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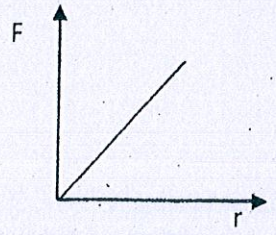
Instructions:

- ❊ This question paper has 10 pages and 50 questions.
- ❊ **Answer all 50 questions.**
- ❊ **Calculators are not allowed.** ($g = 10\ NKg^{-1}$)

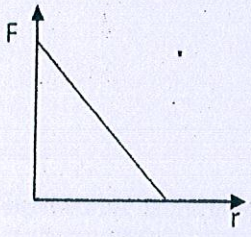
Name : .....

01. SI unit of the electrified intensity is
    1. wb
    2. Am^{-1}
    3. Nm^{-1}
    4. $NC^{-1}\ m^2$
    5. T

02. The variation of electrostatic force (F) between two charges with their Separation (r) is best shown by



(1)



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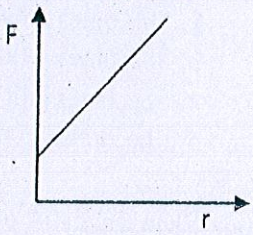

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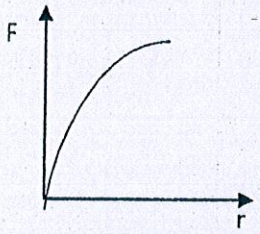

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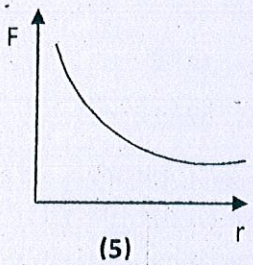
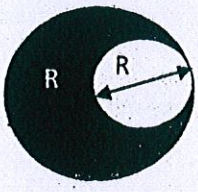


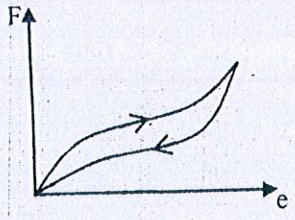
(5)

03. A circular part of diameter R is removed from a circular disc of radius R as shown in the diagram. The distance to the center of gravity of the remaining part from O is



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

04. The variation of tensile force (F) acting on a rubber strip with extension (e) is shown from the graph,



Consider following statements,

(A) The rubber strip has regained the initial length.
(B) Some energy is converted to heat.
(C) Total strain energy is lost when it regains the initial length.

of the statements,

1. Only A is true.
2. Only B is true.
3. Only C is true.
4. Only B and C are true.
5. Only A and B are true.

05. Pressure of an ideal gas becomes 4 times under constant volume. Then root mean square velocity of gas molecules,

1. remains unchanged
2. becomes doubled
3. becomes 4 times
4. becomes halt
5. becomes 16 times

06. When a metal A of mass 0.1kg at 62 ^{0} C is dropped into a liquid B of mass 0.3kg at 20^0 C. Maximum temperature the liquid reaches is 26 ^{0} C. Metal A of mass 0.2kg at 70 ^{0} C is dropped in to the liquid B of mass 0.5kg at 22 ^{0} C, then the maximum temperature the liquid reaches is, (neglect the heat lost and the heat capacity of the vessel)

1. 30 ^{0} C
2. 34 ^{0} C
3. 38 ^{0} C
4. 46 ^{0} C
5. 52 ^{0} C

07.Three energy levels of electrons of a certain LASER gas are as follows,
(-) 20 X 10^{-22} KJ , (-) 5 X 10^{-22} KJ and (-) 1 X 10^{-22} KJ.
Frequency of the LASER photons produced from this gas is, (h = 6 X 10^{-34} Js.)

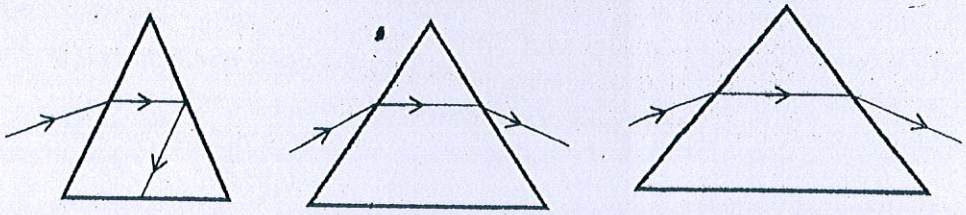
1. 2.5 X 10^{15} Hz
2. 3.3 X 10^{15} Hz
3. 2.5 X 10^{12} Hz
4. 3.3 X 10^{12} Hz
5. 2.5 X 10^{18} Hz

08. A motor cycle engine produces a certain intensity level. How many motor cycle should operate to change the intensity level by 10dB.

1. 2
2. 5
3. 10
4. 20
5. 10

09. Refraction of a light ray from three glass prisms is shown in diagrams below. A is the prism angle and C is the critical angle of glass.

A < 2C A = 2C A > 2C

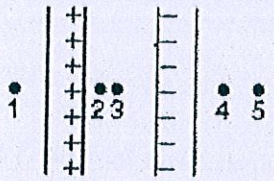


(A) (B) (C)

Of the diagrams

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

10. Two large insulating parallel plates carry charge of equal magnitude, one positive and the other negative, that is distributed uniformly over their inner surfaces.



Rank the points 1 through 5 according to the magnitude of the electric field at the points, least to greatest.

(1) 1, 2, 3, 4, 5
(2) 5, 4, 3, 2, 1
(3) 1, 4, and 5 tie, then 2 and 3 tie
(4) 2 and 3 tie, then 1 and 4 tie, then 5
(5) 2 and 3 tie, then 1, 4, and 5 tie

11. The electric flux passing through a hemi spherical surface of radius R placed in an electric filed E with its axis parallel to the field is,

1) $\pi R^2 E$
2) $2\pi R^2 E$
3) $\pi R E$
4) $3\pi R^2 E$
5) $2\pi R^3 E$

12. Which of the following statements is NOT true about transformers?

(1) Transfer Electrical power from one electrical circuit to another Electrical circuit
(2) It's working without changing the frequency
(3) Work through on electric induction.
(4) When, both circuits take effect of mutual induction
(5) Efficiency depends upon the frequency

13. Current of 0.75A when a battery of 1.5V is connected to wire of 5m having cross sectional area 2.5 x 10^{-7} m^2 will have resistivity

(1) 1 x 10^{-7} Ωm
(2) 1.1 x 10^{-7} Ωm
(3) 2 x 10^{-7} Ωm
(4) 2.1 x 10^{-7} Ωm
(5) 2.5x 10^{-7} Ωm

14. 5 g of water rises in the bore of capillary tube when it is dipped in water. If the radius of bore capillary tube is doubled, the mass of water that rises in the capillary tube above the outside water level is

(1) 1.5 g (2) 10 g (3) 5 g
(4) 15g (5) 4 g

15. A radioactive sample is tested using a Geiger tube with a thin end window. When a piece of paper is placed between the source and the tube, there is no fall in the count rate. When the piece of paper is replaced by a thick sheet of aluminium, the count rate falls significantly, but remains well above the background level. What type of radiation does this sample emit?

(1) Alpha and Beta (2)Alpha and Gamma
(3) Beta and Gamma (4)Beta
(5) Gamma

16. When photons with an energy of 4 eV are incident on a surface, the ejected electrons have energies up to 1.1 eV. What energy photons are required to eject electrons with an energy of up to 10 eV?

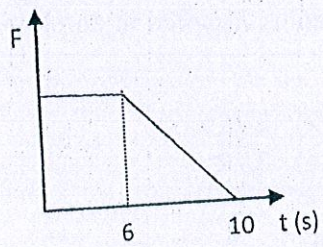
(1) 4 eV (2) 12.9 eV
(3) 14 eV (4) 15.1 eV
(5) 10 eV

17. Consider the following statements.

(A) $\propto$ and β particals have (+) and (-) charge respectively.
(B) The penetration power of β is more than $\propto$.
(C) The neutrino is the antiparticle of the β partical.

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

18. An object of mass 8 kg starting from rest gains the velocity V_1 after 6s and V_2 after 10 s. The variation of the force acting on the object with time is shown in the graph. The magnitudes of V_1 and V_2 are respectively



1. $10ms^{-1}$, $12ms^{-1}$ 2. $15ms^{-1}$, 0 3. $20ms^{-1}$, 0
4. $15ms^{-1}$, $20ms^{-1}$ 5. $20ms^{-1}$, $15ms^{-1}$

19. A body initially at rest exploded in to two parts of masses 2m and 3m respectively having a total kinetic energy E. The kinetic energy of mass 2m after the explosion is,

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

20. A string is connected to a bucket having water of mass m. Then the bucket is whirled in a vertical circle with velocity V from the other end. The radius of the circle is r. The water does not leave the bucket when it is vertically above the center. then

1. $mg = \frac{mv^2}{r}$
2. $mg \geq \frac{mv^2}{r}$
3. $mg \leq \frac{mv^2}{r}$
4. The tension $T = \frac{mv^2}{r}$
5. $T + mg = \frac{mv^2}{r}$

21. Two oscillating particles having same amplitude are in same phase. Consider the following statements.

(a) Their displacement is same at any movement.
(b) Their potential energy is maximum at every movement.
(c) Their total mechanical energy is constant and their magnitude is same.

Of the statement

1. Only (a) is true.
2. Only (a) and (b) are true.
3. Only (b) and (c) are true.
4. Only (c) is true.
5. Only (b) and (c) are true.

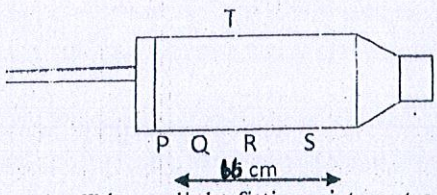
22. A beam of light converging to a point 10cm behind a converging lens is incident on the lens. Find the position of the point image if the lens has a focal length of 40cm.

1. 13.3 cm in front of the lens
2. 10 cm in front of the lens
3. 5 cm behind the lens
4. 8 cm behind the lens
5. At infinity

23. A light ray incident on one side of a prism emerges from the opposite side. The incident angle and the angle of emergence are $36^0\,28'$ and $50^0\,12'$ respectively. The prism angle is 60^0. The angle of deviation is,

1. $13^0\,32'$
2. $26^0\,32'$
3. $56^0\,32'$
4. $43^0\,16'$
5. $54^0\,2'$

03

24. 

A tube T has a light fitting piston at one end and a small loud speaker L at the other end. Nodes are detected in the air at P, Q, R and S. Where PS = 66 m. If the frequency of the sound from L is 800 Hz. Then the speed of sound in air is

1. 764 ms^{-1}
2. 528 ms^{-1}
3. 352 ms^{-1}
4. 176 ms^{-1}
5. 156 ms^{-1}

25. The frequency of the horn of a car as perceived by a stationary observer towards whom the car is moving differs from the actual frequency by 2.5%. If the speed of the sound in air is 320 ms^{-1}, the speed of the car is,

1. 6 ms^{-1}
2. 7.2 ms^{-1}
3. 7.8 ms^{-1}
4. 9 ms^{-1}
5. 9.2 ms^{-1}

26. One end of a metal bar of length 600m and young's modulus 2.88 X 10^{11} $Nm^{-2}$is tapped. One can hear two sounds from the other end with a time delay. The density of mental is 800$kgm^{-3}$and speed of sound in air is 330ms^{-1}. The time delay between the two sounds is,

1. 1S
2. 0.89S
3. 0.11S
4. 0 S
5. 0.33 S

27. Angular magnification of an astronomical telescope.in normal adjustment is 10. The focal length of the objective is 50cm. The separation between the two lenses is,

1. 56cm
2. 55cm
3. 54.9cm
4. 56.8cm
5. 55.9cm

28. An ideal gas is heated under constant pressure. The ration of principle molar heat capacities (γ) is $\frac{4}{3}$. The work done by the gas as a percentage is,

1. 25%
2. 50%
3. 75%
4. 60%
5. 40%

29. Two rods A and B are made of same material and well insulated. The ratio of their diameter is 1:2. The ratio of their length is 2:1. The temperature difference across the rods is equal. The ratio of the rate heat flow is,

1. 2:1
2. 2:3
3. 1:1
4. 1:8
5. 4:1

30. The variation of Fahrenheit temperature (y) with Celsius temperature (x) is a linear graph.

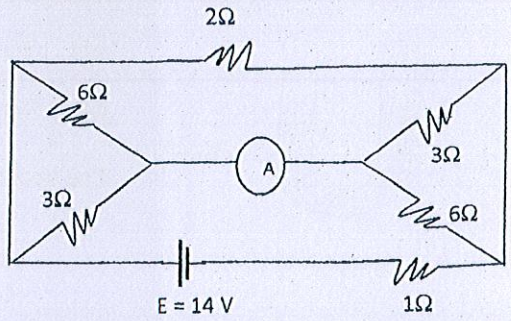
1. The interception at the y - axis is (+)
2. The interception at the x- axis is (-)
3. It is through the origin.
4. The interception at x axis and y axis both is (-)
5. All are wrong.

