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Provincial Department of Education - NWP

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Third Term Test - Grade 13 - 2023

Physics I

Two hours

Instructions:

- *This question paper consists of 50 questions in 10 pages.*
- *Answer **all** the questions.*
- *Write your **index number** in the space provided in the answer sheet.*
- *Read the instructions given on the back of the answer sheet carefully.*
- *In each of the question **1 to 50**, pick the one of the alternatives from* (1), (2), (3), (4), (5) *which is **correct** or **most appropriate** and **mark your response on the answer sheet with a cross (x) in accordance with the instructions given on the back of the answer sheet.***

Use of calculators is not allowed.

($g = 10\ m\ s^{-2}$)

1. The dimensions of power are
(1) ML^2T^3 (2) ML^2T^{-2} (3) MLT^{-3} (4) ML^2T^{-3} (5) $ML^{-2}T^2$

2. The length of 20 equal divisions of a vernier scale is 19 mm. if the least count of the instrument is 0.005 cm, length of a vernier division must be
(1) 1 mm (2) 0.95 mm (3) 0.19 mm (4) 0.05 mm (5) 0.005 mm

3. The index of refraction of a substance is:
(1) the speed of light in the substance
(2) the angle of refraction
(3) the angle of incidence
(4) the ratio of angle of refraction and angle of incidence.
(5) the ratio of the speed of light in the substance and that in vacuum.

4. In the absence of an external unbalanced force on a system, which of the following is conserved in any type of collision?
(1) total kinetic energy (2) total potential energy (3) total mechanical energy
(4) total angular velocity (5) total linear momentum

5. Internal energy per atom of an ideal monatomic gas depend on
(1) Pressure (2) temperature (3) volume
(4) amount of gas (5) molar mass

6. A particle of mass m moving with a velocity v makes a head-on elastic collision with another identical particle which is initially at rest. The velocity of the first particle after the collision is
(1) v (2) $-v$ (3) $2v$ (4) $\frac{1}{2}v$ (5) zero

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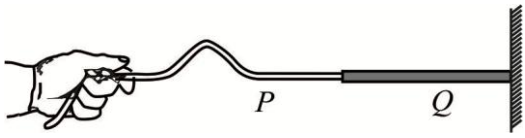
7. Young's modulus of steel is 2×10^{12} N m^{-2}. A steel wire has lengths of 1 m and area of cross section 1 mm^2. The work required to increase its length by 1 mm is

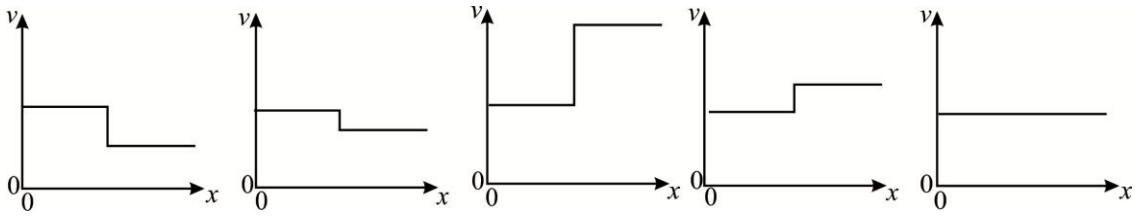
(1) 0.01 J (2) 0.1 J (3) 1 J (4) 10 J (5) 100 J

8. What is the charge of a down quark (d)? (The elementary charge is *e*.)

(1) $+e$ (2) $+\frac{2}{3}e$ (3) $-\frac{1}{3}e$ (4) $-\frac{2}{3}e$ (5) $-e$

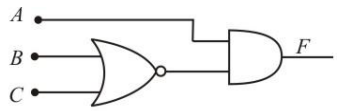
9. The figure shows a composite string made of same material. The cross-sectional area of string *P* is half that of string *Q*. The other end of the string *Q* is attached to a fixed wall. If both strings are under same tension which of the following graphs best represents the variation of speed *v* of transverse waves generated in strings with distance?



