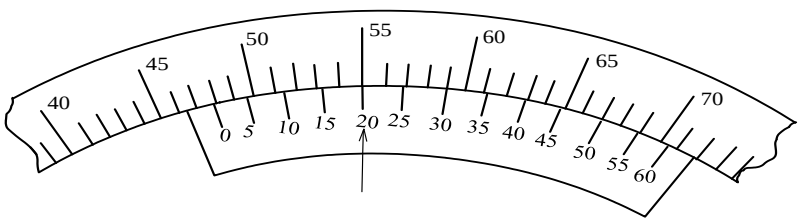
05) Consider the following statements regarding the photoelectric effect.

a. If the frequency of the incident light is constant the stopping potential is independent of the intensity.
b. The work function depends on the type of the metal and the nature of the surface.
c. Photo electric effect shows the particle nature of the radiation.

Of the statements

1. only a and b are correct
2. only b and c are correct
3. only a and c are correct
4. all a, b and c are correct
5. all a, b and c are wrong

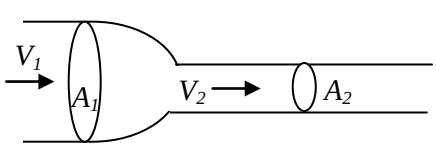
06) Specially designed circular venire scale is used by a spectrometer. Main scale is marked by 1^0 and the vernier scale has 60 divisions marked by 5 divisions. The scale reading shown is



1. $46^0\ 12'$
2. $47^0\ 20'$
3. $48^0\ 30^0$
4. $50^0\ 45^0$
5. $55^0\ 50'$

07) The power of a convex lens is +30 D. The power of the lens combination made by this lens and another lens is -20D. The power of the other lens is

1. -50 D 2. -30 D 3. -10 D 4. +20 D 5. +50 D

08) 

There is a steady air flow along the tube of two cross sectional areas A_1 and A_2 ($A_1>A_2$). The speed of the flow and the density of air in the tube of cross section area A_1 are V_1 and ρ_1 respectively. The speed of the flow and the density of air in the tube of cross section area A_2 are V_2 and ρ_2 respectively. The ratio $\frac{\rho_2}{\rho_1}$

1. is independent of A_1, A_2, V_1, V_2
2. depends on $\frac{A_1}{A_2}$ but is independent of V_1 and V_2.
3. depends $\frac{V_1}{V_2}$ but is independent of A_1 and A_2
4. depends on $\frac{A_1V_2}{A_2V_1}$
5. depends on $\frac{A_1V_1}{A_2V_2}$

09) A compound microscope is adjusted to form the final image at the near point of the eye. The object distance is changed and final image is brought back to the near point. The variation of angular magnification (m) of the microscope with the linear magnification (m_0) of the objective is best shown by the graph

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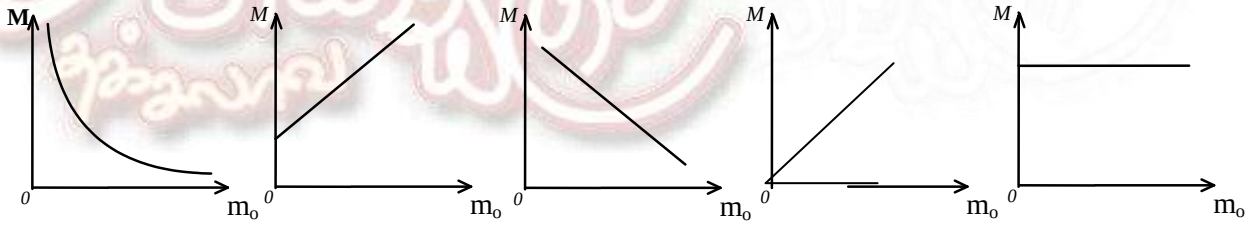


1. 2. 3. 4. 5.

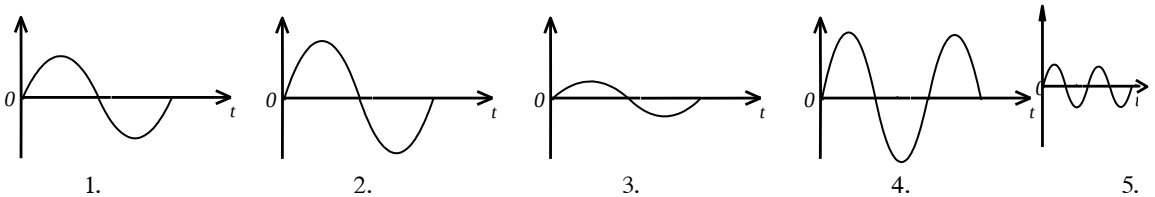
10) Consider the following statements regarding a thermometer.

a. If the volume of the mercury bulb of a mercury thermometer is increased, its sensitivity increases but accuracy decreases.
b. The reason for high sensitivity of the constant volume gas thermometer is due to the large pressure variation even for small temperature change.
c. One advantage of a thermocouple over the other thermometers is it only is capable to measure rapidly changing temperatures.

Of the statements

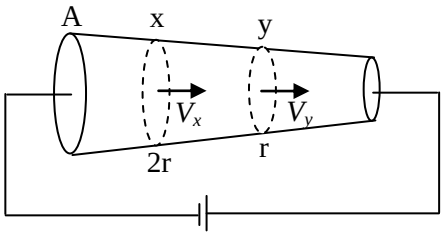
1. only a is correct
2. only b is correct
3. only c is correct
4. only a and b are correct
5. only b and c are correct

11) The wave which produces high pitch sound is,



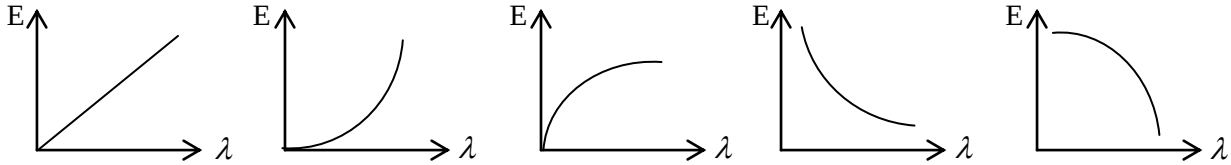
1. 2. 3. 4. 5.

12) The diagram shows a conductor of uniformly decreasing cross section area. The radius at x and y are 2r and r respectively. The conductor is connected across a battery. The drift velocity of electrons at x and y are V_x and V_y respectively. The ratio $\frac{V_x}{V_y}$ is,



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

13) The variation of energy of photons with their wave length is best shown by the graph

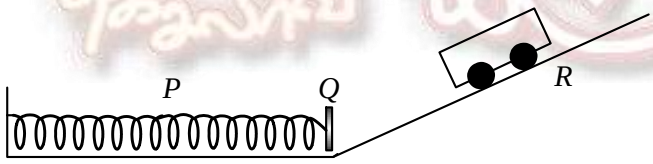


1. 2. 3. 4. 5.

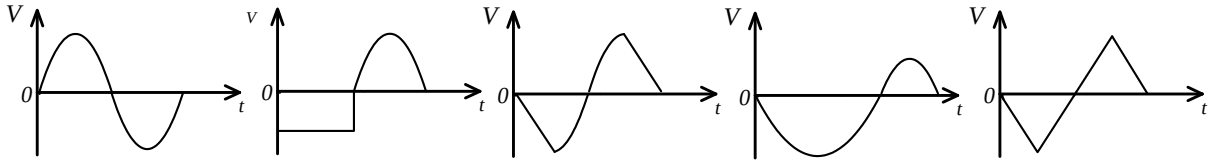
14) Younger's modulus of a material is E. It is subjected to the stress is σ . The energy stored in a unit volume of the material is.

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

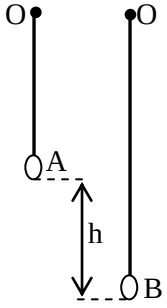
15) A soap film can be formed easily on a wire frame but not the water film. The reason for this is,
1. difference of angle of contact of the two liquids
2. the higher density of water than that of soap solution.
3. the surface tension at points on the soap film is not uniform but it is uniform on the water film.
4. the surface tension of soap solution is greater than that of water.
5. water is in compressible

16) 

The trolley on the smooth inclined plane is released from the point R from rest. It rolls down and strikes the spring. Then it starts oscillating about the point Q along the path PQR. The variation of the horizontal velocity opponent of the trolley with time is best shown by,

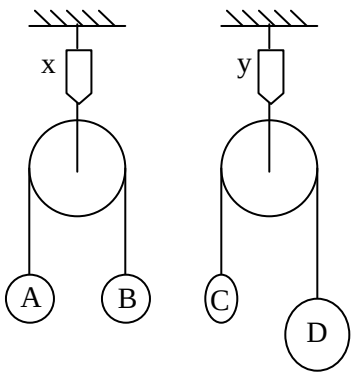


1. 2. 3. 4. 5.

17) 

Mass ***m*** connected to the one end of the light elastic string is hung by connecting the other end to the ceiling. The mass is raised up and dropped from the point A. Then it oscillates between A and B. The elastic potential energy in the string when it is in extension **h** is

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

18) 

Of the two diagrams x and y are spring balances. Two light strings connected to the objects A, B, C and D are going over a smooth pulley. Masses of A and B are 5 kg each and the masses of C and D are 4kg and 6kg respectively. The readings of balances x and y when the two systems are released from rest are,

	x	y
1.	10 kg	10 kg
2.	10 kg	12 kg
3.	0 kg	2 kg
4.	0 kg	3.2 kg
5.	10 kg	9.6 kg

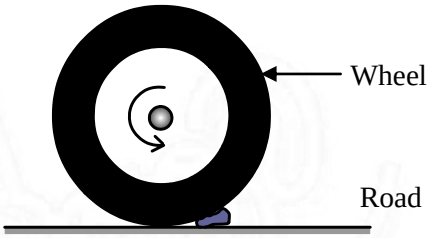
19) Consider the following statements regarding light.

a. The critical angle of glass for red colour is less than for blue colour.
b. Red colour travels faster than blue in glass.
c. The minimum deviation for red colour is greater than that of blue for a given prism.