31. A conductor of length 5m, carrying current 15A is in a magnetic field of flux density 0.1T maximum force on the conductor is,

1. 0.75 N
2. 6N
3. 7.5 N
4. 2.16 N
5. 1.5 N

32. The current through the idea ammeter shown in the circuit is,

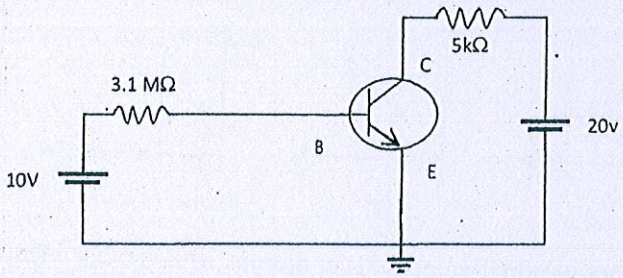
1. 5A
2. 4A
3. 3A
4. 2A
5. 1A



33. The temperature resistance coefficient of the filament of a bulb is $5X10^{-3}\,^0C^{-1}$. The resistance of the filament at 100 ^{0}C is 100Ω. The resistance of the bulb becomes 200Ω at temperature,

1. 500^{0}C
2. 200^{0}C
3. 300^{0}C
4. 400^{0}C
5. 100^0

34. The current gain of the Si transistor shown in the circuit is 100. The emitter – base voltage of the transistor is 0.7V. The voltage between the collector – emitter terminals is,

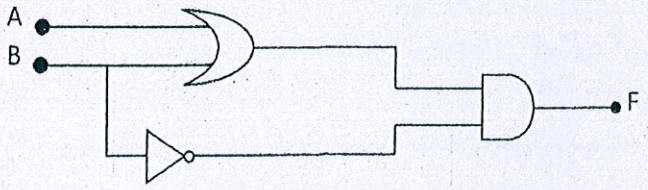


(1) 18.5 v (2) 20v (3) 5v (4) 15v (5) 30v

35. False statement regarding an ideal operational amplifier is,

1. Voltage gain is infinity.
2. Current gain is infinity.
3. Output resistance is infinity.
4. Input resistance is infinity.
5. Frequency rang is infinity.

36. The correct truth table for the given circuit is,



A	B	F
0	0	0
0	1	1
1	0	0
1	1	0

(1)

A	B	F
0	0	0
0	1	0
1	0	0
1	1	1

(2)

A	B	F
0	0	0
0	1	1
1	0	1
1	1	0

(3)

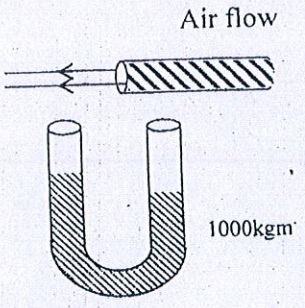
A	B	F
0	0	0
0	1	0
1	0	0
1	1	0

(4)

A	B	F
0	0	0
0	1	0
1	0	1
1	1	0

(5)

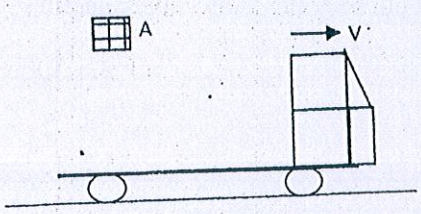
37. The diagram shows an arrangement to find the speed of air flowing through a pipe. One end of a U tube filled with water is held near the opening of the tube. Then the water level difference in the tube is 9cm. The density of the air is $2kgm^{-3}$.



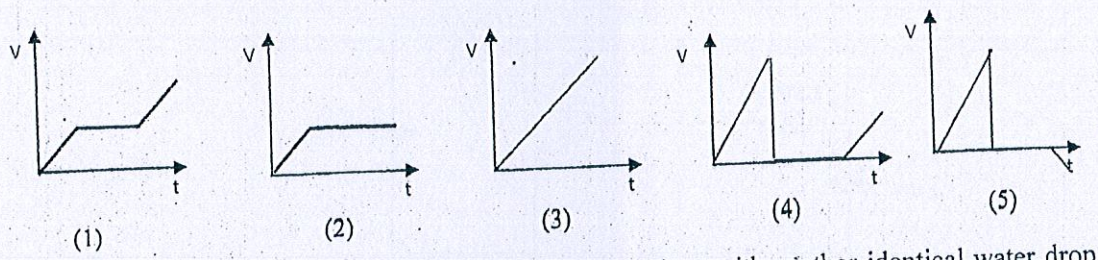
The speed of the flow is,

1. $30ms^{-1}$
2. $40ms^{-1}$
3. $50ms^{-1}$
4. $60ms^{-1}$
5. $70ms^{-1}$

38. A truck having smooth floor board moves horizontally with uniform velocity. An object is dropped from certain height so that it hits the floor board.



The velocity – time graph for the object is best shown by,

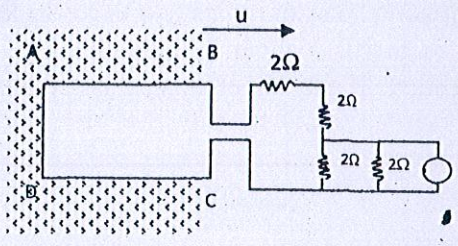


39. A water drop is falling in air with terminal velocity. It combines with another identical water drop and make a large drop. Upthrust from air is negligible. The ratio of the terminal velocity of large drop and small drop is, ,

1. 4
2. $2^{2}/_{3}$
3. $4^{2}/_{3}$
4. 2
5. $^{1}/_{2}$

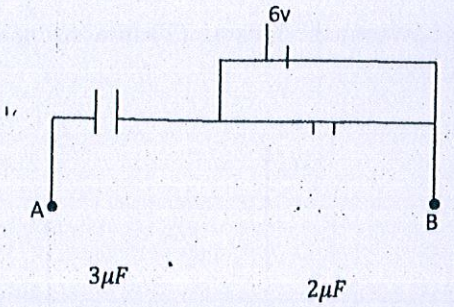
40. On a day where the room temperature was 27^{0} C, the relative humidity in a closed room was 60%. When the room temperature reduced to 17^{0} C the room had become saturated and some water vapour had condensed. Saturated water vapour pressure at 27^{0} C and 17^{0} C are27mmHg and 14.5 mmHg. The fraction of the water vapor condensed is,

1. $\frac{1}{27}$
2. $\frac{12}{27}$
3. $\frac{25}{27}$
4. $\frac{25}{54}$
5. $\frac{3}{5}$

41. 

A square shape wire frame ABCD of sides 10cm is moved across a magnetic field with velocity V as shown in the diagram. The flux density is $2Wbm^{-2}$. The voltmeter shown in the circuit is an ideal one and its reading is 6V. The value of V is,

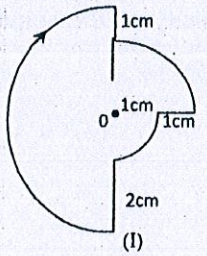
1. $0.5\ ms^{-1}$
2. $10\ ms^{-1}$
3. $50\ ms^{-1}$
4. $100\ ms^{-1}$
5. $150\ ms^{-1}$

42. 

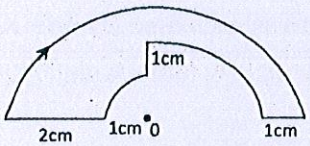
A battery of *emf* 10 V and negligible internal resistance is connected across A and B of the capacitor circuit shown in the diagram. Then the terminals of the battery are interchanged and connected across A and B. The energy change in capacitor is,

1. $0\mu J$
2. $36\mu J$
3. $240\mu J$
4. $360\mu J$
5. $600\mu J$

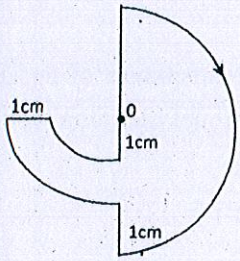
43. Three conducting wire are bent in different ways as shown in the diagram. They carry equal current. The magnetic flux densities at the centers are B_1, B_2 and B_3 respectively. Which correctly shows them in ascending order?



(I)



(II)



(III)

1. $B_1 > B_2 > B_3$
2. $B_1 > B_3 > B_2$
3. $B_3 > B_2 > B_1$
4. $B_2 > B_3 > B_1$
5. $B_2 > B_1 > B_3$

44. The length of two wires A and B are equal. The diameter of A is 3 times that of B. Young's modules of A is half that of B. Their ends are joined together and make a composite wire. An object is hung from one end of the composite wire and the other end is fixed to a support. The ratio, $\frac{\text{extension of A}}{\text{extension of B}}$

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

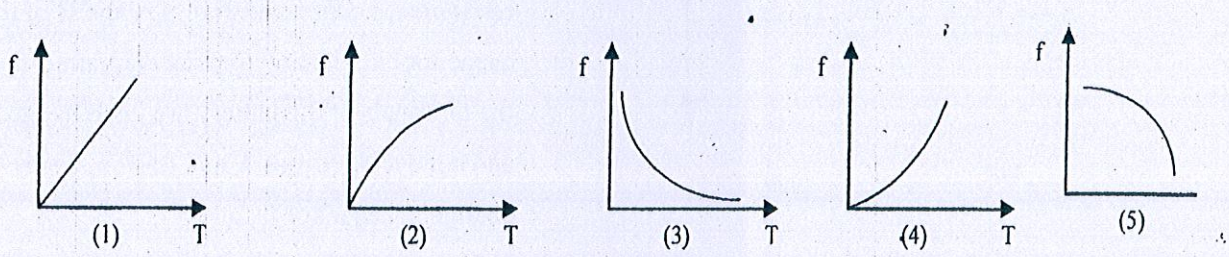
45. The excess pressure inside a soap bubble (X) is twice the excess pressure inside a second soap bubble (Y). The volume of the bubble (X) is N times the volume of the bubble (Y) value of N is,

1. 4
2. 0.5
3. 0.25
4. 0.125
5. 0.625

46. An insect of mass m is moving along the rim of a horizontal disc of radius R with constant speed v in anti-clock wise direction. The disc has movement of inertia I about its own axis about which is rotating with angular velocity ω in clock wise direction. If the insect suddenly stops, what is the angular velocity of the disc?

1. $I\omega$
2. $\frac{I\omega + mvR}{I + mR^2}$
3. $\frac{I\omega - mvR}{I + mR^2}$
4. $\frac{I\omega - mvR}{I}$
5. $\frac{I\omega + mvR}{I}$

47. Choose the correct graph to represent the relationship between the tension (T) in a string of given length and the frequency (f) of the fundamental note emitted,



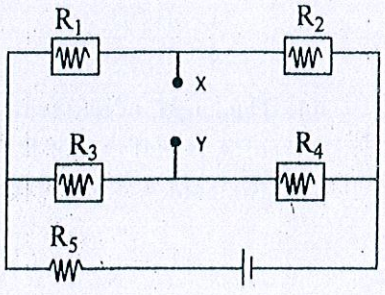
48. A potentiometer wire of length 100 cm has a resistance of 10 Ω and is connected in series with a resistance (R) and a cell of *e.m.f.* of 2 V and negligible internal resistance. A source of *e.m.f.* 12 mV is balanced against a length of 48 cm of the potentiometer wire. What is the value of the resistance (R),

1. 800 Ω
2. 790 Ω
3. 780 Ω
4. 760 Ω
5. 690 Ω

49. When the temperature of an ideal gas is increased by 600 K, the velocity of the sound in the gas become $\sqrt{3}$ times the initial velocity in it. The initial temperature of the gas is,

1. -73^0 C
2. 27^0 C
3. 127^0 C
4. 227^0 C
5. 327^0 C

50. In the figure is shown a circuit consisting of a battery and five unknown resistors. When an ideal ammeter is connected between the terminals A & B, its reading is 4A and when a resistance 3Ω is connected in series with the ammeter its reading becomes 2A. Now the ammeter and the 3Ω resistance are disconnected and ideal voltmeter is connected between the terminals A & B. What would be the voltmeter read?



1. 6 V
2. 10 V
3. 12 V
4. 14 V
5. 18 V

Final Term Test June 2016
Grade 13

භෞතික විද්‍යාව II Physics II	E 022	01 | S | II	පැය තුනයි *Three hours*

Name /Class .....

Instructions : *This quèstion paper consists of 10 questions in 15 pages

*This question paper comprises part A and part B. The time allocated for **both parts** is **three hours**

PART A - Structured Eassy (pages 2 -7)

**Answer all four questions on this paper itself*

**Write your answer in the space provided for each question.Note that the spance provided is Sufficient for your answer and extensive amswer are not expected.*

PART B – Eassy (Page 7 - 15)

**Answer four questions only. Use paper supplied for this purpose . At the end of the time allocated For this paper ,tie the two together so that part A is on the top of part B before handling over the supervisor.*

**Your are permitted to remove only part B of the question paper from the examination hall.*

For Examiner's Use Only

Part	Q. No	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9	
	10	
Total		
Precentage		

Final Marks

In numbers	
In words	

Code Numbers

Examiner	
Checked by	1.
	2.
Supervised by	

Part A – Sturtured essay

- Answer all 4 quations.