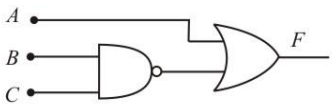


(1) (2) (3) (4) (5)

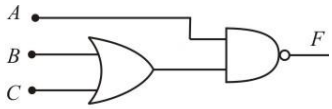
10. Which of the following logic circuit render the logic expression $F = A \bullet \overline{B + C}$



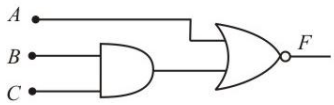
(1)



(2)



(3)



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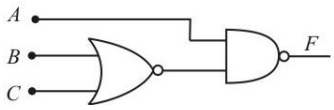


(5)

11. The focal length of a convex lens is 50 cm. Its power is

(1) + 50 D (2) - 50 D (3) + 2 D (4) - 2 D (5) +1 D

12. Variation of displacement *s* of an object with time *t* is shown in the figure. The velocity of the object is maximum when it is

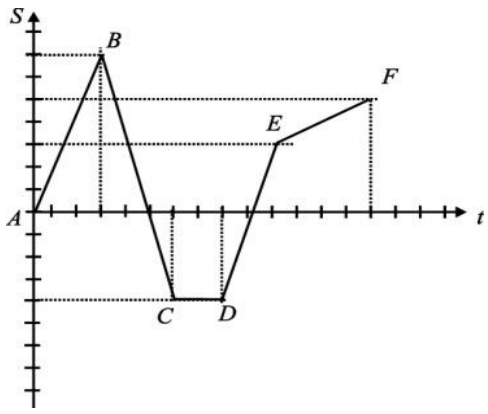
(1) between *A* and *B*.

(2) between *B* and *C*

(3) between *C* and *D*

(4) between *D* and *E*

(5) between *E* and *F*



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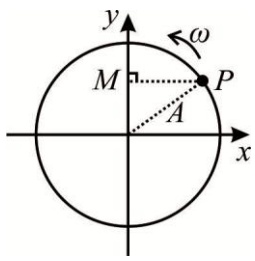
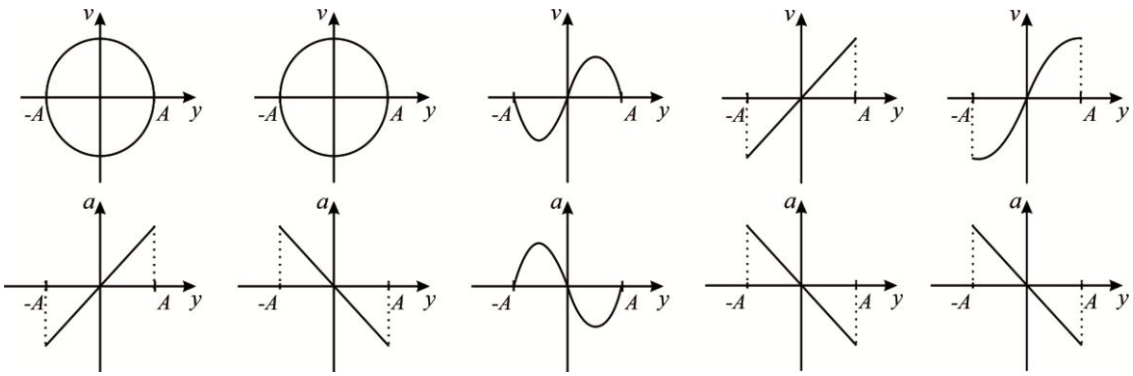
13. A particle P is moving in a circle of radius A with a uniform angular velocity ω as shown in the figure. M is the horizontal projection of P on y axis. The variation of velocity v and acceleration a of M with the displacement y is best represented by





(1) (2) (3) (4) (5)

14. One end of a capillary tube of length 10 cm is dipped vertically into water. The water level rises by 5 cm inside the tube. If the capillary tube is now lowered into the water so that only 4 cm of the tube is above the water surface,
(1) the water inside the tube will not rise.
(2) the water inside the tube will fall to the 2 cm level.
(3) the water inside the tube will rise to the 4 cm level.
(4) the water will overflow tube continuously.
(5) the water will shoot up to a height of 5 cm.