Of statements

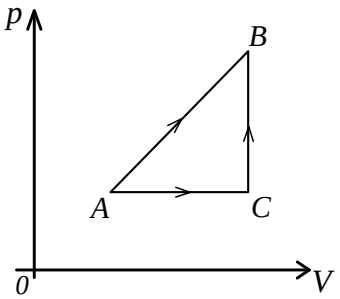
1. only a is correct
2. only b is correct
3. only c is correct
4. only a and b are correct
5. all a, b and c are correct

20) A vehicle traveling to the North runs over a piece of mud and it sticks on the tire. The direction of acceleration when it leaves the ground with the tire is



1. vertically upwards
2. horizontally to the North
3. horizontally to the south
4. no acceleration
5. 45^0 inclined to the vertical

21) A closed vessel contains some amount of dry air. It is expanded from A to B by the two separate processes one along the path AB and the other along the path ACB. Which of the followings is in correct?



1. The work done by the gas is maximum along the path $A \rightarrow B$
2. The change of internal energy is the same along the both paths.
3. A maximum energy is absorbed in the path $A \rightarrow B$
4. The work done along the path $C \rightarrow B$ is zero.
5. Heat is absorbed only in one of the two processes along the path AC and CB

22) A satellite orbiting round the earth experiences the air friction. Of the following statements what is true?

1. It enters to near orbit with a high speed.
2. It enters to a near orbit with a low speed.
3. It leaves the earth in a spiral path.
4. It falls down in spiral path with increasing velocity and decreasing radius
5. Its speed decreases and hence the period about the earth increases.

23) Cool breeze at temperature -10^0C blows over the ice layer deposited on the water surface of a lake. It takes 10 s to grow the ice layer from the thickness 20 mm to 21mm. The time taken to grow the layer from the thickness 40 mm. to 42 mm. approximately is

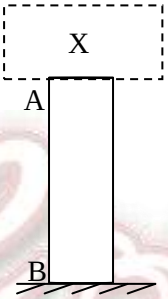
1. 10 min
2. $10\sqrt{2}$ min
3. 20 min
4. 40 min
5. 80 min

24) A radio active sample contains two radioactive elements X and Y. At the time t=0 activities of both elements are equal and it is A_0 .The half life time of X is 24 days and that of Y is 16 days. The activity of the sample after 48 days is

1. $\frac{1}{4}A_0$
2. $\frac{3}{5}A_0$
3. $\frac{1}{4}A_0$
4. $\frac{3}{16}A_0$
5. $\frac{3}{8}A_0$

25) The input power of an ideal transformer is 10 kW. The current in the secondary coil is 25A. The ratio of number of turns between the primary and secondary coils is 8:1. The input voltage is

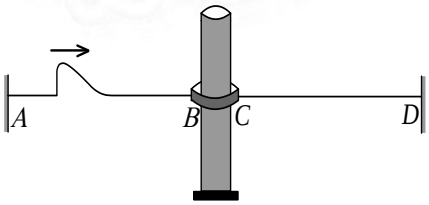
1. $\frac{10^4 x8^2}{25}V$
2. $\frac{10^4 x8}{25}V$
3. $\frac{10^4}{25}V$
4. $\frac{10^4}{25x8}V$
5. $\frac{10^4}{25x8^2}V$

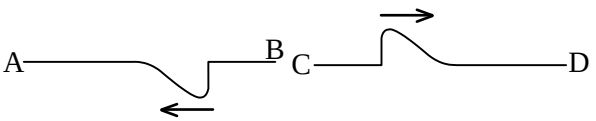
26) 

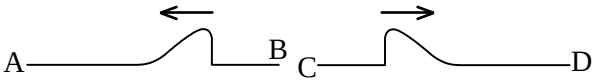
The cross-sectional area, linear expansivity and younger modulus of the pillar of negligible weight shown in the diagram are 10 cm^2, $2x10^{-5}$ k^{-1} and $1x10^{11}$ Nm^{-2} respectively. The load X required to put on the pillar to stop the expansion when its temperature is increased by 100^0C is

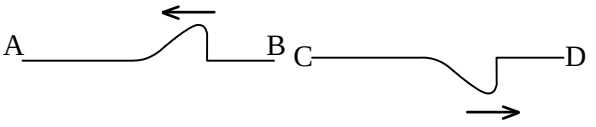
1. $2x10^5$ N
2. $4x10^5$ N
3. $2x10^4$ N
4. $2x10^3$ N
5. $2x10^2$ N

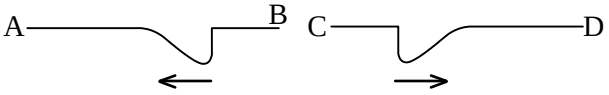
27) Two light strings AB and CD are connected to a smooth light ring which goes through the rod as shown in the diagram. The wave pulse on the string AB is moving towards the ring. The shapes and directions of the pulses moving along the strings after the first pulse reaches the ring are best shown by

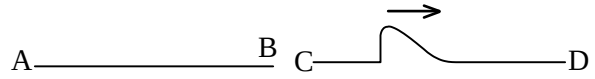


1. 

2. 

3. 

4. 

5. 

28) The fundamental frequency of a one end closed tube is f_o when it contains H_2 gas . The fundamental frequency of the tube if it contains O_2 gas at the same temperature is

1. $\frac{1}{4}f_0$
2. $\frac{1}{2}f_0$
3. f_0
4. $2f_0$
5. $4f_0$

29) Consider the following statements regarding water vapour in the atmosphere.

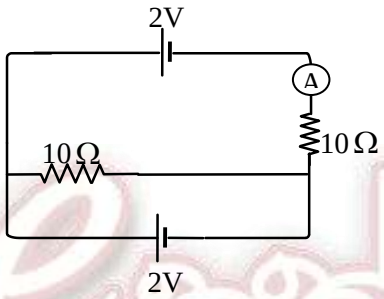
a. The relative humidity is low when absolute humidity in low.
b. The relative humidity is low if the dew point is low
c. The vapour pressure in the atmosphere is equal to the saturated vapour pressure at the dew point only in open space.

Of the statements

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

30) The object A of mass **m** is at temperature 100 ^{0}C. The object B of the mass 2m is at temperature 0^0C. Their specific heat capacities are S_A and S_B respectively. If the two objects are kept in contact without heat lost to the surrounding, the system reaches to the final temperature 20^0C . The correct relation between S_A and S_B is

1. $2S_A = S_B$
2. $4S_A = S_B$
3. $S_A = 2S_B$
4. $S_A = 4S_B$
5. $S_A = S_B$

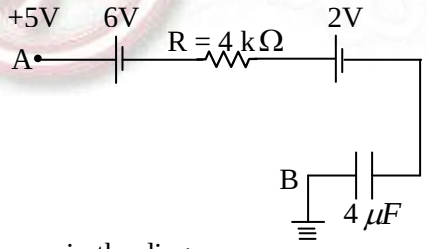
31) 

The internal resistances of the cells shown in the circuit is negligible. The ammeter reading is,

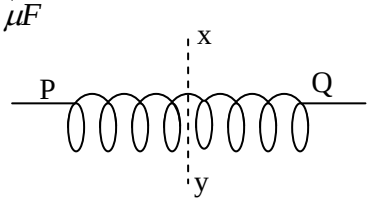
1. 0.2 A
2. 0.1 A
3. 0.4 A
4. 0.3 A
5. zero

32) The potential difference and the energy stored in the capacitor shown in the circuit are respectively

1. 3V, 18 μ J
2. 1V, 20 μ J
3. 5V, 16 μ J
4. 8V, 20 μ J
5. 8V, 18 μ J

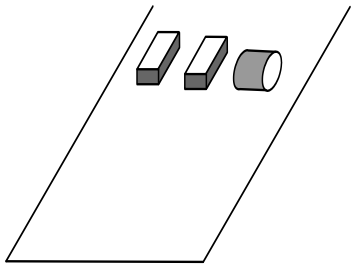


33) If a battery is connected across a solenoid PQ shown in the diagram Magnetic flux density at the axis is 0.4T. The half of the solenoid is removed and the other half is connected across the battery. The magnetic flux density now at the axis is

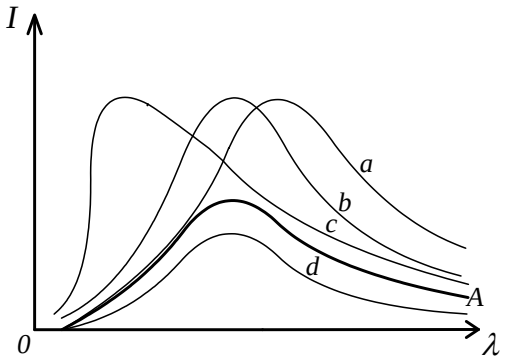


1. 0.8 T
2. 0.6 T
3. 0.4 T
4. 0.2 T
5. 0.1 T

34) A, B and C are steel block magnet and steel cylinder of equal size and mass. Three objects are released from the to P the aluminum plane inclined with the horizontal at the same time. What is true regarding their arrival to the bottom?



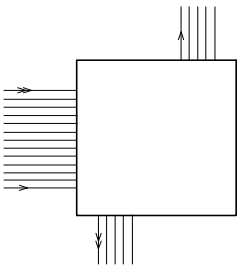
1. A comes first and C at the last
2. C comes first and A at the last
3. A comes first and B at the last
4. B comes first and C at the last
5. All come same time

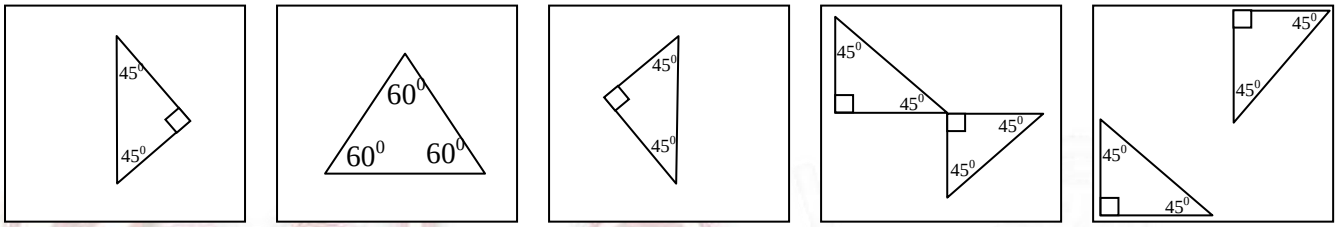
35) 

The graph A shows the variation of radiation intensity of white body at temperature T_1 with the wave length. The corresponding graph of a black body at the same temperature is shown by the graph.