01) The diagram show a student sitting on a table rotating about the vertical anis through its center. The rotation speed is displaced on a computer screen. Initially she is stretching arms forward as shown in the diagram. Then the movement of inertia of the table with the student is $4.1 kgm^2$ and the speed of the table is $2.7 rad\ s^{-1}$

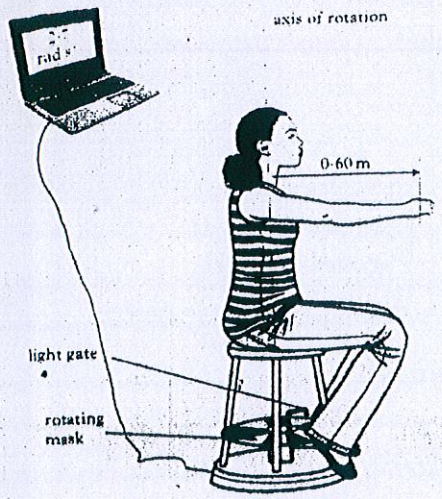


Figure 1

(a) Find the angular momentum of the table with the student.

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(b) Define the angular momentum of a particle in two wags.

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(c) The student while rotating picked an object of mass 2.5kg at her hand level as shown in the diagram.

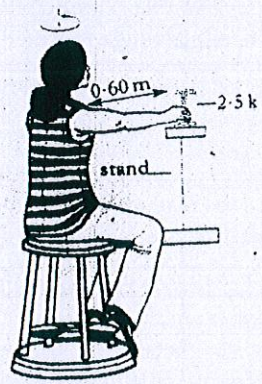

Figure 2

(i) Find the angular velocity of the system after that.

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(ii). Write down the principle applied for the about calculation.

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(iii). Now the student folds her arms closing the object towards her body. Explain what happen to the speed of the system giving reasons

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(iv). While rotating as in par (c) suddenly the object falls from her hand. What is the angular velocity of the reaming system in the subsequent motion?

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(d) In another experiment using the same set up the table with the student is rotating with angular velocity 1.5 $rads^{-1}$. Now she put down her one leg to touch the ground. Due to the frictional torque from the ground, the table comes to rest in 0.75s. The moment of inertia of the system is 4.5kgm^2 calculate.

Figure 3

(a) The angular retardation?

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(b) Frictional torque?

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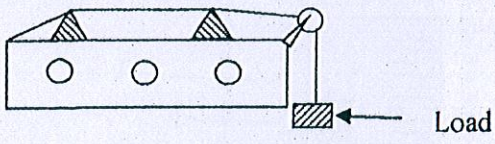
02)



(a) Why is the sonometer is made of hollow wooden box with holes?

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(b) In most sonometer euperiments resonance length is obtained for the fundamental vibration. Explain the reason for this?

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(c) A tuning fork of frequency 500Hg is vibrated and kept on the sonometer box. When the length of the wire is 20cm it resonates with the tuning fork. Explain how the resonance state is obtained by using a paper rider.

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(d) The tension in the wire described in part (c) is 20N. Calculate the liner density of the wire.

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(e) The volume of the 20N load hung from the sonometer wire is $12x10^{-4}$ m^3. When this load is fully submersed in a liquid, the corresponding resonance length is 15cm. Find the density of the liquid.

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(f) Now the load is taken out from the liquid and kept in air. Then vibrating part of the wire increased to 80cm by adjusting the bridges, When the wire is plucked from the middle and vibrated together with a tuning fork of frequency 508Hg, beats are produced. Find the beat frequency.

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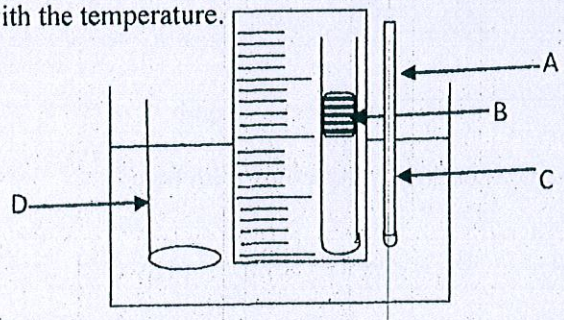
03) The diagram shows an enperimental set up to study the variation of saturated uapour pressure of water with the temperature.



(a) Latel the parts A ,B, Cand D.

A:-.....

B:-.....

C:-.....

D:-.....

(b) Write an enpression for air pressure trapped inside tube. Atmopheric pressure is P_o and saturated vnpour at temperature θ_1 is P_1.

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(c) How do you make sure that the tube is saturated with vapour?

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(d) Why is it required to have a unitrom tube of small crosseetional area?

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(e) The length of the air colnmn at temperatures 30^0C and 42^0C are 40.4cm and 44.1cm respectinely. Almospheric pressure is 760mmHg. Saturated vapour pressure at 30^0C ils 32mmHg. Find the saturated vapour pressure at 42^0C?

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(f) Sketch the variation of saturated vapour pressure of water with the temperature. Mark its value at 100^0C.

(g) Befor meaturing the lengh of the air column, the temperature in the wather bath needs to be maintained steady. How can you do this?

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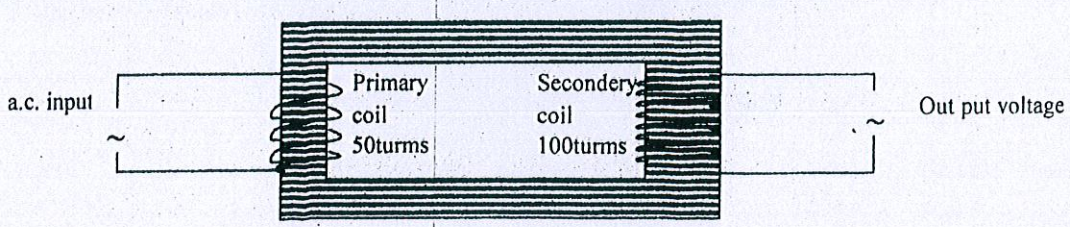
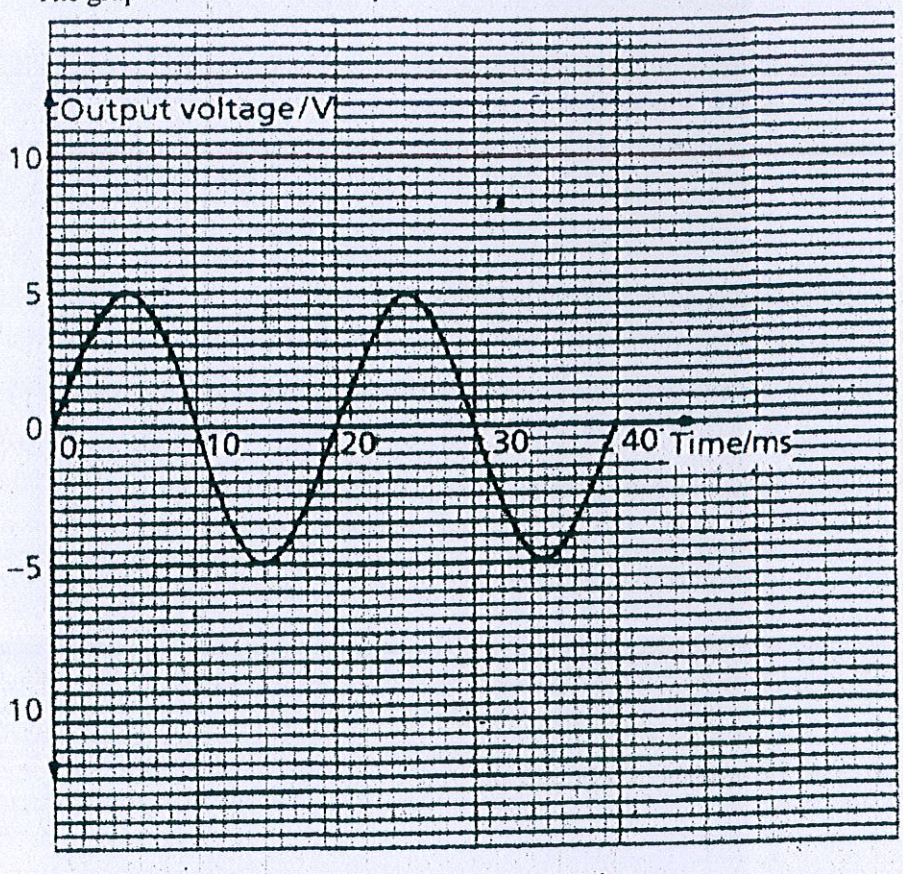
04) The diagram below show a simple arrangement of an ideal transformer.



The graph shows how the output varies with time.



(a) Calculate the peak value of the input voltage.

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(b) The number of the turns on the secondary coil is chaged from 100 to 150. On the graph show how the out put voltage now varies with time

(c) Explan why a transformer will not operate using a direct current input.

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(d) Why is input voltage and the out put voltage are not in same phase.

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(e) Electrical energe is usually transmitted using alternating high voltage. Suggest one advantage, for the transmission having

i. Alternating;

.....

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ii. High voltage;

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(f) An a.c powe of 120kW is supplied to a small town from a power plant 10km away. The transmission wries have resistane of $0.02\Omega\ km^{-1}$

i. Calculate the power loss if the power is transmitted at 240V.

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ii. Calculate the power loss if the power is transmitted at 24000V

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iii. Estimated how much power saved if the voltage is stepped up from 240V to 24000V

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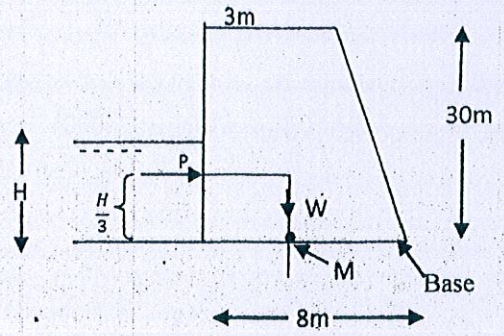
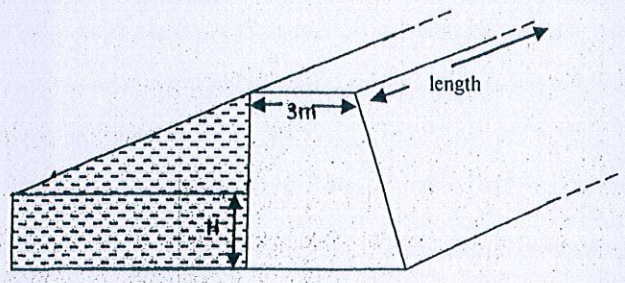
Part A – Sturtured essay E 02

- **Answer only 4 quations.**

05) (a) The diagram show a dam across a river having a trapeciam shape cross section.





The breadth of the dam at the top	= 3m
The breadth at the bottom	= 8m
Height of the dam	= 30m
Weight of the concrete	= 24KN

(i) Show that the force on a unit length of the dam due to hydrostatic pressure is given by $P = \frac{H^2 w}{2}$ Where H is the depth of the river and W is the pressure per unit length.

(ii) If H = 16m and W = 10^4 pam^{-1} find P value in KN m^{-1}.

(iii) Find the weight of a unit length of to dam in KN m^{-1}.

(iv) Find the masnitude and direction of the resultant force acting on a unit length of the dam (R).
Hydrostatic force P and the weight of the dam W are acting through a point at height $H/3$ from the bottom.

(v) Copy the figure on to your answer script and mark P,W and R. Find the distance to the point where R cuts the basement from M.

(b) The minimum operating level of the tank is 1190m ms*l*. Total capacity level of the tank is 1194m ms*l*. ms*l*(mean sea level) is the height to the water level from the sea level. Total surface area and the volume capacity of the tank are 24 x10^4 m^2 and 17.6 x 10^5 m^3respectivily. When the water level is rising to spilt level , spilt gates are opened and the excess water is discharged. There ara 5 spilt gates of area 10m x 9m in the dam, Dischares rate is 3000m^3 s^{-1}

(i) Water level rises from the minimum operating level to the manimum level during a ranny season. Find the capacity at the minimum operatin level.

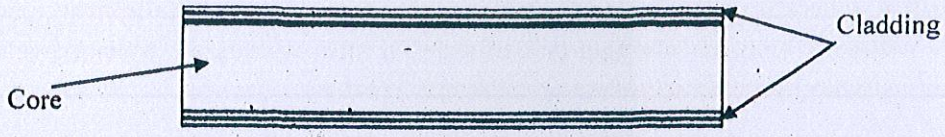
(ii) Due to a continuous heavy rain all 5 spilt gates were opend. Find the speed of water leaving the gates.

(c) Due to the discharged water flood situation occures in low level area down the river. Houses and roads were submerged due to the flood. People were evacuvated using boats. Density of flood water is 1000kgm^{-3}

i. Find the hight of water level that can make a refrigerator of size 0.8m x 0.6m floats in water. Mass of the refrigerate is 150kg.

ii. If boats of dimensions 2.5m x 1m x 0.75m are used to evacuvat people, how many persons of average mass 60kg can be carried from one boat? Mass of the boat is 1260kg.

06) An optical fiber uses the principle of total internal reflection to guide the light along the fibre.



Each fiber is coated in a cladding which prevents leakage of the light from sides. The cladding has a lower refractive index than the core. Optical fibers are used in medicine and communication where infrared light pulses carry disital signals. Also laser light is sent along fiber optic since it has a much spread of warelengths.