15. Consider the following statements about a rolling body
(A) rotational kinetic energy is always greater than the translational kinetic energy.
(B) Velocity of the point in contact with the ground is always zero.
(C) linear momentum and angular momentum are always equal.
Of the above statements
(1) Only (A) correct (2) Only (B) correct (3) Only (C) correct
(4) All (A), (B) and (C) are correct (5) All (A), (B) and (C) are incorrect

16. A 0.3 kg apple falls from rest through a height of 20 m onto the head of a person. Upon impact, the apple comes to rest in 0.1 s, and 4 cm^2 of the apple comes into contact with the head during the impact. What is the average pressure exerted on the apple during the impact? Ignore air resistance.
(1) 600 000 Pa (2) 150 000 Pa (3) 60 000 Pa (4) 2 100 Pa (5) 600 Pa

17. A point charge of 2 μC is placed in a medium of relative permittivity 3. The electric field intensity at a point 40 cm from the charge is ($\frac{1}{4\pi\varepsilon_0} = 9\times10^9$ N m^2 C^{-2})
(1) 3.00 x 10^4 N C^{-1} (2) 3.75 x 10^4 N C^{-1} (3) 3.50 x 10^4 N C^{-1}
(4) 4.75 x 10^4 N C^{-1} (5) 5.00 x 10^4 N C^{-1}

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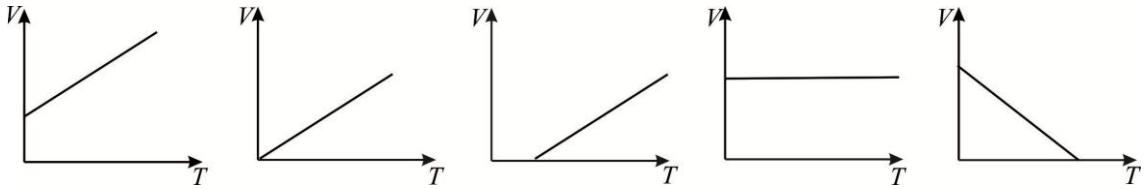
18. If an ice skater, on a frictionless ice surface spin around himself with his arms outstretched, suddenly lowers his arms, then
(1) His angular velocity decreases. (2) his moment of inertia increases
(3) his angular velocity increases (4) his angular momentum increases
(5) he falls.

19. Which of the following best represent the variation of volume of an ideal gas with absolute temperature?



(1) (2) (3) (4) (5)

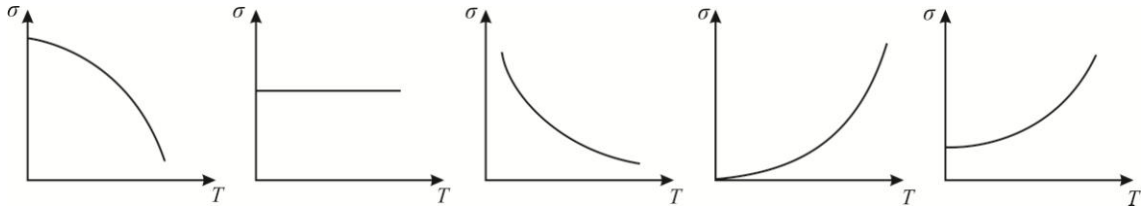
20. Two metallic spheres each of mass *m* are suspended by two strings each of length *l*. The distance between the upper ends of strings is *l*. The angle which the string made with the vertical due to mutual attraction of the spheres is

(1) $\tan^{-1}\left(\frac{Gm}{gl^2}\right)$ (2) $\tan^{-1}\left(\frac{Gm}{2gl^2}\right)$ (3) $\tan^{-1}\left(\frac{2Gm}{gl^2}\right)$

(4) $\tan^{-1}\left(\frac{2Gm}{gl}\right)$ (5) $\tan^{-1}\left(\frac{Gm}{gl}\right)$

21. A balloon filled with hydrogen just holds a weight of 150 kg (having negligible volume) in air. Given that the density of hydrogen = 0.00009 g cm^{-3} and density of air = 0.00129 g cm^{-3}, the volume of the balloon is (neglect the mass of the material of the balloon)
(1) 1.25×10^4 cm^3 (2) 1.25×10^5 cm^3 (3) 1.25×10^7 cm^3
(4) 2.5×10^4 cm^3 (5) 2.5×10^5 cm

22. Which of the following best represent the variation of electrical conductivity σ of an intrinsic semi conductor with absolute temperature *T*?