1. a
2. b
3. c
4. d
5. A

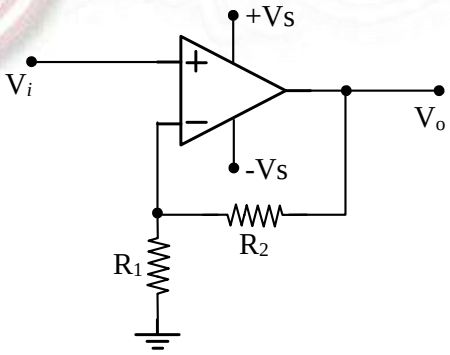
36) A monochromatic beam of light passes through an optical device as shown the diagram. The device is shown by the box. The possible optical device is





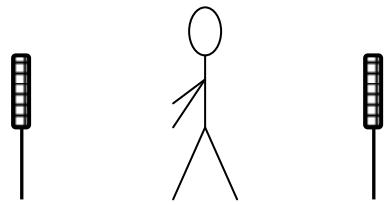
1. 2. 3. 4. 5.

37) The circuit shows a close loop operational amplifier supply voltage (Vs) =±10V. Resistances R_1 and R_2 are 10 kΩ and 30 kΩ respectively and input voltage V_{in} = 3V possible output voltage (V_0),



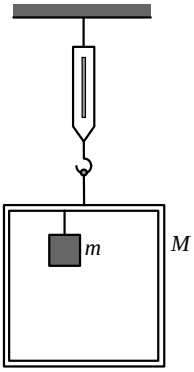
1. 6.5 V
2. 7.8 V
3. 9.6 V
4. 11V
5. 13 V

38) The frequency of the two stationary sound sources S_1 and S_2 is f_o. An observer O in between S_1 and S_2 is running towards S_1 with velocity v. The speed of sound in air is V. The beat frequency heard by the observer is



1. $\frac{vf_0}{V}$
2. $\frac{vf_0}{2V}$
3. $\frac{2vf_0}{V}$
4. $\frac{V}{2v}f_0$
5. $\frac{V}{v}f_0$

39) The mass m is attached to the ceiling of the hollow box of mass M as shown in the diagram. The system is hung by the spring balance. Then the rending in the balance is A. The string breaks and the mass m is falling down. Then the reading is B. The mass m hits the bottom and comes to rest. Then the reading is C. The right values of A, B and C are

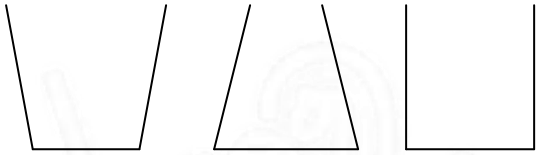


	A	B	C
1.	M+m	m	M+m
2.	M+m	M+m	M+m
3.	M+m	M	M+m
4.	M	M+m	m
5.	M+m	M-m	M+m

40) A heater of power 100W is kept inside a metal block. The block comes to the maximum steady temperature 80^0C. If the power is disconnected it starts cooling and cooling rate at 50^0C is 0.04 ^{0}C s^{-1}. The room temperature is 30 ^{o}C. The heat capacity of the heater is negligible. The heat capacity of the metal block is

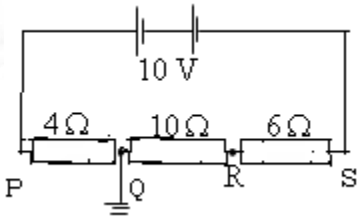
1. 1000 Jk^{-1} 2. 2000 Jk^{-1} 3. 3000 Jk^{-1} 4. 4000 Jk^{-1} 5. 5000 Jk^{-1}

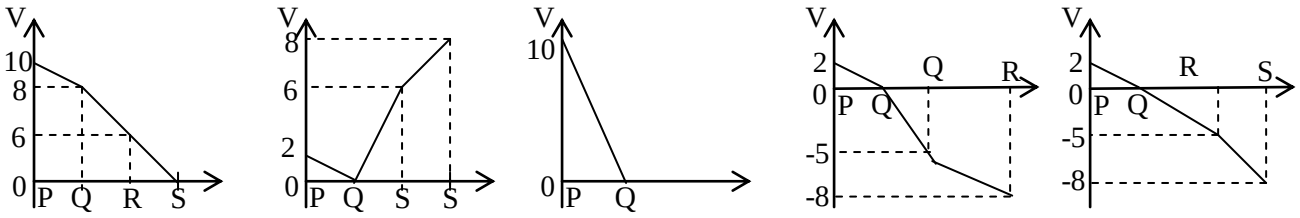
41) The three vessels A, B and C of equal base area are filled with 2 kg of water. All three bases barely withstand the pressure. Now the water is removed from the vessels and three blocks of masses 2 kg are kept on the bases.



1. the base A only can withstand the pressure
2. the base B and C only can withstand the pressure
3. the base C only can withstand the pressure
4. the base A and B only can withstand the pressure
5. all the bases A ,B and C can withstand the pressure

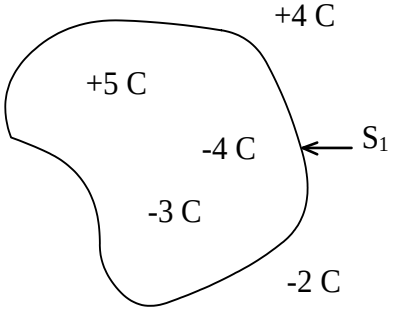
42) The resistances of three uniform wires of same length PQ, QR and RS are 4Ω, 10Ω and 6Ω respectively. Resistors are connected in series to the battery of EMF 10V and negligible internal resistance. The length of the connecting wires between the resistors are negligible. The variation potential from P to S is best shown by



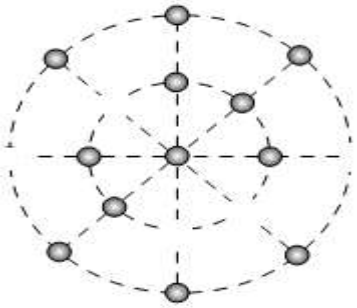


1. 2. 3. 4. 5.

43) S_1 shown in the diagram is a close gausian surface. Charged inside S_1 are +5C, -4C and -3C . The charges outside S_1 are +4C and -2C. To reverse the amount of flux through the S_1



1. +2C should be kept inside S_1
2. +4C should be kept inside S_1
3. -4C should be kept inside S_1
4. +5C should be kept outside S_1
5. -6C should be kept outside S_1

44) 

The radius of circle shown by the dotted lines are R and r (R>r). At the circles and the centre 12 identical particles of mass m are kept. The resultant gravitational force on the particle at the center is

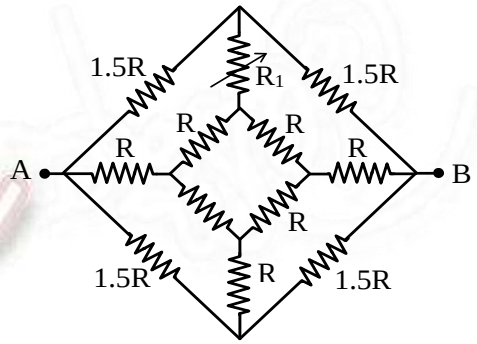
1. $\frac{12Gm^2}{R^2}$
2. $\frac{6Gm^2}{R^2}$
3. $\frac{5Gm^2}{r^2}$
4. $Gm^2\left(\frac{6}{R^2}+\frac{5}{r^2}\right)$
5. $\frac{Gm^2}{r^2}$

45) Masses of four cylinders of same cross sectional area made by iron, copper, lead and aluminum are 4g, 5g, 6g and 7g respectively. These four cylinders are kept in water at 100^0C equal time and then kept vertical on an ice block at 0^0C. The ice in surrounding area gets melt and the part of the cylinders go into the ice block. The specific heat capacities of the cylinders respectively are 4.6×10^2 $Jkg^{-1}k^{-1}$, 4×10^2 $Jkg^{-1}k^{-1}$, 1.3×10^2 $Jkg^{-1}k^{-1}$ and 9×10^2 $Jkg^{-1}k^{-1}$. The height of the cylinders which immerse in ice in ascending order is

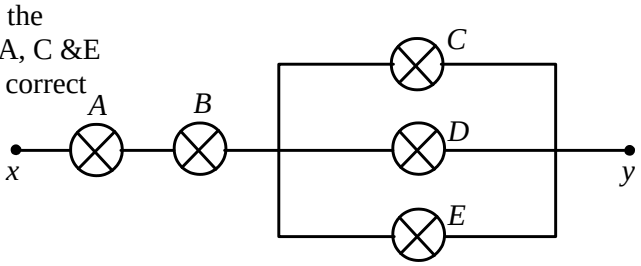
1. Iron, Copper, Lead, Aluminum
2. Iron, Lead, Copper, Aluminum
3. Lead, Iron, Copper, Aluminum
4. Aluminum, Copper, Iron, Lead
5. Aluminum, Copper, Lead , Iron

46) The circuit shows the network of resistors. The resistance R1 is increased 0 to R. The resultant resistance between A and B changes from

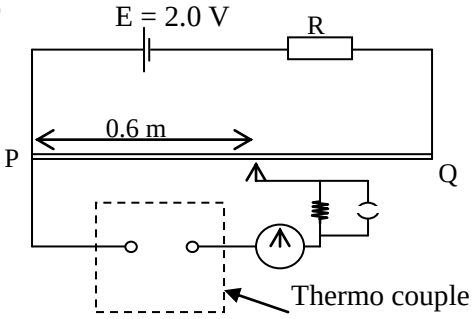
1. O to 0.5R
2. O to R
3. R to 2R
4. R to 4R
5. no change