(a) Write two uses of fiber optics.
(b) write two conditions for total internal reflection?
(c) In which material, the core or the cladding, does the light have more speed? Explain.
(d) Refractive index of the core and the cladding are 1.6 and 1.4 respectinely. Find the critical angle for these two mediums.
(e) A short pulse of white light is sent out at one end of an optical fibre 4km long. Calculate the time interval between the red and blue light emerging at other end given the speed of light in air is $3x10^8 ms^{-1}$ and refruetive inden of blue and red light 1.53 and 1.50 respectively.
(f) Fibre optics are used for decoration purposes also. A light sent out at one end leaves from the other end. This is seen as a light dot. This light dot is observed from a microscope in normal adjustment. Then its angnlar magnitication is 10. One end of the microscope has a lens combination made of two convex lenses of focal length 6cm each. The other end has a convex lens of focal length 4cm.
(i). Identity the objective and the eyepiece.
(ii). Find the object distance for the objective. eyepiece -
(iii). Find the linear magnification of the objective
iv) Find the length of the microscope tube.

07) (I) (a) Frictional force and viscos drag both oppose relative motion. Suggest one similarity and one difference between them.

(b) The stress (σ) between two planes of molecules in a moving liquid is given by

$\sigma = \frac{\eta v}{x}$

V = differrance in the velocities of the plances
X = their distance apart
η = constant for the liquid.

Find the deension of η

(c) A large wooden plate of area $10m^2$ floating on the surface of a pond is move to mave horizontally with a speed of $2ms^{-1}$ by applying a tangentrial force. If the pond is 1m deep and the water in contact with bed is stationary, find the tangential force needed to the keep the plate moving. The coefficient of viscosity of water $10^{-3}Nms^{-2}$.

(II) (a) Draw digrams to show the forces acting on a sphere falling through a viscos liquid.
(i). At the instent of release (at this moment the sphere is just underneath the surface)
(ii). When it has reached its termineal velocity

(b) Write down an equation for the forces acting on the sphere in (a) (ii).

(c) (i) describe the motion of a sphere projected downward throught a viscos meduam. Assume that the projection velocity is grater them its termined velocity.

(ii) Sletch a graph for the velocity of the sphere against the time.

(d) A spherical ball of radlus 1 $x10^{-4}$m and density 10^4 kg m^{-3} falls freely under granty through a distance h before entering a tank of water. If after entering the water the velocity of ball does not change. (The viscosity of water is 9.8 $x10^{-6}$ Nsm^{-2})

(i) Write down an expressrom for the velocity of the ball when it toches the water surface.

(ii) What is the terminal velocity of the ball when it moves through the water. Density of 10^3 kgm^{-s}. g = 10 ms^{-2}

(iii) Find the value of h.

08) a) An electron beam is accelerated from a potential different 2000V. Then it is directed to a masnetic field of flux density $1x10^{-4}$T which extends in a vast area. If the heam enters to the field in different directions as given below, describe its path in each case.

(i) (1) Parallel to the magnetic field.

(2) Perpendicular to the field.

(3) With some angle to the magnetic field.

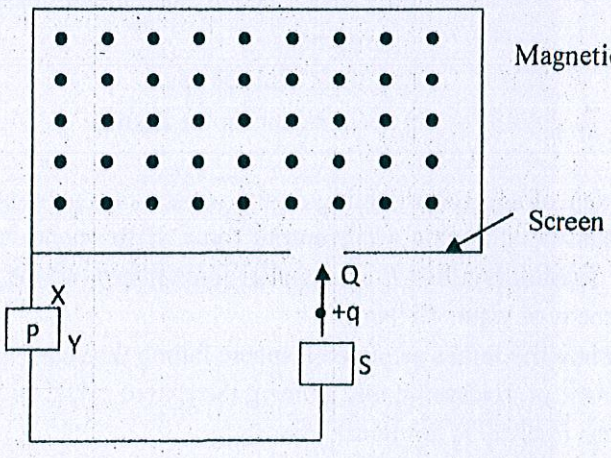
(ii) Calculate the maximum velocity gained by electrons when leaving the electric filed.
Charge of an electron = 1.6 x 10^{-19} C
Mass of an electron = 9 x 10^{-31} kg

(iii) (1) Calculate the distances travelled by electrons in lns which entered parallel to the magnetic field.

(2) Find the radius and the period of the circular of the path of electrons which entered perpendicular to the magnetic field.

(3) Find the radius of the path of an electron entering the field with angle 30^0C with the field.

b) Mass specetrometer used to find the mass of an ion is shown in the diagram.



S is an ion source. It can emit ions of charge +q. These ions are accelerated by a potential difference V applied across Q and S. Then the iron enters a chamber from Q where uniform magnetic field of flux density B prevails.

(i) P is a voltage source. What is the polarity of X?

(ii) Copy the chamber area on to your answer script and draw the path of the ion in this area.

(iii) Obtain an expression for the velocity of the ion U when entering the magnetic field. Mass of the ion is m?

(iv) The ion hits the screen at T. Mark T on your diagram. If QT = Y, obtain an expression for Y in terms of m, u, B and q.

(v)

09) **Answer only for A or B part.**

(A) a) N number of cells of EMF E and internal resistance r connected in ,

(i)Series (ii)Parallel

are joined across an external resistor R separately.

(i) Show that the same current flows through R in each case if R = r.Obtain an expression for the current through R.

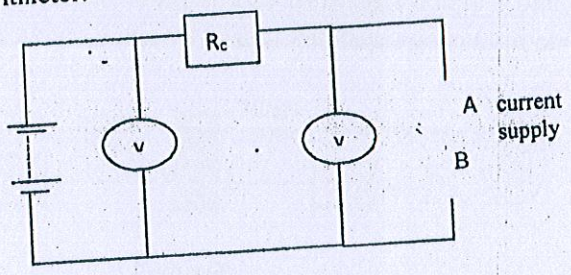
(ii) Obtain an enpression for R to generate a maximum power dissipation from it in each combination of cells.

i. Series

ii. Parallel.

(iii) If N = 6 , E = 2V and r = 0.1Ω how many bulbs of resistance 0.2Ω should be connected in series to generate the maximum power dissipation through them if they are joined aeross the cells combination in series.

b) The above cells combination in series [N = 6 , E = 2V , r = 0.1Ω] is charged using a dc current supply of EMF 24V and internal resistance 1Ω. The circuit diagram for that is shown below. V_1 and $V_2$are ideal voltmeter.

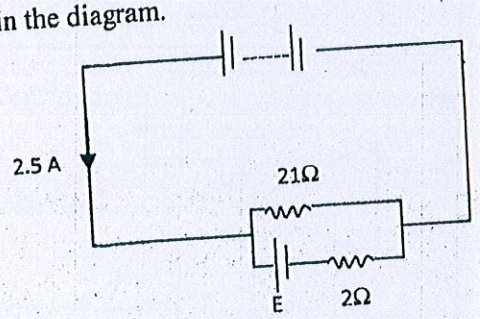


i) What is the polarity of the terminal A?

ii) The current drawn by the current supply is 4A. Calculate R_c?

iii) Calculate V_1 and V_2readings.

c) The above cells combination in series is used to drive a small motor. The motor is equivalent to a battery of back *emf* E and internal resistance 2Ω connected in parallel with a resistance 21Ω as shown in the diagram.

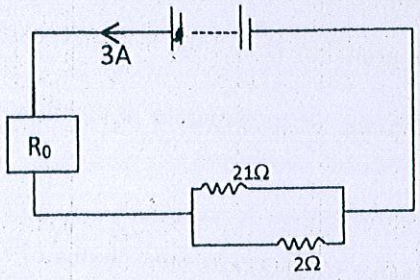


The current drown from the cells combination is 2.5A

(i) What is the current through 2Ω resistor?

(ii) Find the value of baet *emf* E?

(iii) Immediately after the motor is switched on the back *emf* E is zero. Then very high current flows through the motor. To control this current a resistor R_0 is connected in series with the motor. To limit the starting current to 3A what should be the R_O value?



B) Analog to Digital Converter (ADC) and Digital to Analog Converter (DAC) are very important components in electronic equipment. ADC converts analog signals into digital signals without altering their essential content. DAC converts the processed digital signal back into the analog signal

As an example in Figure 1, ADC converts the analog signal collected by audio input equipment, such as a microphone, into a digital signal that can be processed by a computer. DAC converts the processed digital signal back into the analog signal that is used by audio output equipment such as a speaker.

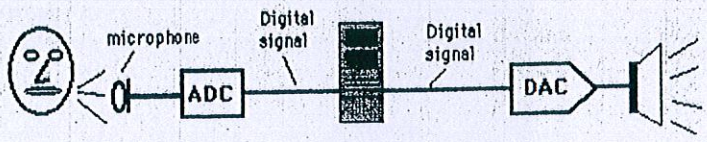


Figure 1

(a) The ADC shown in the diagram is used to convert the audio analog signal into digital signal. Consider a basic ADC with 2 outputs given in figure 2.

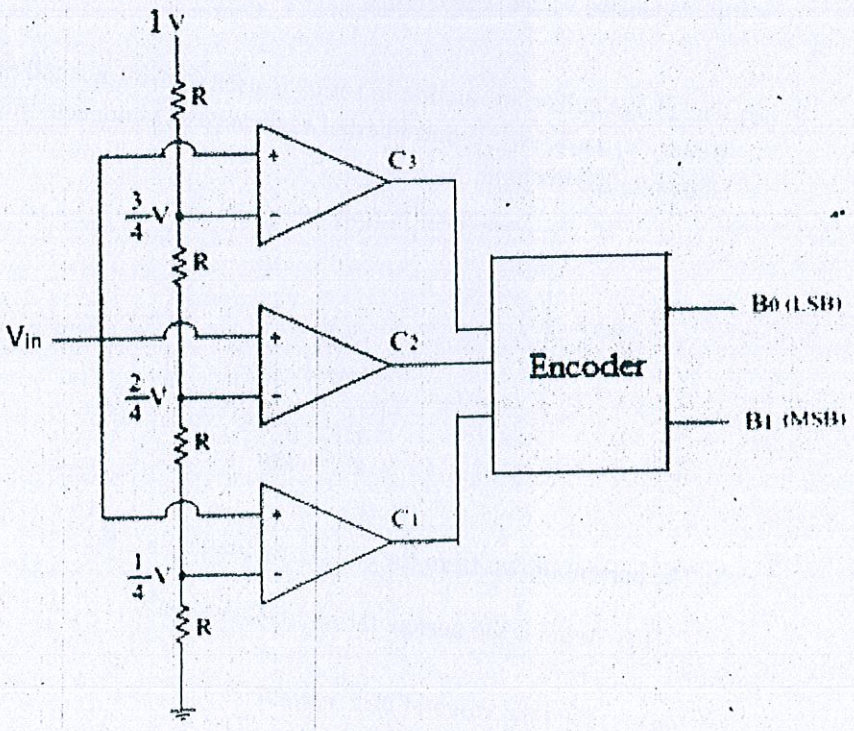


Figure 2

(i) Copy the given table to your answer script and fill it giving digital values for C_1, C_2 and C_2 for given input voltage ranges

Analogue input conditions(V)	Comparator outputs			Digital outputs	
	C_1	C_2	C_3	B_1	B_0
$0<V_{in}<0.25$				0	0
$0.25<V_{in}<0.5$				0	1
$0.5<V_{in}<0.75$				1	0
$0.75<V_{in}<1$				1	1

(ii) C_1, C_2 and C_3 values are applied to further coding circuit (encoder) to get the digital outputs B_1 and B_0. Design a circuit for the encoder using basic logic gates

(b) Op amps shown in the diagram acts as a summing amplifier. It can add input values V_1,V_2. This also acts a DAC

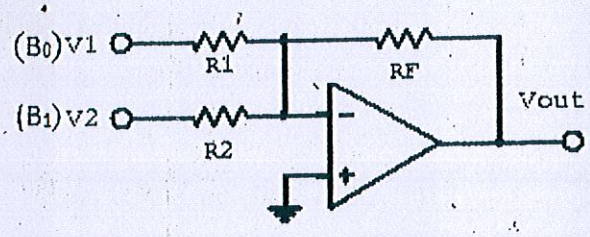


Figure 3

(i) Obtain an expression for V_{out} in terms of data given in the diagram

(ii) Rewrite the expression for V_{out} taking $R_1=R_2=R_F=R$

(c) Analogue audio signal produced by a microphone is shown in the figure 4.