47) Five bulbs A, B, C, D and E are connected as shown in the circuit. If a voltage is applied across x and y, the bulbs A, C &E light bright and the bulbs B & D do not light. The most correct statement regarding the circuit is,



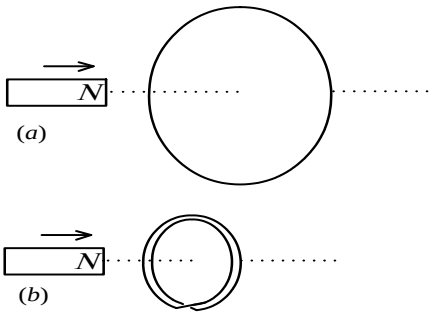
1. The power of B is very low and D is burn.
2. B is burn and the power of D is very low.
3. The powers of both B and D are high.
4. Both B and D are burn.
5. As the resistances of the bulbs are not known, the right explanation can be given regarding the lighting of the bulbs

48) 

The potentiometer is connected to the thermocouple of EMF 6 mV as shown in the diagram. The resistance of the potentiometer wire PQ is $5\,\Omega$ and length is 1m. The EMF of the driver cell is 2V. The balance is obtained at the length 60 cm from the P. The resistance R is

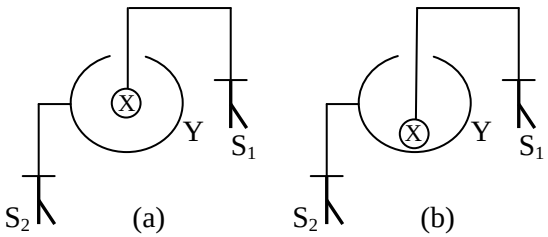
1. $95\,\Omega$
2. $195\,\Omega$
3. $495\,\Omega$
4. $995\,\Omega$
5. $1995\,\Omega$

49) A current I is induced when the magnet is brought towards the insulating conducting ring. The ring is bent to form two identical rings as in the figure (b) and the magnet is brought towards the rings with the same speed again. The new current produced in the ring is,



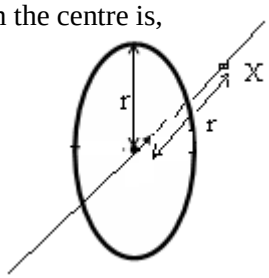
1. I 2. $2I$ 3. $4I$ 4. $\frac{I}{2}$ 5. 0

50) Y is a hollow conducting sphere and X is a small conducting sphere inside Y. Both spheres are connected to two separate electroscopes S_1 and S_2. In diagram (a) two spheres are concentric and the deflection of S_1 and S_2 are θ_1 and θ_2 respectively. In diagram (b) X is in touch with the inner surface of Y and the deflection of S_1 and S_2 are θ_3 and θ_4 respectively. What is true regarding the deflections of the electroscopes?



1. $\theta_1 < \theta_2$, $\theta_4 < \theta_3$
2. $\theta_1 > \theta_2$, $\theta_4 < \theta_3$
3. $\theta_1 = \theta_2 = \theta_4$, $\theta_3 = 0$
4. $\theta_1 > \theta_2 = \theta_3 = \theta_4$
5. $\theta_1 = \theta_2$, $\theta_3 > \theta_4$

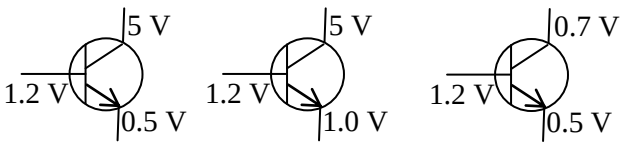
51) Liner charge density of the ring of radius r is σ cm^{-1} . Electric field intensity at the point x on the axis the distance r from the centre is,



1. $\frac{\varepsilon\sigma}{\sqrt{2}}$
2. $\frac{\sigma}{2\sqrt{2}\varepsilon}$
3. $\frac{2\sigma}{\varepsilon}$
4. $\frac{\varepsilon\sigma}{2\sqrt{2}}$
5. $\sqrt{2}\sigma\varepsilon$

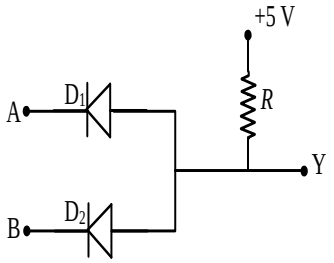
52) Three diagrams a, b and c show the dc biasing voltage at the terminals emitter, base and the collector of a transistor. The diagrams which correctly show the transistor biased to cut off, saturated and active region respectively is

	cut off	saturated	active
1.	a	b	c
2.	b	a	c
3.	a	c	b
4.	c	b	a
5.	b	c	a



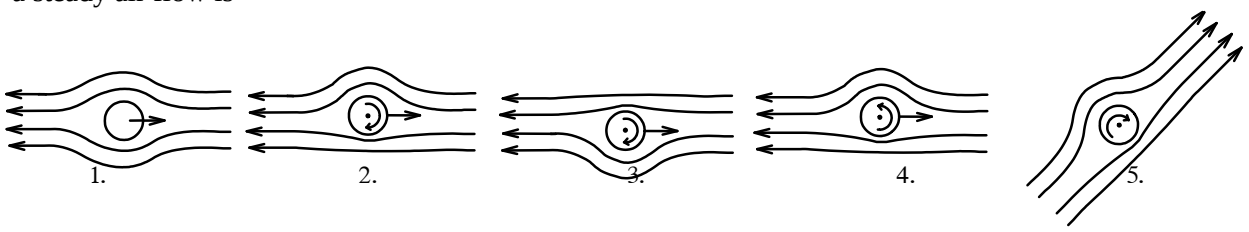
53) The circuit of a logic gate is shown in the diagram. D_1 and D_2 are silicon diodes. The terminal X is at potential +5V. A and B are inputs and Y is the output. The potentials given in the table are applied to A and B. The outputs Y for each inputs are

A	B
0	0
0	5
5	V
V	0

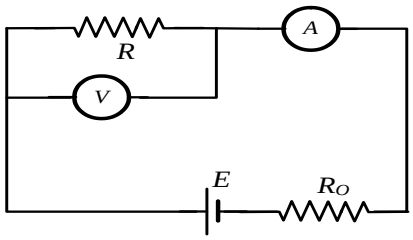


1. Y: 0, 5V, 5V, 5V
2. Y: 0, 5V, 5V, 0
3. Y: 0, 5V, 0, 5V
4. Y: 5V, 0, 0, 0
5. Y: 0, 0, 0, 5V

54) The correct stream line pattern when a ball is moving without rotation with rotation and at rest with rotation in a steady air flow is

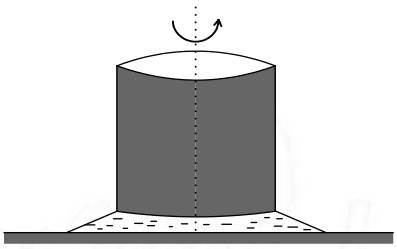


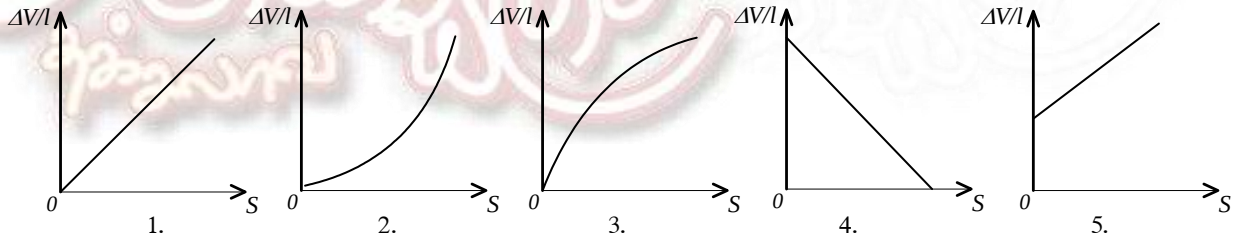
55) The circuit shown in the diagram is used to find the unknown resistance R. The readings in the voltmeter and the ammeter are V and I respectively. The internal resistance of the voltmeter is R_V . The resistance given by the ratio $\frac{V}{I}$ is $R^{/}$. The relatio between R, $R^{/}$ and R_V is given by



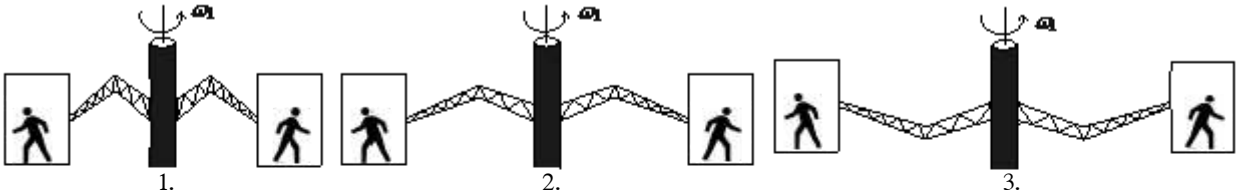
1. $R = R^{/} - R_V$ 2. $R = R^{/} + R_V$ 3. $\frac{1}{R} = \frac{1}{R^{/}} - \frac{1}{R_V}$ 4. $\frac{1}{R} = \frac{1}{R^{/}} + \frac{1}{R_V}$ 5. $R = \frac{R^{/}}{R_V}$

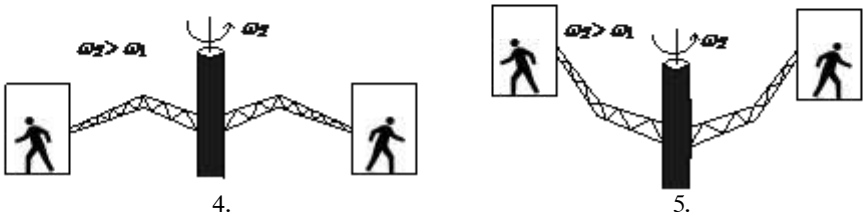
56) A cylinder is kept vertical on a horizontal plane which is applied with viscus fluid. The cylinder is rotating about its axis with angular velocity . The variation of velocity gradient downward of the liquid along a radius is,