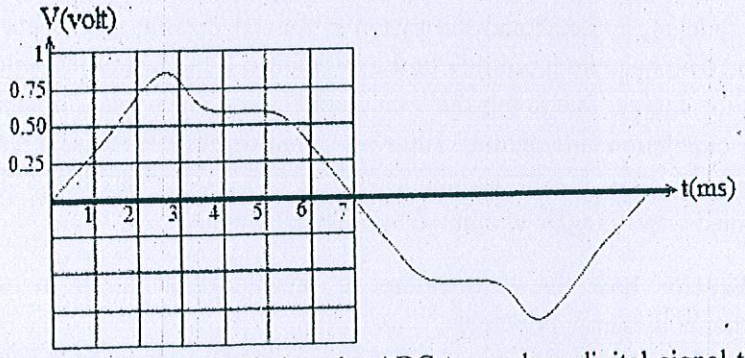


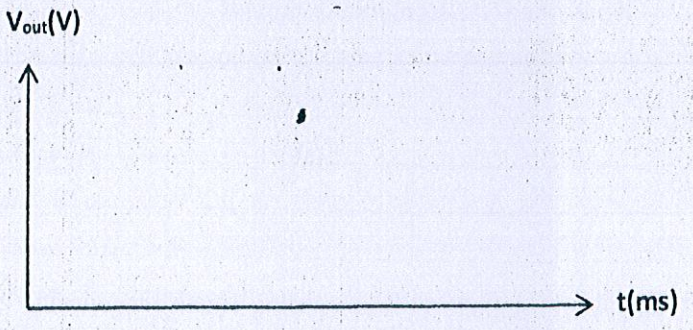
Figure 4

This analogue signal is applied to the ADC to produce digital signal then to a computer for processing. After that it is again applied to the DAC

(i) Copy the table given on to your answer script and fill it giving ADC outputs and DAC output for input voltages at given time intervals. Take $R_F=R$, $R_1=20R$, $R_2=10R$, Digital signal reference voltage is 5 V.

Time(ms)	ADC outputs		DAC output(v)
	B_1	B_0	
0			
1			
2			
3			
4			
5			
6			
7			

(ii) Reproduce the output signal generated by the DAC using the above table.



(d) Why is it useful to digitalize an analogue signal before it is being transmitted and processed by a computer?

10) **Answer only for A or B part.**

(A) (i) Define the thermal conductivity.

(ii) The operation of a petrol ensine is described below.

The engine consists of several cyinders. Some air is trapped inside them by pistons. The air is suddeuly compressed by lifting the pistons and the temperature is raised to the ignition point of the petrol. Then the petrol vapour is injeeted in to the cylinder and allow for self combustion. Due to this the air quickely expands and the piston is moved downand. The burned air is removed from the cylinder. The heat produced due to the combition leaks from the cylinder and it is absorbed by the wall of the engine. Due to this the temperature at the inner side of the engine wall rises to 180° C. By a water circulation through the ensin wall its temperature is reduced back to 80° C.The water leaving the engine at 80° C is sent through a radiator and the temperature is further reduced to 30° C. Now this cooled water is again circulated through the ensine.

(a) Explain how the temperature is raised when is air is suddenly compressed, using thermodynamic principles.

(b) Find the rate of heat flow through the walls of ensine using following data.

The effective area of the wall $= 6.25 \times 10^{-2} m^2$

Thickness of the wall $= 0.5$ cm

Thermal conductivity $= 2 W m^{-1} k^{-1}$

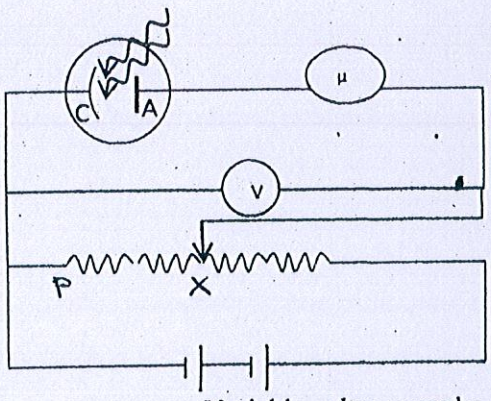
(c) Find the rate of water circulation through the engine to maintain the inner wall temperature at 80°C. The specific heat capacity of water is $4000 J kg^{-1} k^{-1}$

(d) The temperature surrounding the radiator is maintained at 20° C by operating a cooling fan. What should be the minimum surface area of the radiator to maintain the temperature of water at 30° C in the radiator.

The emisiving of the radiator surface is $0.8 W m^{-2} k^{-1}$

(e) Due to the decrease of the fan speed surronnding temperature rises to 30° C. Explain how does it effects the engine operation.

(B) When high frequency radiation is incident on a metal surface, electrons are emitted from the surface. To demonstrate this effect following experimental set up is used.



Variable voltage supply

C and A are cathode and anode respectively made of well polized group 1 metal such as potacius (K) and cecium (Cs). Electrodes are inside vaccunmed glass bulb and they are connected to an external circuit as shown in the diagram. When the tube is in a dark room, the reading of the microameter is zero. When high frequency monochromatic radiation beam is incident on the cathode, the ammeter shows a reading.

(a) What is the name of the effect discussed from the passage?
(b) If the frequency of the radiation is below a certain critical value, electrons are not emitted from the cathode whatever high intensity beam is incident on it. What is this frequency called?
(c) Radiation of high frequency is incident on the cathcd. Sketch the variation of ammeter reading with the potential at X with respect to P. Consider both positive and negative potential at X.
(d) Sketch the variation of ammeter reading with the potential at X on same anis for three enperiments which used light intensities I, 2I and 3I at same frequency.
(e) What is meant by a work function of a metal?
(f) Write down the Eienstine equation which explains the effect discussed in the passage and define the terms.
(g)
  (i) Obtain an expression for the stopping potential using the equation mentioned in part (f)
  (ii) Sketch the variation stopping potential with the frequency
  (iii) How do you find the plank constant and the work function using the graph.

(h) Work function of the sodium metal is 2.3 ev.
  (i) Find the threshold frequency for sodium.
  (ii) Sodium metal is illuminated from radiations of wave length 4.5×10^{-7}m. Find the maximum velocity of electrons emmited from the metal.
  (iii) Find the stopping potential for above mentioned wave length.

  Plank constant (h) $= 6.6 \times 10^{-34}$Js
  Speed of light (c) $= 3 \times 10^{8}$ ms^{-1}
  Mass of an electron (m) $= 9.1 \times 10^{-31}$Js
  lev $= 1.6 \times 10^{-19}$J

Grade-13 July-2016
A - භ්‍රමණ ගතිය

Nimali

Gr. 13 July 2016

(1) (i) $L = I\omega$

$= 4.1 \times 2.7$

$L = 11.07\ kgm^2s^{-1}$ —— (01)

(ii) කෝණික ගම්‍යතාව යනු සලකන අක්ෂය වටා කෝණික ප්‍රවේගයේත්, අවස්ථිති ඝූර්ණයේත් ගුණිතයයි. $(L = I\omega)$ —— (01)

කෝණික ගම්‍යතාව යනු සලකන අක්ෂය වටා රේඛීය ගම්‍යතාවයේ ඝූර්ණය ලෙස. —— (01)

(iii) කෝ: ගම්‍ය: සංස්: නියමයෙන් $I_1\omega_1 = I_2\omega_2$

$11.07 = (4.1 + 2.5 \times 0.6 \times 0.6)\omega_2$

$11.07 = 5\omega_2$

$\omega_2 = 2.21\ rad\ s^{-1}$ —— (01)

(b) කෝණික ගම්‍යතා සංස්ථිති නියමය — භ්‍රමණ චලිතයක යෙදෙන වස්තුවක් හෝ වස්තු පද්ධතියක් මත බාහිර ව්‍යාවර්තයක් ක්‍රියා නොකරන්නේ නම්, එම අචල දිශාවක් ඔස්සේ ඇති වස්තුවේ හෝ වස්තු පද්ධතියේ මුළු කෝණික ගම්‍යතාව නොවෙනස්ව පවතී. —— (01)

(c) කෝණික ප්‍රවේගය ω වැඩිවේ.

හේතුව — මෙහිදී r අඩුවන නිසා $I = \Sigma mr^2$ බැවින් I අඩුවේ. L නියතව තබා ගැනීමට ω ↑ වේ. (01)

(d) $2.21\ rad\ s^{-1}$ —— (01)

(iv) (a) $\omega = \omega_0 + \alpha t$ මගින්

$\alpha = \frac{\omega - \omega_0}{t}$

$= \frac{0 - 1.5}{0.75}$

$= -2\ rad\ s^{-2}$ —— (01)

(b) $\tau = I\alpha$ —— (01)

$= 4.5 \times (-2)$

$= -9\ Nm$ —— (01)

10

(2) වාත කඳ කම්පනය වී ඊට හඬක් ජනනය ලබා දීම (01)
සඳහා

(b) කන් ප්‍රස්ථාරත් සමාන්තර ඇති නිසා උපරිම ප්‍රචලනයක්
(01) ලබා දෙන ලෙසක් අනුනාද අවස්ථාව හඳුනා ගැනීම පහසුය.

(c) සෙවූ දෙක අතර පරතරය අවම අගයක නිසා පරිපූර්ණ
කම්පනය කර එවක ලෙසයි. එය නොවේ. ආසන්නව
(01) එකු අතර කම්පනය වන ඇති කෙවැක්ප ආරම්භයේ
ඉහල පිහිටා උරුල සෙල වෙලා පිටු මාරු කරමා

(d) $\lambda = 40cm$ (01)

$v = n\lambda$

$\sqrt{\frac{T}{m}} = 500 \times 40 \times 10^{-2}$ (01)

$\frac{20}{m} = 200 \times 200$

$m = \underline{\underline{5 \times 10^{-4}}} \ kg\,m^{-1}$ (01) (with units).

(e) $T' = mg - u$

$= 20 - 12 \times 10^{-4} \times \rho \times 10$ ——— (01)

$= 20 - 12 \times 10^{-3} \rho$

$v = n\lambda$

$\sqrt{\frac{T'}{m}} = 500 \times 30 \times 10^{-2}$

$\frac{T'}{m} = 150 \times 150$

$20 - 12 \times 10^{-3} \rho = 225 \times 10^{2} \times 5 \times 10^{-4}$

$\rho = \underline{\underline{729.16}} \ kg\,m^{-3}$ (01)

$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$ (01)

(f) කම්පන සංඛ්‍යාතය f නම්: $f = \frac{1}{2 \times 80 \times 10^{-2}} \sqrt{\frac{20}{5 \times 10^{-4}}}$

$= \frac{10}{16} \times 2 \times 100$

$= 125 \ Hz$

නුගැසුම් ගණන $= 130 - 125 = \underline{\underline{5}}$ (01)

3) (a) A – උෂ්ණත්වමානය
B – දිය බඳුන
C – සිහින් ඒකාකාර නලය
D – රසදිය
} (01)

(b) වියළි වාතයේ පීඩනය = $P_0 - P_1$ (01)
උපකල්පනය – දිය බඳුනේ වෙනත් පීඩනයක් ඇති නොවේ. (01)

(c) වාතය සමග දිය බඳුන ගැටී පවතිමින්. (01)

(d) ඒකාකාර – $V \propto l$ වීමට (01)
කුඩා හරස්කඩ – සංවේදීතාව වැඩි වීමට (01)
(දිය බඳුන රඳවා තබා ගැනීමට).

(e) වායුවට $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ යෙදුවිට

$$\frac{(760-32)40.4}{(273+30)} = \frac{(760-P_0')44.1}{(273+42)}$$ (01)

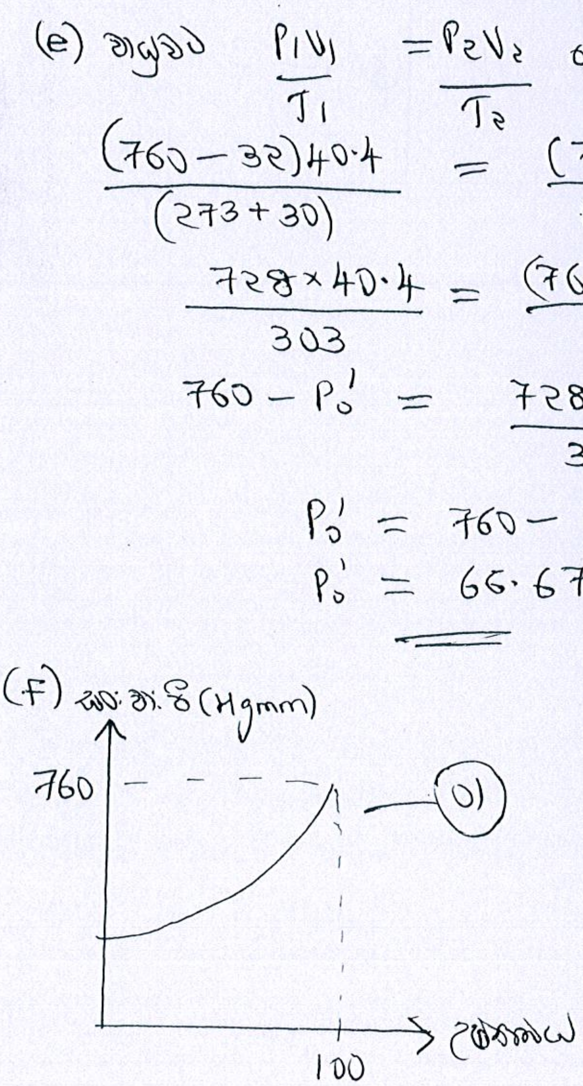
$$\frac{728 \times 40.4}{303} = \frac{(760-P_0') \times 44.1}{315}$$

$$760 - P_0' = \frac{728 \times 315 \times 404}{303 \times 441} = 693.33$$

$$P_0' = 760 - 693.33$$

$$P_0' = 66.67 \text{ Hgmm}$$ (65 – 69) අතර (01)

(f)



(01)

(g) අදාල උෂ්ණත්වයට වඩා 1°, 2° පමණ වැඩි කාලයේ උෂ්ණත්වය ඇති විට පාඨාංක ලබා ගෙන මධ්‍යනය කිරීම. (01)

OR

අදාල උෂ්ණත්වයට වඩා 1°, 2° පමණ වැඩි කාලයේ උෂ්ණත්වය වැඩිවන සෙම් රත් කර දාරකය ක්‍රියාත් කර ගෙන

MCQ — 2016

(1) – 4	(11) – 1	(21) – 1	(31) – 3	(41) – 5
(2) – 5	(12) – 5	(22) – 4	(32) – 4	(42) – 4
(3) – 2	(13) – 1	(23) – 2	(33) – 4	(43) – 2
(4) – 5	(14) – 2	(24) – 3	(34) – 1	(44) – 3
(5) – 2	(15) – 4	(25) – 3	(35) – 3	(45) – 4
(6) – 1	(16) – 2	(26) – 2	(36) – 5	(46) – 3
(7) – 1	(17) – 3	(27) – 3	(37) – 1	(47) – 2
(8) – 3	(18) – 4	(28) – 1	(38) – 4	(48) – 2
(9) – 911	(19) – 4	(29) – 4	(39) – 2	(49) – 2
(10) – 3	(20) – 3	(30) – 1	(40) – 911	(50) – 3

(4)

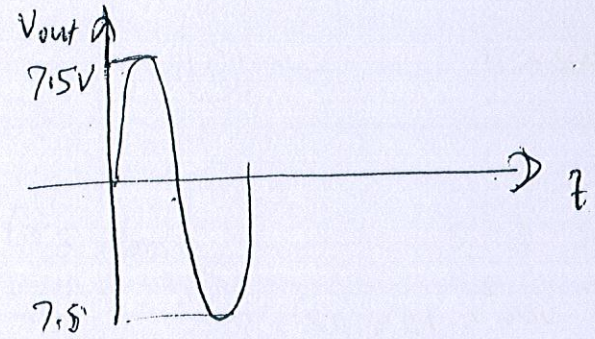
$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

(a) $\frac{V_0}{V_i} = \frac{100}{50}$

$\frac{5}{V_i} = \frac{\cancel{100}^{2}}{\cancel{50}}$

$V_i = 2.5V$ —— (01)

(b)



—— (01)

$\frac{V_0}{2.5} = \frac{150}{50}$

$V_0 = 2.5 \times 3$

$V_0 = 7.5V$

(c) ට්‍රාන්ස්ෆෝමරය ක්‍රියාත්මක වන්නේ ප්‍රේරිත ~~[illegible]~~ ව.ගා.බ.ක්
ඇති වීම. ඒ සඳහා වෙනස් වන චු. ස්‍රාවයක්
අවශ්‍ය වෙයි. සරල ධාරාවක්
වෙනස් නොවන චු. ස්‍රා. ක් ඇති කරයි —— (01)

(d) ලෙන්ස් නියමය අනුව ප්‍රේරිත ව.ගා.බ.
හට ගන්නේ එය ඇති වීමට හේතු වූ කාරණය
විරුද්ධ වන ~~[illegible]~~ දිශාවට ය. —— (01)

(i) සුළිධාරා හානි - ද්වීතීයික ...
... ලෝහ ... ~~[illegible]~~ ...
... ට්‍රාන්ස්ෆෝමරය ක්‍රියාත්මක
... සුළිධාරා ... —— (01)

(ii) ජූල් තාපනය —— ජූල් තාපනය ...
ද්වීතීයික ...
...
... —— (01)

(e) (i) ~~V = IR~~

~~200 = I x~~

(f) (i) $P = VI$

$120 \times 10^3 = 240 \times I$ — (01)

$I = 500\ A$

ශක්ති හානිය $= I^2 R$

$= 500^2 \times 10 \times 10^2 \times 2$ (කම්බි 2ක් නිසා.)

$=$ ~~$20 \times 10^3\ W$~~ $= 100\ KW$ — (01)

(ii) $120 \times 10^3 = 24{,}000\ I$

$I = 5\ A$

ශක්ති හානිය $= 5^2 \times 10 \times 10^2 \times 2$ — (01)

$= 10\ W$

$= 0.01\ KW$

(iii) ~~99 KW~~ — (01)

99.99 KW

(5) (a) (i) l දිගක් ඔත ඇණවන බලය $= \frac{0+H\rho g}{2}.H.l$

$= \frac{H}{2}\rho g.H.l.$

එකක දිගක් ඔත ඇණවන බලය $P = \frac{H/2\rho g.H.l.}{l.}$ —(01)

$P = \frac{H^2}{2}\omega.\ (\omega = \rho g)$

(ii) P හි අගය $= \frac{H^2\omega}{2}$

$= \frac{16^2\times 10\times 10^3}{2}\ m^2\times kgm^{-1}s^{-2}\times m^{-1}$

$= 1280\ kNm^{-1}$ —(01)

(iii) එකක දිගක බර $W = 24\times\left[30\times\left(\frac{3+8}{2}\right)\right]\ kNm^{-3}\times m^2$ —(01)

$= \frac{24\times 30\times 11}{2}$

$= 3,960\ kNm^{-1}$ —(01)

(iv) සම්පුක්ත බලය $R = \sqrt{1280^2+3960^2}$

$= 4161.73\ kNm^{-1}$ —(01)

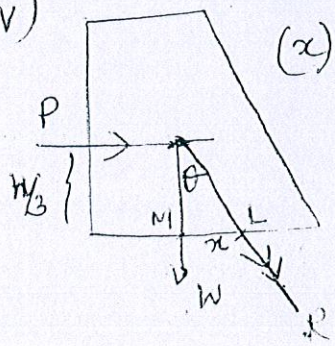
සිරස සමඟ සාදන $\angle\theta$ නම්,

$\tan\theta = P/W = \frac{1280}{3960}$

$= 0.3232$

$\theta = 17^\circ 54'$ —(01)

(v)



(x) LM ගැ සෙවීමට L වටා සූත්‍රය ගැනීම

$R.O = P\times\frac{H}{3} = W.x$ —(01)

$x = \frac{P}{W}.\frac{H}{3}$

$= 0.3232\times\frac{16}{3}$

$= 1.724\ m$ —(01)

(b) (i) ඉහළ ගිය ජලයේ උස $= 1194 - 1190 = 4m$

ඉහළ ගිය ජල පරිමාව $= 4 \times 24 \times 10^4$

$= 96 \times 10^4 m^3$

අවම ක්‍රියාත්මක ජල පරිමාව $= 176 \times 10^4 m^3 - 96 \times 10^4 m^3$

$= 80 \times 10^4 m^3$ — (01)

(ii) වාං දොරටුවක වර්ගඵලය $= 10 \times 9 = 90 m^2$

වාං දොරටු පහක වර්ගඵලය $= 90 \times 5 = 450 m^2$ — (01)

ජලය පිටවන වේගය $= \frac{3000 \, m^3 s^{-1}}{450 \, m^2}$

$= 6.67 \, ms^{-1}$ — (01)

(C) (i) ශීතකරණය මත උඩුකුරු තෙරපුම = ශීතකරණයේ බර

(ප්‍රතික්‍රියාව $R = 0$ නිසා)

එවිට $(~~0.75~~ \; 0.6 \times 0.8 \times h)1000g = 150g$ — (01)

ගිලෙන විට ජල මට්ටම. $h =$ ~~1.07 m~~ $= 0.3125 m$. — (01)

(ii) බෝට්ටුවක පරිමාව $= 2.4 \times 1 \times 0.75 = 1.8 m^3$

බෝට්ටුවේ සමතුලිතතාව සඳහා,

$1.8 \times 1000g = (1260 + 60 \times n)g$.

$n = \frac{540}{60}$

$= \underline{\underline{9}}$ — (01)

(iii) ජලය (ගංවතුර) ඒකාකාර ඝනත්වයෙන් යුතු බව.

ගංවතුර නිශ්චල බව. — (01)

Essay

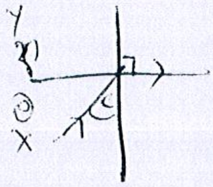
6 (a) වෙදුළු තරංග සහ
පතිවෙදන තරංගවලදී (01)

(b) පූර්ණ අභ්‍යන්තර පරාවර්තනය
අවශ්‍යතා:- ආලෝකය ගහන මාධ්‍යයක සිට විරල මාධ්‍යයට ගමන් කළ යුතුය. (01)
පතන කෝණය එම අතුරු මුහුණත සඳහා වන අවධි කෝණයට වඩා විශාල විය යුතුය.

(c) වාතය අපවර්තනය වලදී ($n_{green} > n_{blue}$ ∴ $V_{blue} > V_{green}$)
අපවර්තනය වර්ණ අනුපාතය, නිල් වර්ණ අනුපාතයට වඩා අඩු බැවින් (01)

(d) මැදය – X අපවර්තනය – Y

$$x n_y = \frac{\sin c}{\sin 90} \quad ; \quad \frac{n_y}{n_x} = \sin c$$



$$\sin c = \frac{1.4}{1.6} = 0.875 \Rightarrow c = 61^\circ 2'$$ (01)

(e) රතු හා නිල් වර්ණ සඳහා ප්‍රවේග පිළිවෙලින් V_R හා V_B ලෙස ගනිමු.

$$n_R = n_R = \frac{V_a}{V_R}$$

$$V_R = \frac{3\times10^8}{1.5} \quad හා \quad V_B = \frac{3\times10^8}{1.53}$$ (01)

ගමන් කාලාන්තරය T නම්;

$$V = \frac{S}{t} \qquad t = \frac{S}{V} \qquad n = \frac{c}{V}$$

$$T = \frac{4000\times1.53}{3\times10^8} - \frac{4000\times1.5}{3\times10^8}$$

$$= \frac{4000}{3\times10^8} \times 0.03$$

$$T = 4\times10^{-7}\,s$$ (01)

(f) (i) $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$ (01) $\frac{1}{F} = \frac{1}{-6} + \frac{1}{-6} = \frac{-2}{6} = -\frac{1}{3}$

$F = 3\,cm$ $F = -3\,cm$

∴ $F_o = 3\,cm$

$F_e = 4\,cm$ (01)

(ii) උපරිමය; $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ යෙදීමෙන්
eyepiece.

(01) $\frac{1}{25} - \frac{1}{u} = -\frac{1}{4}$ $u = 3.4\,cm$ (01)

$\frac{1}{u} = \frac{1}{25} + \frac{1}{4}$

$\frac{1}{u} = \frac{29}{100}$

$u = 100/29 = 3.4\,cm$

$m_e = \frac{25 \times 29}{100} = 25$ $m_e = \frac{25}{100/29} = \frac{25 \times 29}{100}$

(iii) උපනෙත් රේඛීය විශාලනය $= \frac{25}{100} \times 29$ (01) $\frac{D}{f_e}$

$m = m_e \times m_o$

∴ අවනෙත් " " $m_o = \frac{10}{29/4} = \underline{1.38}$ (01)

(iv) අවසාන ප්‍රතිබිම්බය ඇසට වම 40cm 38ට හමුවන ලක්ෂ්‍ය.

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

$\frac{1}{40} - \frac{1}{u} = \frac{-1}{4} \Rightarrow \frac{1}{u} = \frac{1}{40} + \frac{1}{4} = \frac{11}{40}$ (01)

$u = 40/11$

$u = 3.64m$

~~අවනෙට ඇති ප්‍රතිබිම්බය දුර v නම්;~~

අවනෙට $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ යෙදීමෙන්;

$\frac{1}{v} - \frac{29}{100} = \frac{-1}{3}$

$\frac{1}{v} = \frac{29}{100} - \frac{1}{3} = \frac{87 - 100}{300}$ (01)

$V = -300/22$

නවම නාල දිග ඇත $= \frac{300}{22} + \frac{40}{11}$

$= \underline{17.4cm}$ (01)

OR

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

ල.ස $V \to -, u \to +, f \to -$

$\frac{1}{-v} - \frac{1}{+u} = \frac{1}{-f_o}$

$\times V \Rightarrow 1 + \frac{V}{u} = \frac{V}{f_o}$

$1 + m_o = V/f_o$

$1 + \frac{40}{29} = \frac{v}{3}$

$\frac{69}{29} \times 3 = V$ (01)

$V = 7.14cm$

∴ නාල ද දුර වෙනස $= 7.14 + 3.64$

$= \underline{10.78cm}$ (01)

$10 = m_o \times m_e \Rightarrow 10 = m_o \times \frac{40}{40/11} = 11m_o$

$m_o = 10/11$

අවනෙට $1/v - 1/u = 1/f$ ල.ස $V \to -, u \to +, f \to -$

$\frac{1}{-v} - \frac{1}{u} = \frac{1}{-f_o} \Rightarrow \times v \quad 1 + \frac{V}{u} = V/f_o$

$1 + \frac{10}{11} = \frac{V}{3} \Rightarrow V = \frac{21}{11} \times 3$

$V = \frac{63}{11} = 5.73cm$

∴ නාල 2 දුර වෙනස $= \frac{63}{11} + \frac{40}{11}$

$= \frac{103}{11} = \underline{9.36cm}$

(1)

I (a) සමානකම - සර්ෂණ බලයත් දුස්ස්‍රාවී බලයත් චලිතය විරුද්ධව ක්‍රියා කරයි. (01)

සර්ෂණ බලය සාපේක්ෂ චලිතයේ යෙදෙන වස්තු 2 ක් අතර ක්‍රියා කරන අතර දුස්ස්‍රාවී බලය සාපේක්ෂ චලිතයේ යෙදෙන ද්‍රව ස්තර 2 ක් අතර ක්‍රියා කරයි

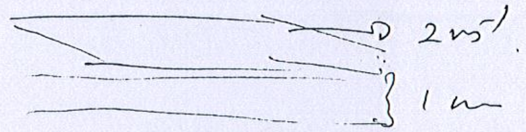
අසමානතා සර්ෂණ බලය ස්පර්ශ අතර වර්ගඵලය මත රඳා නොපවතී.