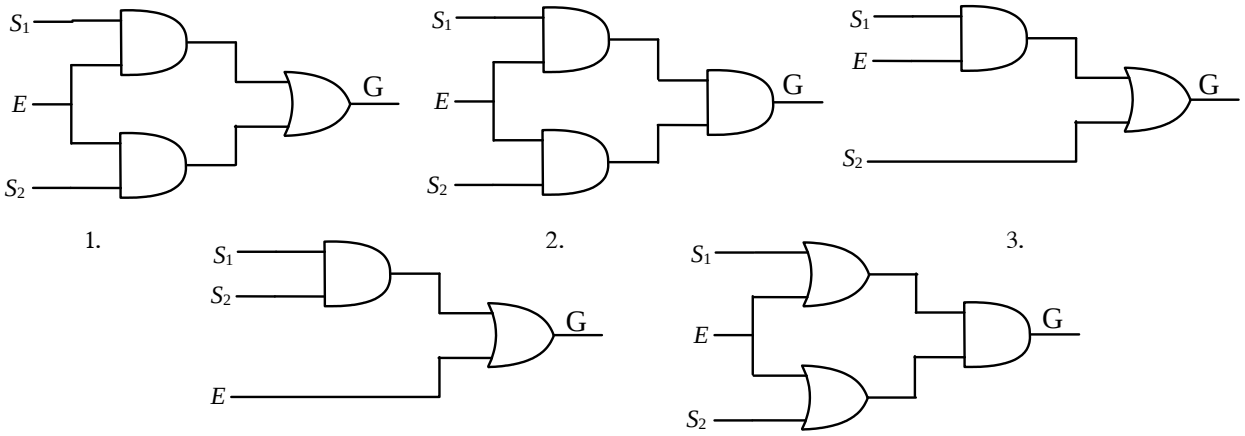


57) A merry-go-round at a fair ground can rotate in two difference angular velocities w_1 and w_2 ($w_1 < w_2$) about the vertical axis. It's horizontal arms can be stretched or folded to change the distances to the seats at the ends of the arms. Also the seats can be lowered or raised as necessary. The most stable rotation of the merry-go-round is





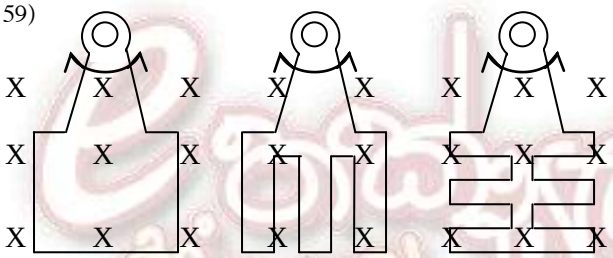
58) It is required to design a logic circuit to open the gate of a home. This is done by pressing a switch S_1 when the gate is powered by the main supply. Also it is required to open the gate by pressing the switch S_2 when the power is supplied by extra battery during a power cut. Having the power and not having the power on the main line E are logic "1" and logic "0" respectively. The switch S_1 close and open are the logics '0' and '1' respectively. The gate should open when the output G is "1" . The correct logic circuit which satisfy these condition is



1. 2. 3.

4. 5.

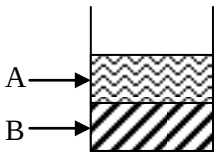
59)



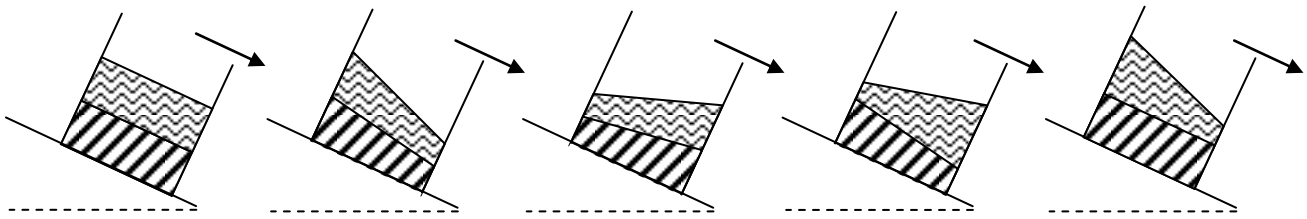
Three sheets of equal area made by same material are free to rotate about the axis O Magnetic fields of equal strengths are acting perpendicular to each sheets. Their dampping in descending order is

1. A > B > C
2. B > C > A
3. B > A > C
4. C > A > B
5. A > C > B

60)



The diagram shows container filled with two immiscible liquids. The container is falling down along a inclined plane. The correct shapes of the interfaces of the liquids are shown by



1. 2. 3. 4. 5.

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Grade 13 13 ශ්‍රේණිය	***Final Term Test*** අවසාන වාර පරීක්ෂණය	***July 2010*** 2010 ජූලි
Physics II භෞතික විද්‍යාව II		***Two Hours*** පැය දෙකයි

Part A – Structured Essay

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

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

01. Draw a labeled diagram of the experimental setup to determine the coefficient of viscosity of water using a capillary tube at the school laboratory in the space provided.

(a) Write down an expression for the volume of water flow Q in time t through the capillary tube clearly identifying the symbols used.

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(b) How would you determine the rate of flow of water practically?

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(c) An accurate value for the radius **a** can be obtained if the mercury thread method is used rather than measuring it directly using a traveling microscope. What is the reason for this?

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(d) Water is generally not used instead mercury in the method mentioned (c) above. Give two reasons.

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(e) i) If you are asked to plot a suitable linear graph to determine the coefficient of viscosity of water. What measurements do you take?

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ii) What is the experimental measurement represented by the x-axis?

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iii) What are the readings that you would take to find the measurement mentioned in (e) (ii)

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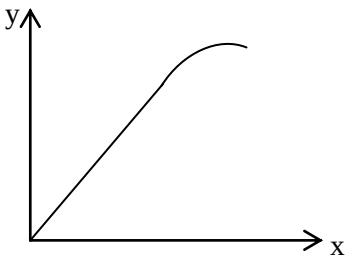
(f) 

The graph obtained by a student in this experiment is shown here. What is the reason for graph being curved for higher values of x?

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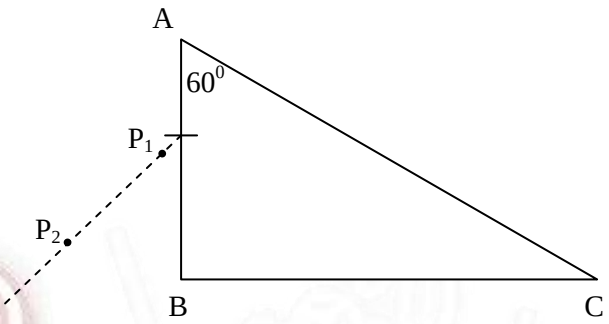
02. The diagram shows a laboratory setup to determine the angle of deviation of light due to refraction from a prism.



(a) Pins P_1 and P_2 represent an incident ray. Pose two other pins P_3 and P_4 to track the ray of emergence. Show the position of eye with respect to P_3 P_4 .

(b) Mark the apparent positions of the images of P_1 and P_2 as I_1 and I_2 in the diagram with respect to the position of the eye.

(c) Show the angle of deviation of the ray by the symbol *d* .

(d) Plot the variation of *d* with the incident angle *i*.

(e) What is quantity that is obtained from the graph to determine the refractive index of the prism ?

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(f) Plot the respective d-i graph along the same axis if a prism of prism angle 30^0 is used?

(g) State why a prism of prism angle 90^0 cannot be used for this experiment?

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(h) The spectrometer can be used to find the deviation a light by a prism. Draw the image pattern on cross wires if a white light is used to illuminate the slit? Name the boundary colours in the diagram.

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(i) What are the two spectrometer readings you should take to determine the quantity mentioned in part (e) for the mid colour of the spectrum?

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(j) By what method the spectrometer method or graphical method you obtain more accurate value for the quantity mentioned in part (e)? state the reason.

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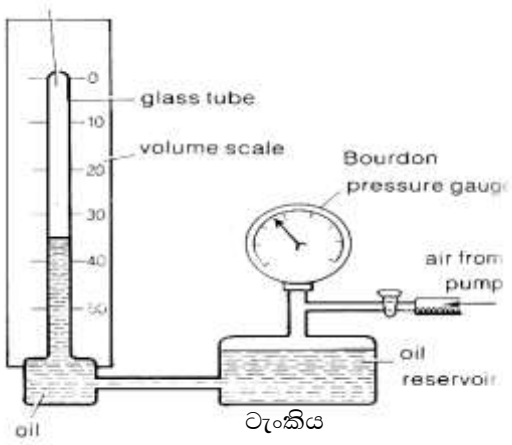
03. The diagram shows a setup to investigate variation of volume of a fixed mass of gas at content temperature with the pressure. By pumping air into the tank pressure and the volume of the air column trapped in the tube can be varied. The pressure of the air column (***P***) is shown by the pressure gangue and the volume of the air column (***v***) is measured b the scale.



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(a) You should be careful to keep the temperature in the tube unchanged when the air volume is reduced. How do you perform the experiment ensuring this fact?

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(b) As the pressure in the tank is increased the pressure in the air column equally increases. Explain how this can happen

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(c) Sketch the graph of ***P*** vs. $\frac{1}{v}$ you obtain by the experiment.

(d) Write the gas law which is verified by this experiment

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(e) A student suggests to increase the pressure in the tube by directly pumping air into it without doing it through the oil tank to investigate the same relation. Comment on his suggestion.

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(f) When the pressure gauge reading is 2.5×10^5 Pa the volume of the air column is 25 cm^3. What is the volume of the air column when the pressure gauge reading is 5×10^5 Pa?