දුස්ස්‍රාවී බලය ස්පර්ශ අතර වර්ගඵලය මත රඳා පවතී (01)

• සාපේක්ෂ චලිතයක් නොමැති විට සර්ෂණ බලය ක්‍රියා කළ හැකි නමුත් දුස්ස්‍රාවී බලය සඳහා සාපේක්ෂ චලිතයක් අවශ්‍යයි.

(b) $\sigma = F/A = \frac{\eta v}{x}$

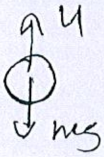
$[\eta] = \left[\frac{F x}{A v}\right] = \frac{MLT^{-2} \times L}{L^2 \times LT^{-1}} = ML^{-1}T^{-1}$ — (01)

(c) 

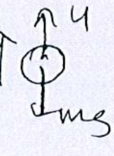
$F = \eta A \frac{\delta v}{\delta x}$

$= 10^{-3} \times \frac{10 \times (2-0)}{1}$ — (01)

$= 2 \times 10^{-2}$ N — (01)

II (a) (i) 

— (01)

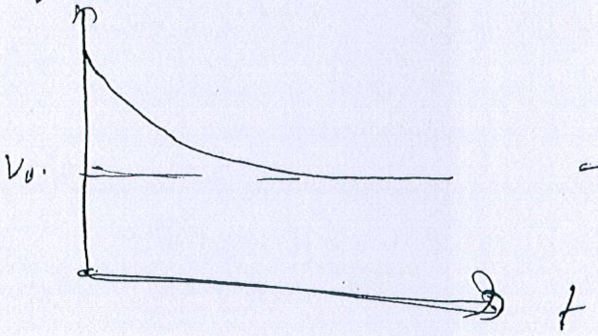
(ii) 

— (01)

(b) $F + U = mg$ — (01)

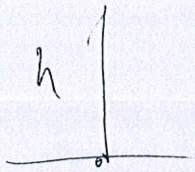
(c)(i) ගෝලයේ ආරම්භක ප්‍රවේගයේ ප්‍රවේගය , ආන්ත
ප්‍රවේගයට වඩා වැඩි නිසා බලය වැඩි — 01
ඉහළට දුස්ස්‍රාවී බල ක්‍රියා කරයි
∴ බලය මන්දනයකට ලක් වී ආන්ත ප්‍රවේගය
ලබා ගනී. ඉන්පසු නියත එම ප්‍රවේගයෙන් ගමන් — 01
කරයි

(ii)



— 01

(d)



(i) $v^2 = 2gh$

$v = \sqrt{2gh}$ — 01

(ii) $v_0 = \frac{2}{9}\frac{a^2(\sigma-\rho)g}{\eta}$

$= \frac{2}{9} \times \frac{(10^{-4})^2(10^4-10^3)}{9.8\times10^{-6}} \times 10$ — 01

$= \frac{2}{9} \times 10^{-8} \times \frac{10^3[10-1]}{9.8\times10^{-6}} \times 10 = 0.2041\times10^2$

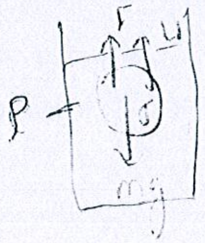
$v_0 = 20.41\ ms^{-1}$ — 01

(iii) $20.41 = \sqrt{2gh}$

$(20.41)^2 = 20 \times h$ — 01

$h = 20.83m$

(ii)



$F + U = mg$

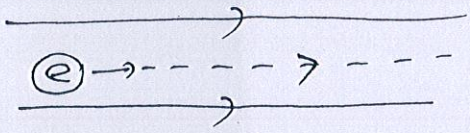
$6\pi a\eta v_0 + \frac{4}{3}\pi a^3\rho g = \frac{4}{3}\pi a^3\sigma g$

$6\pi a\eta v_0 = \frac{4}{3}\pi a^3 g(\sigma-\rho)$

$v_0 = \frac{4}{3}\frac{a^3 g(\sigma-\rho)}{6a\eta}$

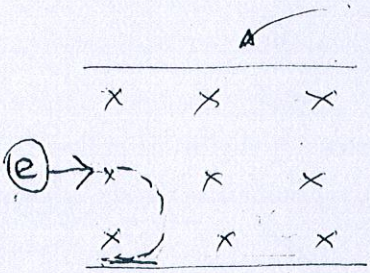
$v_0 = \frac{2a^2(\sigma-\rho)g}{9\eta}$

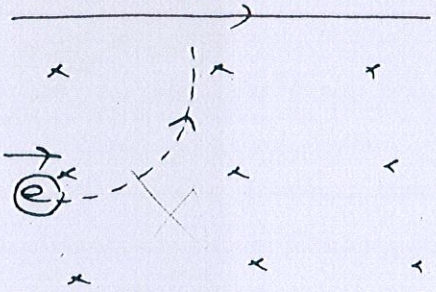
(08) (a) I (අ)



— (01)

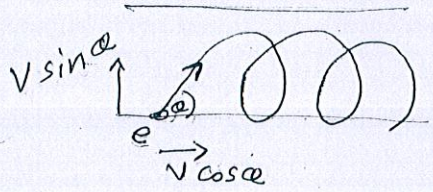
(ආ)

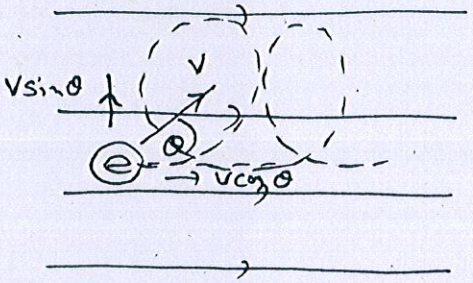




— (01)

(ඇ)





— (01)

II

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

$\frac{1}{2} \times 9\times10^{-31} \times V^2 = 1.6\times10^{-19} \times 2000$ — (01)

$V^2 = \frac{16\times4\times10^{14}}{9} \Rightarrow V = \frac{8\times2\times10^7}{3}$

$V = 26.67\times10^6\ ms^{-1}$ // — (01)

III (අ) $V = s/t$

ගමන්කරන දුර $= 26.67\times10^6 \times 1\times10^{-9}$

$= 26.67\times10^{-3}\ m$ // — (01)

(ආ)

$Bqv = \frac{mv^2}{r}$

$r = \frac{mv}{Bq}$

$r = \frac{9\times10^{-31} \times 26.67\times10^6}{1\times10^{-4} \times 1.6\times10^{-19}}$ — (01)

$r = 150.02\times10^{-2}\ m$

$r = 1.50\ m$ — (01)

එක් වටයකට කරන ලද T ය

$$T = \frac{2\pi}{\omega}$$

$$T = \frac{2\pi r}{V}$$

$$T = \frac{2 \times 3.14 \times 1.5}{26.67 \times 10^{6}}$$

$$T = 3.53 \times 10^{-7}\ s \quad \text{---} (01)$$

$$T = \frac{2 \times 3 \times 1.5 \times 10^{-9}}{26.67 \times 10^{6}}$$

$$T = 0.337 \times 10^{-15}$$

$$T = 3.37 \times 10^{-16}\ s \quad \text{---} (01)$$

(ii) $Bqv\sin 30^\circ = \frac{m(v\sin 30^\circ)^2}{r}$

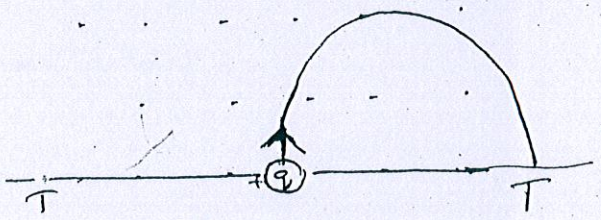
$$r = \frac{m \times v \times \frac{1}{2}}{Bq}$$

$$r = \frac{9 \times 10^{-31} \times 26.67 \times 10^{6}}{2 \times 1 \times 10^{-4} \times 1.6 \times 10^{-19}} \quad \text{---} (01)$$

$$r = 75.0 \times 10^{-2}\ m$$

(b) I චාප මුවිකාවරණ. — (01)

II . . . . . .



— (01)

III $\frac{1}{2}mu^2 = qV$

$$u = \sqrt{\frac{2qV}{m}} \quad \text{---} (01)$$

IV T චලිතය කඩිවට

$F = ma.$

$Bqu = \frac{mu^2}{r}$ $(r = Y/2)$

$Bqu = m\frac{u^2}{Y} \times 2$

$Y = \frac{2mu}{Bq}$ — (01)

V

$$m = \frac{BqY}{2u}$$

$$m = \frac{BqY}{2}\sqrt{\frac{m}{2qV}}$$

$$m^2 = \frac{B^2q^2y^2m}{8qV}$$

$$m = \frac{(1\times10^{-4})^2 \times (1.602\times10^{-19})^2 \times (1.625)^2}{8\times(1.6022\times10^{-19})\times 1\times10^{-3}}$$

$$m = 0.53 \times 10^{-30}\ kg \quad \text{——} (01)$$

$$m = \frac{BqY}{2u} = \frac{BqY}{2}\sqrt{\frac{m}{2qV}}$$

$$m^2 = \frac{B^2q^2y^2m}{8qV} \Rightarrow m = \frac{B^2qY^2}{8V}$$

$$m = \frac{(8\times10^{-4})^2 \times 1.6022\times10^{-19} \times (1.6254)^2}{8\times1\times10^{-3}}$$

$$m = \frac{8\times8\times10^{-8}\times1.6022\times10^{-19}\times(1.6254)^2}{8\times10^{-3}}$$

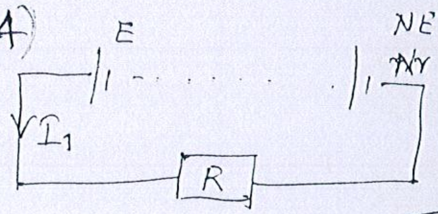
$$m = 8\times1.6022\times(1.6254)^2\times10^{-14}$$

$$m = 33.56\times10^{-14}$$

$$m = 3.39\times10^{-13}\ kg \quad \text{——} (01)$$

a) (9) (A)

i)

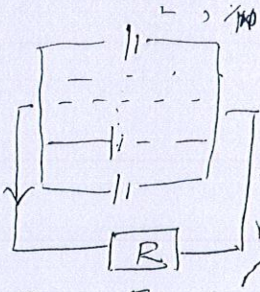


කෝෂයේ E

$E_w = NE$

$r_w = Nr$

$$I_1 = \frac{NE}{Nr+R} = \frac{NE}{Nr+r} = \frac{NE}{r[N+1]}$$ — 01



$E_w = E$

$\frac{1}{r_w} = \frac{N}{r}$

$r_w = \frac{r}{N}$ — 01

$$I_2 = \frac{E}{R + r/N} = \frac{E}{r + r/N} = \frac{NE}{r[N+1]}$$

$$I_1 = I_2 = \frac{NE}{r(N+1)}$$

ii) ශ්‍රේණිගත අවස්ථාවේ උපරිම ශක්ති සම්ප්‍රේෂණය සඳහා $R = Nr$

සමාන්තරගත අවස්ථාවේ $R = r/N$

දෙකම සමාන වේ නම් — 01

උපරිම ශක්තිය [illegible]

iii) කෝෂ සැදීමේදී අභ්‍යන්තර ප්‍රතිරෝධය $= 0.6\Omega$

∴ ශ්‍රේණිගත බල්බ $(2\Omega \times 3\Omega)$ 3 ක් අවශ්‍ය වේ. — 01

b) i) A අග්‍රය + වේ. — 01

ii) $24 - 12 = 4(R_c + .6 + 1)$ — 01

$3\cancel{12} = \cancel{4}(R_c + 1.6)$

$R_c = 3 - 1.6$

$R_c = 1.4\Omega$ — 01

iii) කෝෂය ආරෝපණය වේ.

$E = V - Ir$ — 01

$12 = V_1 - 4 \times 0.6$

$V_1 = 12 + 2.4 = 14.4V$ — 01

* ප්‍රභවයට

$24 = V_2 + 4 \times 1$ — 01

$V_2 = 24 - 4$

$V_2 = 20V$ — 01

* විකල්ප

$V_R = IR$

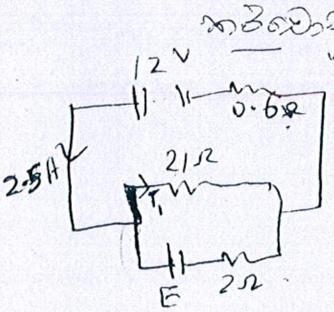
$= 4 \times 1.4$

$= 5.6V$

$V_2 = 14.4 + 5.6$

$= 20.0V$

(ආ) 21Ω හරහා ධාරාව I_1 නම්.



කර්චොෆ්

$$12 = 2.5 \times 0.6 + 21 I_1 \quad \text{—— 01}$$

$$21 I_1 = 12 - 1.50 = 10.5$$

$$I_1 = \frac{10.5}{21} = 0.5\,A$$

2Ω හරහා ධාරාව $= 2.5 - 0.5$

$$= 2A \quad \text{—— 01}$$

ii)

කර්චොෆ්

$$12 - E = 2.5 \times 0.6 + 2 \times 2 \quad \text{~~01~~}$$

$$V = E + I_c R_c + I_r r$$

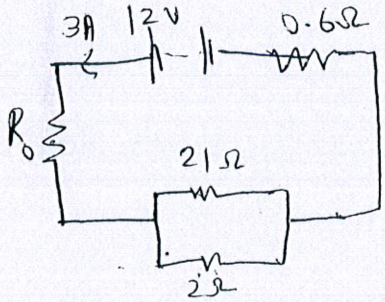
$$12 = E + (2 \times 2) + (2.5 \times 6)$$

$$12 - E = 1.5 + 4$$

$$E = 12 - 5.5$$

$$= 6.5\,V \quad \text{—— 01}$$

iii)



කර්චොෆ්

$$\frac{1}{21} + \frac{1}{2} = \frac{1}{R_w} = \frac{23}{21 \times 2}$$

$$R_w = \frac{21 \times 2}{23}$$

~~12~~ $4 = 3\left(R_0 + \frac{21 \times 2}{23} + 0.6\right)$

~~$R_0 = 4 - \frac{42 + 0.6}{23} = \frac{92 - 42}{23} = \frac{50}{23}$~~

~~$R_0 = 2.17\,\Omega$ —— 01~~

$$R = \frac{V}{I} = \frac{12V}{3A}$$

$$R_{eq} = 4\Omega$$

$$4 = R_0 + \frac{42 + 13.8}{23}$$

$$R_0 = 4 - \frac{55.8}{23} = \frac{92 - 55.8}{23} = \frac{36.2}{23}$$

$$R_0 = 1.574\,\Omega \quad \text{—— 01}$$

Q8

(a)

(i)

	C_1	C_2	C_3	B_1	B_C
$0 \le V \le 0.25$	0	0	0	0	0
$0.25 < V \le 0.5$	0	0	1	0	1
$0.5 < V \le 0.75$	0	1	0	1	0
$0.75 < V \le 1$	1	1	1	1	1

If all correct → 02

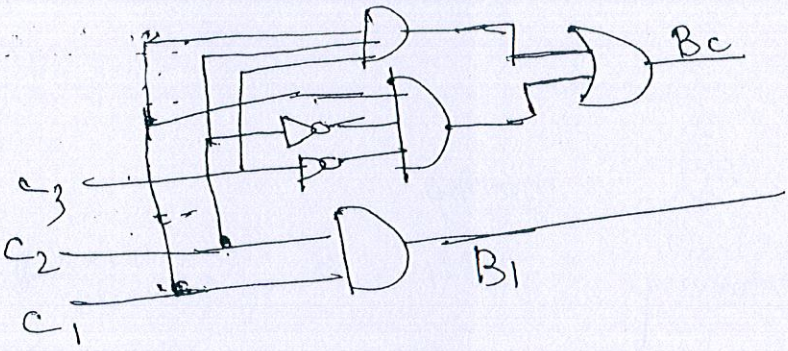
If two correct → 01

(ii)

$$B_0 = C_1\bar{C}_2\bar{C}_3 + C_1C_2C_3$$

$$= C_1(\bar{C}_2\bar{C}_3 + C_2C_3) \longrightarrow 01$$

$$B_1 = C_1C_2 \longrightarrow 01$$



→ 01 → 01 → 01

(b)

(i) $i_1 + i_2 = i_f$

$$\frac{V_1}{R_1} + \frac{V_2}{R_2} = \frac{0 - V_{out}}{R_f}$$

$$V_{out} = -R_f\left(\frac{V_1}{R_1} + \frac{V_2}{R_2}\right) \longrightarrow 01$$

$$V_{out} = -(V_1 + V_2) \longrightarrow 01$$

(ii) $V_{out} =$

(c) (i) $V_{out} = -R\left(\frac{V_1}{20R} + \frac{V_2}{10R}\right)$ ⟶ (01)

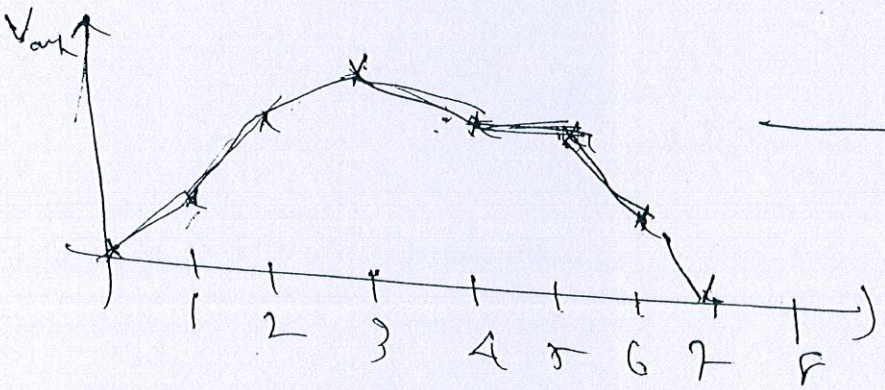
$= -\left(\frac{V_1}{20} + \frac{V_2}{10}\right)$

Time	A to C B_1 B_0		Ans (V)
0	0	0	0
1	0	1	−0.25
2	1	0	−0.50 V
3	1	1	−0.75
4	1	0	−0.50
5	1	0	−0.50
6	0	1	−0.25
7	0	0	0

If all correct ⟶ (02)

If ± or above ⟶ (01)

(ii)



⟶ (02)

(d) 1. computers can process only digital signals

2. Noise signals (disturbance) do not affect the original signal

Any correct reason ⟶ (01)

15

10 A

(i) ...

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

$0 = \Delta U + \Delta W$ (01) ... $\Delta Q = 0$

$\Delta U = (-)\Delta W$ (01) ... ΔW (−) ... $\Delta U > 0$

$\Delta U > 0$ (01)

II $\frac{dQ}{dt} = KA\frac{d\theta}{dx}$ — (01)

$= 2 \times 6.25 \times 10^{-2} \left[\frac{180 - 80}{0.5 \times 10^{-2}}\right]$ (01)

$= 2500\,W$ — (01)

III $\frac{dQ}{dt} = mc\frac{d\theta}{dt}$ — (01)

$2500 = \frac{m}{dt} \times 4 \times 10^{3} \times [80 - 30]$ (01)

$\frac{m}{dt} = \frac{1}{8 \times 10^{2}} = 1.25 \times 10^{-2}\,kgs^{-1}$ (02)

IV $\frac{dQ}{dt} = E A [\theta - \theta_R]$ —— (01)

$2500 = 0.8 \times A [30 - 20]$ —— (01)

$A = \frac{25}{8}$

$A = ~~3.125~~ \ 312.5 \ m^2$ —— (01)

V ජලය [illegible] සංවහනය සිදු
වේ. —— (01)

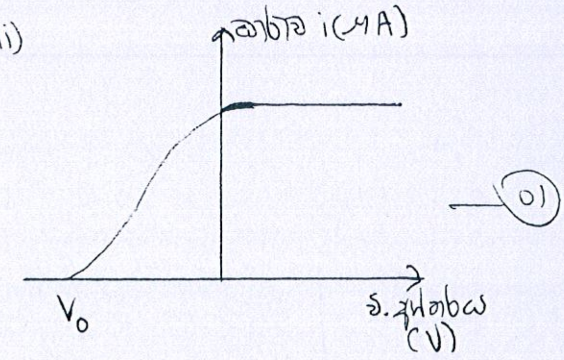
(~~ජ~~ .

(10-B)

(i) ප්‍රකාශ විද්‍යුත් ආචරණය — (01)

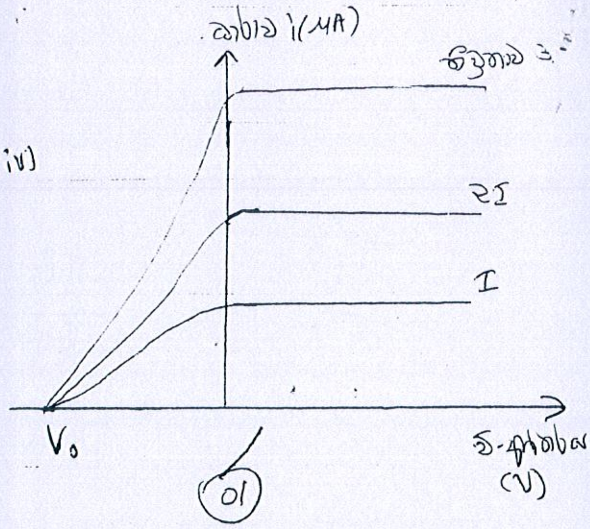
(ii) දේහලී සංඛ්‍යාතය — (01)

(iii)



— (01)

(iv)



(01)

(v) ලෝහ පෘෂ්ඨයෙන් ප්‍රකාශ ඉලෙක්ට්‍රෝනයක් ඉවත් කිරීමට අවශ්‍ය අවම ශක්තිය. (01)

(vi) $hf = \phi + \frac{1}{2}mv^2$ — (01)

hf - පතිත ෆෝටෝනයේ ශක්තිය
ϕ - කාර්ය ශ්‍රිතය
$\frac{1}{2}mv^2$ - ප්‍රකාශ e හි සතු උපරිම චාලක ශක්තිය. — (01)

(vii) (a) $hf = \phi + \frac{1}{2}mv^2$

$\frac{1}{2}mv^2 = k_{max} = hf - \phi$

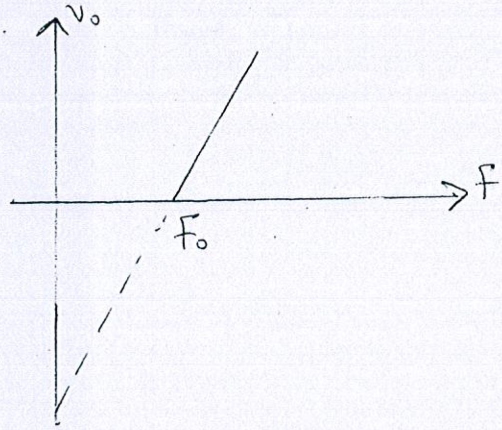
$k_{max} = eV_0$

$eV_0 = hf - \phi$

$V_0 = \frac{hf}{e} - \frac{\phi}{e}$ — (01)

(b) $V_0 = \frac{h}{e}f - \frac{\phi}{e}$

$y = mx - c$



(01)

(c) $m = \frac{h}{e}$

$h = me$ — (01)

$c = \frac{\phi}{e}$

$\phi = ec$ — (01)

(viii)(a) $\phi = hf_0$ —— (01)

$2.3 \times 1.6 \times 10^{-19} = 6.6 \times 10^{-34} \times f_0$

$f_0 = \dfrac{2.3 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}}$

$f_0 = 5.58 \times 10^{14}\ Hz$ —— (01)

(b) $hf = \phi + \frac{1}{2}mv^2$

$\dfrac{hc}{\lambda} = \phi + \frac{1}{2}mv^2$

$\frac{1}{2}mv^2 = \dfrac{hc}{\lambda} - \phi$

$\frac{1}{2}mv^2 = \dfrac{6.6 \times 10^{-34} \times 3 \times 10^8}{4.5 \times 10^{-7}} - 2.3 \times 1.6 \times 10^{-19}$ —— (01)

$\frac{1}{2}mv^2 = 4.4 \times 10^{-19} - 3.68 \times 10^{-19} = 0.72 \times 10^{-19}$

$v^2 = \dfrac{2 \times 0.72 \times 10^{-19}}{9.1 \times 10^{-31}} = \dfrac{2 \times 0.72 \times 10^{12}}{9.1}$

$v = \sqrt{\dfrac{2 \times 0.72 \times 10^{12}}{9.1}} = 10^6 \times 0.40$

$v = 4 \times 10^5\ ms^{-1}$ —— (01)

(c) $eV_0 = \frac{1}{2}mv^2$

$V_0 = \dfrac{0.72 \times 10^{-19}}{1.6 \times 10^{-19}}$

$V_0 = 0.45\ V$ —— (01)

15

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