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(g) i) If water is used in the tank instead of oil, obtain an expression for the **air pressure *P*** in the tube. Define all the terms you used.

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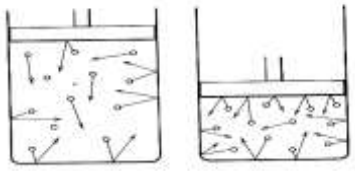
ii) Sketch the graph of ***P*** vs $\frac{1}{v}$ at this condition

(g) According to the Boyles law when the volume is halved pressure of the air column doubles. How do you explain this by the kinetic theory of gas.



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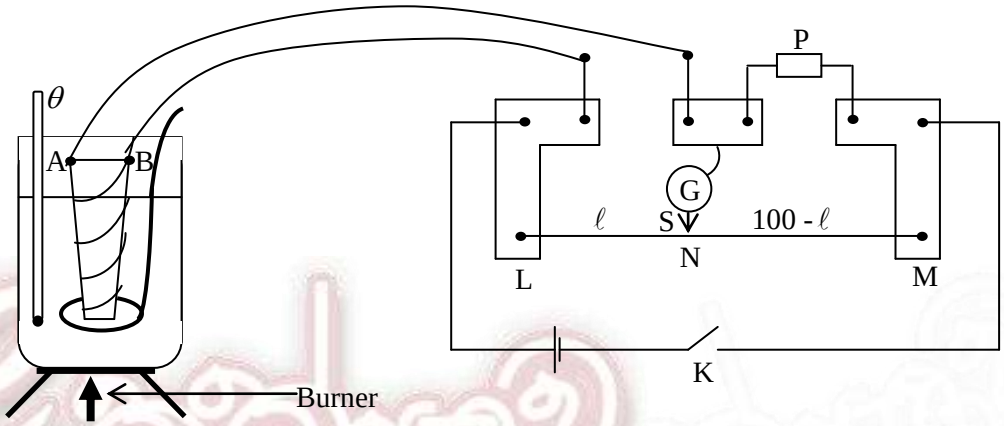
04. The diagram shows an experimental setup to determine the temperature resistance co-efficient of nicrome wire. AB is the nicrome wire coiled around the ceramic rod and it is connected to meter bridge by the wires x an y. The nicrome wire is heated by oil bath which is heated by the burner.



(a) How do you maintain the steady constant temperature in the oil bath?

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(b) Why is the wire heated by the oil bath not keeping it directly in the flame of the burner?

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(c) What are the important steps you should follow to find the resistance of the wire at a given temperature?

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(d) In this experiment it is required to bring the balance point close to the mid point of the wire LM. Give two reasons for this?

1.....

2. .....

(e) Why is it more suitable to use the meter bridge than the other instruments available in the laboratory to measure the resistance of the wire?

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(f) If a high resistance is not connected in series with the galvanometer there is a possibility to fuse it at off balance points. At what position of the meter bridge wire where the contact key s is touched there is more possibility to burn the galvanometer. Explain your answer.

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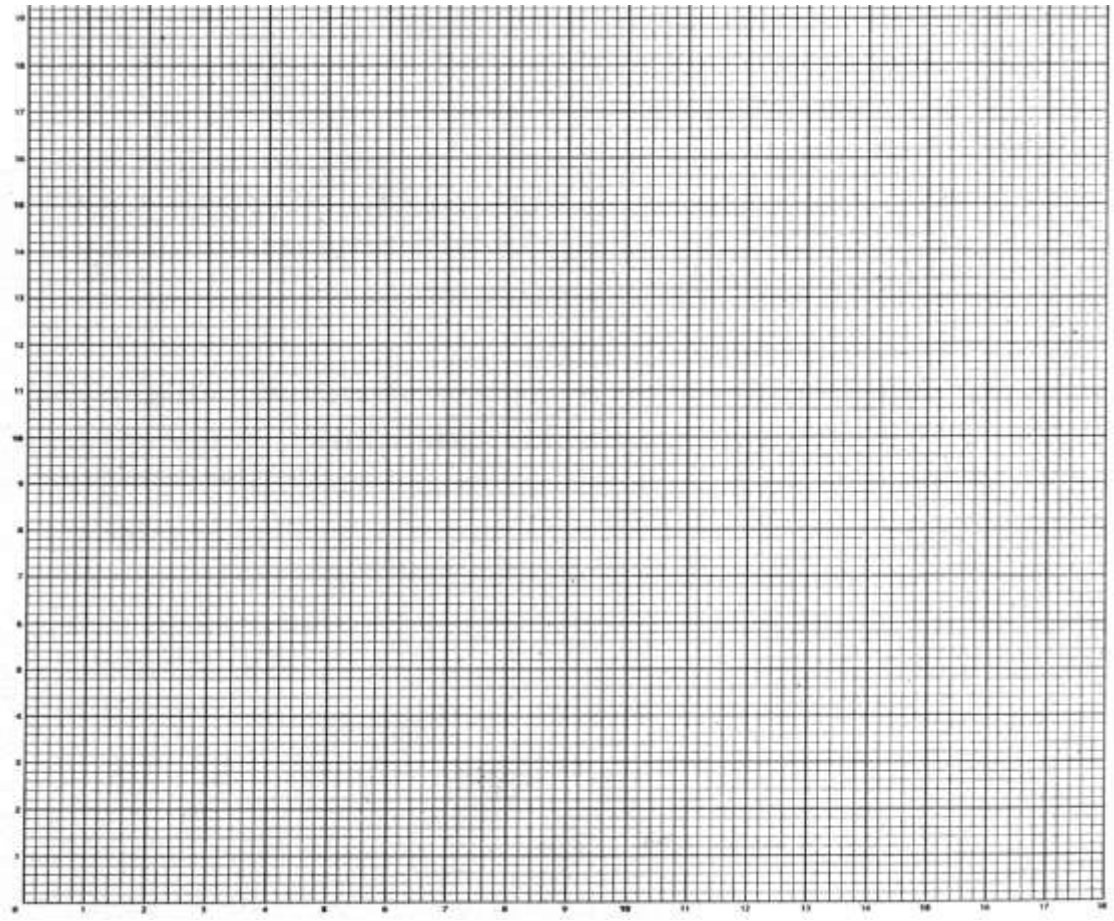
(g) The graph shows variation of resistance of the wire with the temperature.

Resistance(**Ω**)



Temperature(°C)

Calculate temperature resistance coefficient using the graph.

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(h) The length and the diameter of the nicrome wire are 30 cm and 12 mm respectively. Calculate the resistivity of nicrome at 0^0C.

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Royal College, Colombo 07
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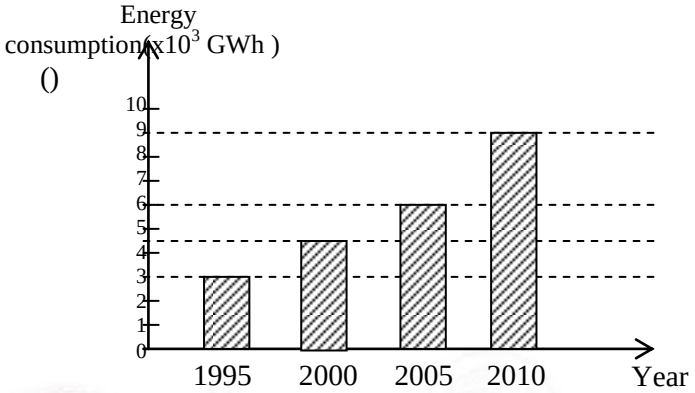
Grade 13 13 ශ්‍රේණිය	***Final Term Test*** අවසාන වාර පරීක්ෂණය	***July 2010*** 2010 ජූලි
Physics II භෞතික විද්‍යාව II		***Two Hours*** පැය දෙකයි

Part B – Essay

*Answer **four** questions only*

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

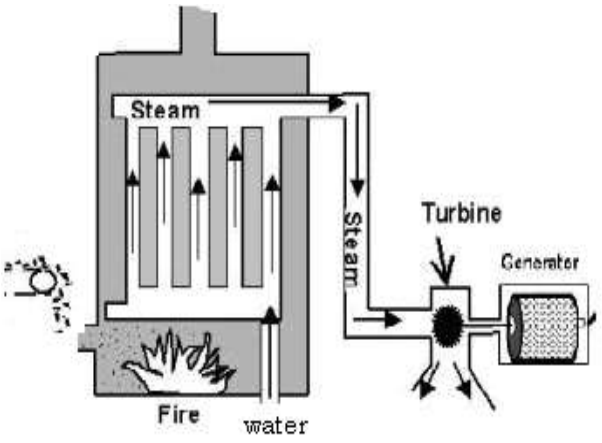
(01) According to the statistics the increase of electric power consumption from the 1995 to 2010 is shown by the bar chart below.



i) What is the energy 1 GWh in Jules?

ii) The increase of energy consumption from 2005 to 2010 was produced by a then built hydro power station. At the power station potential energy of water falling from height 500m is converted to electric power. The water fall is fed by the rain fall to the catchment area of cross section area 216 km^2. What is the average height of the annual rain fall to this region during the given period. The density of water is 1000 kgm^{-3} . Write your assumption for this calculation.

iii) At a coal power station the heat produced by the combustion of coal is used to boil the water and to produce steam at high pressure 10^6 kPa and at high temperature 250^0C. The part of a boiler to produce steam is shown by the diagram below.



The steam produced in the boiler is flowing along the tube of cross-section area 1 m^2 and strikes the turbine. Then turbine rotates and produces electricity.

a. The speed of the gas inside the boiler is negligible. The pressure at the turbine is 10^5 kPa and the density of stem is 0.2 kgm^{-3}. Assuming the steam obeys the Bernoulli Principle calculate the speed of steam striking the turbine.

b. Assuming that total power of the steam flowing along tube is absorbed by the turbine. Calculate the power transferred to the turbine .

c. The speed of the steam completely destroys after striking the turbine. What is the force excreted on the turbine by the steam.

d. Can the power of the energy be increased by reducing the cross section area of the opening of the tube where the steam is ejected without changing the rate of combustion of coal?

e. Energy produced by the combustion of 1 kg coal is $3x10^5$ kJ kg^{-1}. To produce energy need in the year 1995 coal of mass $6x10^7$ kg was used . What is the efficiency of the power station?

(02) i) Give four differences between the travelling waves and stationary waves in relation to energy, frequency amplitude and phase angle.

ii) Explain the meaning of the ***resonance***.

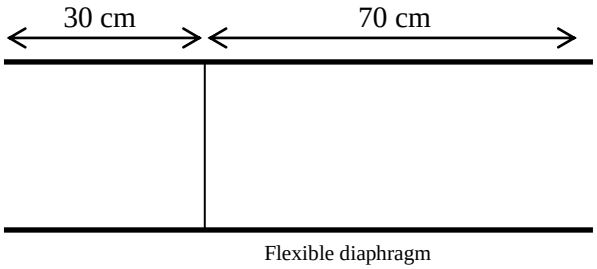
iii) In a day of room temperature 16^0C the air column inside a one end closed tube is vibrated by variable sound frequency source. The frequency of the source is increased from 0 Hz to 1000 Hz. The speed of sound at 16^0C is 340 ms^{-1}. Neglect the end error of the tube.

a. Calculate the frequencies at which the tube resonates with the source.

b. Sketch the variation of sound intensity at the open end with the frequency of the source indicating the resonance frequencies.

iv) The air column in a one end close tube of length 16.8 cm is vibrated by the variable sound frequency source. The minimum frequency the source resonates with the tube at the room temperature 16^0C is 500 Hz. Calculate the end error of the tube.

v) The diagram shows two end open tube AB of length 1 m. The flexible diaphragm is kept inside at 30 cm from the end A separating the tube into two sections.



Flexible diaphragm

The air column inside is vibrated by external variable frequency source kept close to the one end and the source frequency is increased gradually from zero. The air column on both sides vibrates with displacement node at the diaphragm. The temperature inside the tube is 127^oC. Neglect the end correction of the tube.

a. what is the lowest frequency of the source which resonates with the air the columns?

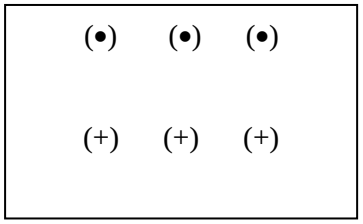
b. draw the corresponding wave pattern in the tube at this moment

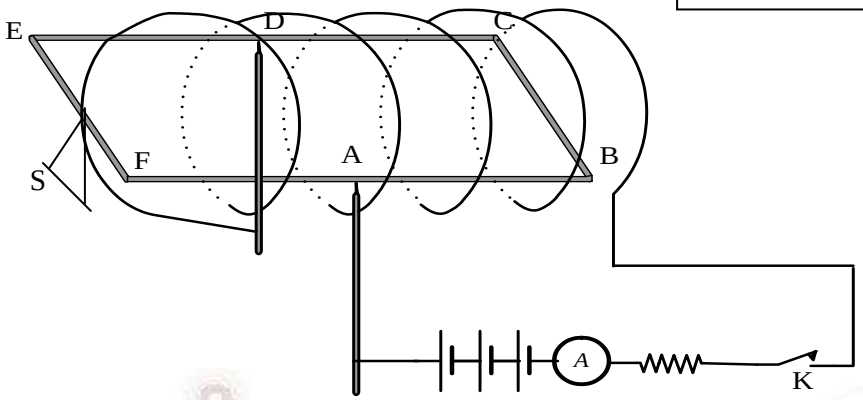
(03) The magnetic flues density on the axis of a current carrying solenoid B is given by B = μ_0nI , Identify terms μ_0 , n and I .

i) A cross section of the solenoid along the axis is given below. Copy the diagram and draw the magnetic field lines in it according to the direction of the current.

The current out of the plane (•)

The current into the plane (+)





The diagram above shows how the magnetic field in the solenoid is used in a current balance. The rectangular frame BCEF supports on two conducting tips at A and D. The section ABCD of the frame is a conductor the remaining part is an insulator. S is a light scale pan and AB=AF. The frame balances horizontally when the switch K is open.

iii) a. What's the direction of the current in BC when K is closed.

b. Evaluate B if n = 200 m^{-1}, I = 2A and μ_0,= 4π x 10^{-7} .

c. Assume that the field in the solenoid is uniform. When the switch K is closed the balance in the frame lost moving the scale pan up.

What mass is needed on the scale pan to counter balance it if the length BC is 4 cm.

iv) What are the magnitude of the magnetic forces on AB and BD if AB = BD = 12 cm.

v) How do you expect to loose the balance if the current in the circuit is reversed?

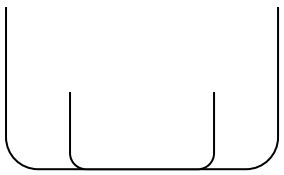
vi) State why soft iron is not suitable for the frame instead of copper.

vii) Now the frame is removed and D.C supply is replaced by an A.C supply .You are provided with a secondary flat small coil. Propose a method to induce an e.m.f. in the coil using the above setup.

(04) i) a. Why is it necessary to clean the bore of the capillary tube in the capillary rise method to determine the surface tension of water?

b. What are the two readings obtained to find the capillary rise.

c. State reasons for why this type of method is not applicable for mercury.

ii) 

A vessel of square base of side length 4 cm and 15.4g mass is kept in another vessel. Now water is poured gently into the large vessel the density and the surface tension of water are 10^3 kgm^{-3} and $7.5x10^{-2}$ Nm^{-1} respectively. The angel of contact between the vessel with water is 60^0.

a. What are the forces acted upon the small vessel when it floats in water.

b. What height of the vessel will be below the water level when it just begin to float?

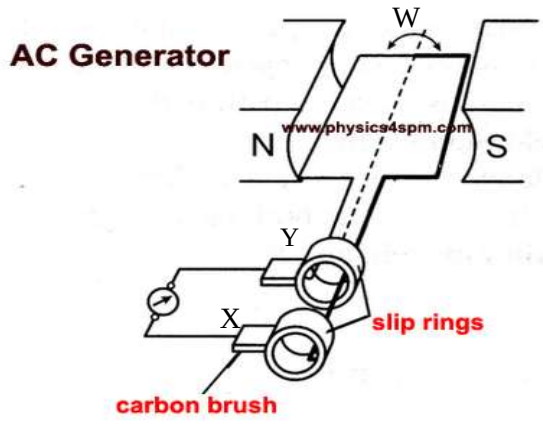
c. There is a hole of radius 1mm at a side of the bottom. Show by a calculation that water doesn't enter the vessel through the hole.

d. Find the maximum mass that can be kept in the middle of the vessel go that water doesn't enter it through the hole.

e. The above vessel with that weight is suspended by a sensitive spring balance it is gently raised up to the water level. What's the maximum reading of the balance?

f. Plot the rough variation of the radius of the water bubble forming through the hole with the depth h of the vessel in water.

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

A) 

The diagram shows the wire frame of a AC dynamo. The effective area of the wire frame, its number of turns and flux density of the uniform magnetic field are A, N and B respectively. Initially the frame is parallel to the magnetic field and rotates anti clock wise direction with angular velocity ω as shown in the diagram.

i) ve force (EMF) produces across carbon brushes X and Y.

ii) Which terminal has the highest potential when the frame is in the given position? State the law which is applied to come to your answer.

iii) Sketch the variation of EMF and root mean square EMF generated across X and Y with time in the same axis.

iv) A small scale hydropower station uses similar AC dynamo mentioned above.

It uses a magnetic field of flux density $\frac{1}{6}$ T and a wire frame of 1000 turns and cross sectional area 350cm^2 . Water column flowing through a tunnel from a small water tank strikes the turbine. The turbine connected to wire frame rotates with the frequency 600 r.p.m.

a. Calculate the peak EMF and root mean square EMF produces across the carbon brushes.

($\pi = 3,\ \sqrt{2} = 1.4$)

b. A house uses 4 bulbs rated 60W/240V and two fans rated as 120W/240V . All are connected in parallel with the dynamo if these appliance are operating with the rated power what is the total current drawn from the dynamo.

c. The dynamo is connected to the house by cable of length 50 m which has two wires. What is the potential drop across the cable when the above current is drawn from the dynamo?

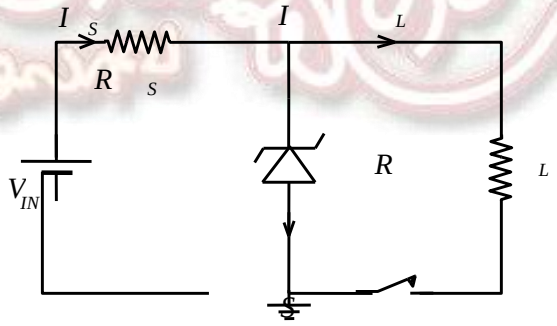
d. Bulbs are manufactured to withstand the 5% power increase than their given power ratings. Calculate the power of the bulbs when the two fans are switched off and hence show that bulbs are not fused at this moment.

v) Show only the necessary changes to convert the ac dynamo to dc dynamo by a diagram

B) i) Sketch the voltage (V) – current (I) characteristic curve of a diode.

ii) Explain the action of a Zener diode.

iii)



In the circuit given Zener diode of voltage 12V is used. The resistances R_s and R_L are $120\,\Omega$, $200\,\Omega$ respectively supply voltage V_{in} = 25V

a. Calculate the currents through R_s , R_L and the diode. I_S, I_L and I_z respectively.

b. What is the power of the diode?

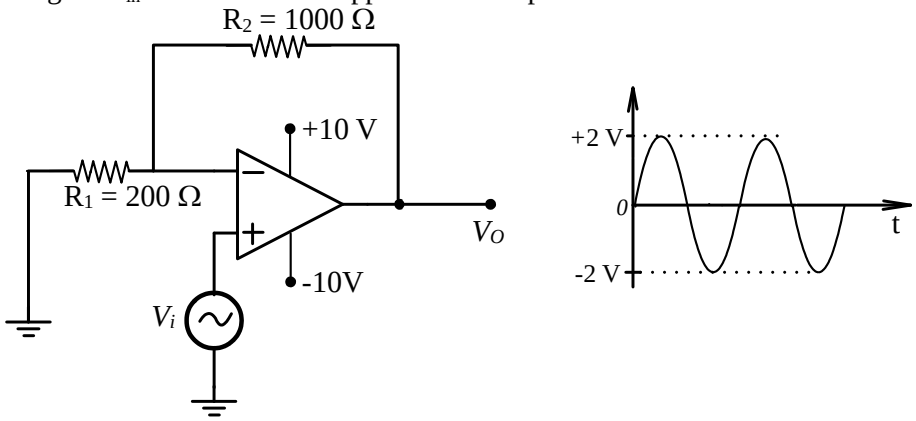
c. What is is the possible maximum power of the diode?

d. What should be the minimum power rating of the diode used for proper operation of the circuit?

iv) The circuit shows operational amplifier used to amplify small alternating single.

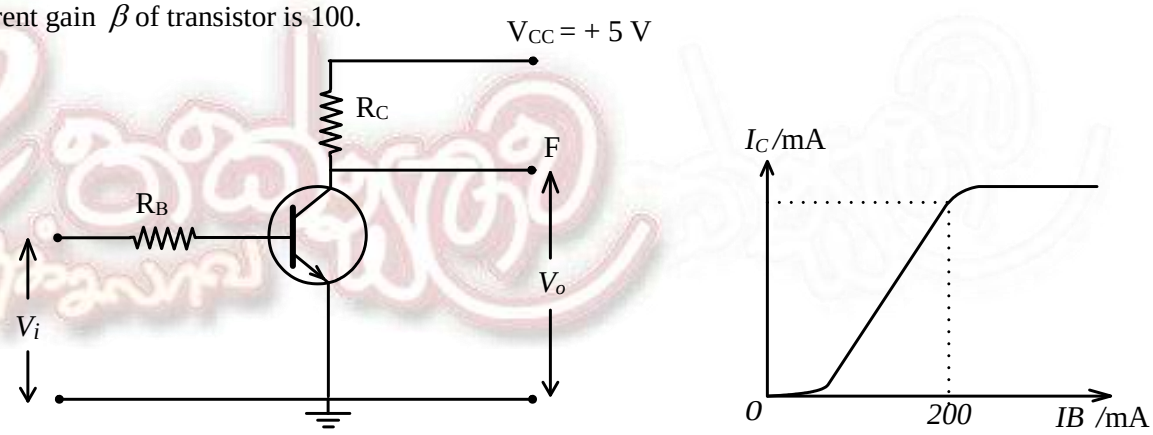
a. What is the voltage gain of the amplifier?

b. The input signal V_{in} shown below is applied to the input of the circuit.



Sketch the variation of output signal with time, indicating the peak voltage.

v) The transistor shown in the circuit is biased to cut off region and saturated region respectively by applying input voltages 0V and 5V respectively. Transfer characteristic (I_C Vs I_B) of the transistor is shown in the graph. The dc current gain β of transistor is 100.



a. Calculate the resistance R_C and the maximum resistance for R_B.

b. Copy the table below and complete it giving the outputs for inputs 0V and 5V.

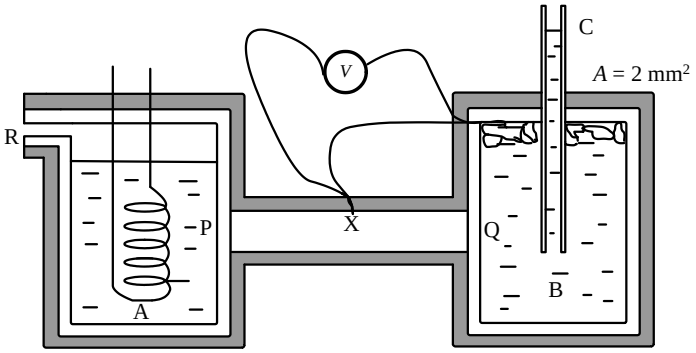
Input (A)	Output (F)
0V	
5V	

c. What is the equilant logic gate which gives the same output and give its truth table.

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

(A) The water in the vessel A is boiled by a heater immersed in it. The vessel is totally lagged the vessel is connected to the conducting vessel B with a well lagged conducting rod PQ vessel B contains water with some ice at 0^0C.

A narrow uniform glass tube is fitted to the vessel B initially it is filled with water. The vessel B totally lagged.



One junction of a thermo couple, connected to a sensitive galvanometer is touched at the middle of the rod PQ and the other junction is kept at B.

Sometimes after the heater has been operated the voltmeter reading began to increase gradually and finally stabilized. When the voltmeter reading is stable it is found that the water level in the tube C changes at a constant rate of 0.5 cms^{-1}.

i) State why the water level changes.

ii) Evaluate the mass of ice melts in one second at this instant provided that the densities of ice and water at 0^0C are 920 kgm^{-3} and 1000 kgm^{-3} respectively.

iii) Then the junction X of the thermopile is kept at the hot water bathe then voltmeter reads 4 mV. Then what should be the voltmeter reading when that Junction is kept at the middle of PQ.

iv) The length of PQ is 40 cm The cross-sectional area is 5 cm^2 conductivity of metal is 230 evaluate the latent heat of fusion of ice.

v) It is found that the mass of the condensed steam at the open end R of the vessel A in 10 min is 17.1 g Find the power of the heater if the latent heat of steam is $0.5x10^6$ kg^{-1}

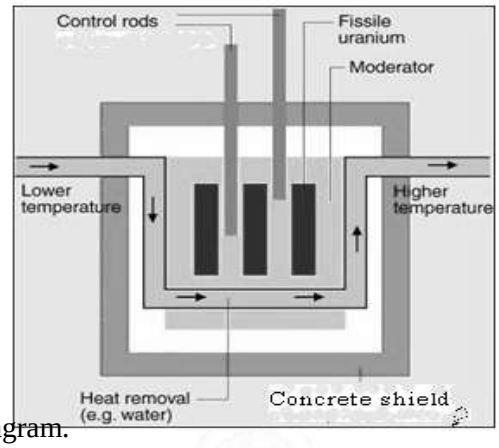
Suppose that a significant length of water exists in the tube C when all the ice is melted. Plot the variation of the height h of the water column in C with the temperature θ if the heater is operated continuously.

State why water in B is not boiled. Propose a method to boil the water in B by the same setup (neglect the vessel expansion)

(B) The nucleus of any atom is composed of protons and neutrons. In heavier nuclei the protons try to repel each other because they have the same charge. There must be a strong attractive force between any two protons or neutrons in the nucleus and this nuclear force responsible for holding the nucleus together must be big enough to overcome the coulomb repulsion between two protons 10^{-14} m apart given by $F = 9\times10^{9}\,\frac{q_1 q_2}{r^2}$.

Nuclear force between any two nucleons (protons and neutrons) is same. To remove a nucleon from the nucleus, work must be done on it against the nuclear force.
The work done to separate the nucleons increases their masses. So the mass of the separated nucleons is greater than the combined mass in the nucleus before separation. This mass difference is called the mass defect of the nucleus. Mass at atomic level is usually expressed in atomic mass unit (u) where, 1 u is equal to 1.66x 10^{-27} kg and the energy relevant to mass is found by $E=mc^2$. This energy is equal to work done to separate nucleon from the nucleus and is also called binding energy of the nucleus

Fission of a nucleus occurs when the nucleus splits into two fragments. This happens when the uranium $^{235}_{92}U$ is bombarded with neutrons.



$$n + {}^{235}_{92}U \rightarrow {}^{138}_{56}Ba + {}^{95}_{36}Kr + 3n + energy$$

Fission neutrons produce further fissions giving more and more neutrons and so on. So huge amount of energy would be released in very short time in an uncontrolled chain reaction.

This chain reaction is controlled in nuclear reactor shown in the diagram.

The uranium used as the fuel is in the form of rods enclosed in metal containers. These fuel rods are spaced regularly in a moderator such as graphite or water chosen to slow fission neutrons down. Slow neutrons are more effective in fissionning U-235 than the fast neutrons. Controls rods, to maintain steady rate of fissioning are inserted into the moderator core and it contains element such as boron or cadmium which absorbs neutrons without fissioning. The water as coolant is pumped through the channel in the moderator to remove heat energy to heat exchanger. The moderator is enclosed in a steel vessel design to withstand high pressure and temperature inside the reactor. The concrete shield round the vessel prevents escaping radiation from the chamber.

Fusion takes place where the nuclei combine to form a bigger nucleus. Solar energy is produced as a result of fussion reaction inside the sun. Moving with very high speed due to enormous temperature inside the sun protons overcome the coulomb repulsion and fuse together one by one to form helium nuclei. From every helium nucleus formed from the protons 1 Mev of energy is released. This energy is equal to the mass change and also equal to the kinetic energy change of the protons when they fuse.

i) Calculate nuclear force between two protons in the nucleus. Charge of a proton=1.6 x 10^{-19} C
ii) What is meant by the mass defect?
iii Calculate the amount of energy in 1u in Mev
iii) Calculate binding energy of the $^{4}_{2}He$ nucleus in Mev

Mass of the He nucleus = 4.001504 u
Mass of a proton = 1.00728 u
Mass of a neutron = 1.008665 u

v) According to the paragraph why are the masses of separated nucleons and combined nucleus different
vii) Give one use for each of the following parts of the nuclear reactor
Moderator
Control rod
Concrete shield

viii) energy release from the fission of U- 235 in Mev

Mass of the neutron = 1.00866 u
Mass of the U-235 = 235.04390 u
Mass of Ba = 137.90500 u
Mass of Kr = 94.90000 u

ix) Estimate the velocity of the protons inside the sun
Estimate the temperature at the inside of the sun
One mole of proton is 0.00 kg
Hint: use the equation in kinetic theory of gasses and ideal gas equation
Gas constant R = 8.3 J mol^{-1} k^{-1}