(1) (2) (3) (4) (5)

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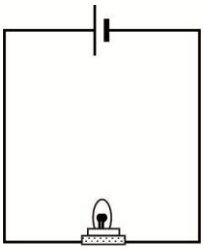
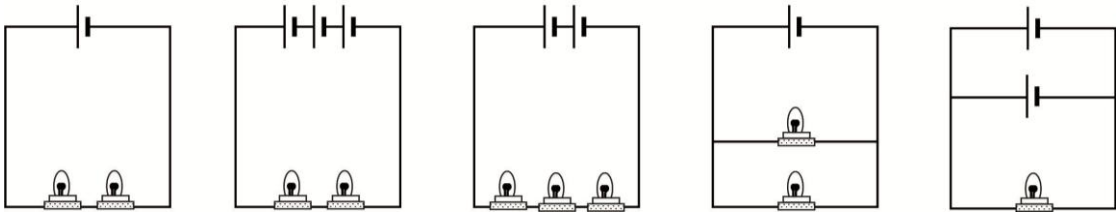
23. All the bulbs and cells shown in following figures are identical. If the intensity of a bulb is proportional to the current through it, which of the following circuit will the bulb glow with the almost same brightness as in circuit (A)?

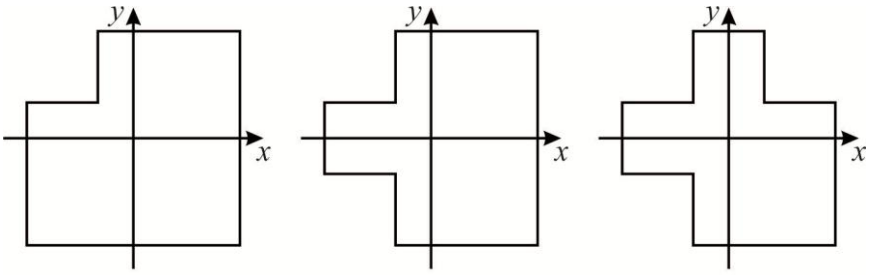


(A)



(1) (2) (3) (4) (5)

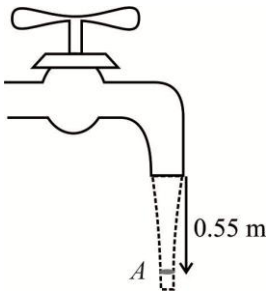
24. (A), (B) and (C) are shapes cut from three identical plates. Identical square parts have been cut from them as shown in the figure. (One corner from (A), two corners from (B), and three corners from (C). Consider the origin to be at the center of the complete sheet. The x co-ordinate of center of gravity of respective sheets are x_A, x_B and x_C . Then which of the following is correct?



(A) (B) (C)

(1) $x_A < x_B < x_C$ (2) $x_A = x_B < x_C$ (3) $x_A < x_B = x_C$
(4) $x_A < x_C < x_B$ (5) $x_A = x_C < x_B$

25. Water is streaming downward from a tap opening with an area of 3.0×10^{-5} m^2 as shown in the figure. It leaves the faucet with a speed of 5.0 m s^{-1}. The cross-sectional area of the stream 0.55 m below the tap is:



(1) 1.0×10^{-5} m^2 (2) 1.5×10^{-5} m^2
(3) 2.0×10^{-5} m^2 (4) 2.5×10^{-5} m^2 (5) 3.0×10^{-5} m^2

26. In which of the following cases is the resultant force on the object zero?

(A) a satellite moving round the earth

(B) a feather falling freely in a vacuum cylinder in a laboratory

(C) a gas bubble rising with terminal velocity in water

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

(4) (B) and (C) only (5) (A), (B) and (C)

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27. Consider following statements regarding reflection of waves.

(A) When a sound wave reflects from a wall, reflected wave is in opposite phase with the incident wave.

(B) When a ripple in water tank reflects from its vertical wall, reflected wave is in opposite phase with the incident wave.

(C) Any wave reflects according to the laws of reflection of light.

Which of the above state is **wrong?**

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

28. Given: mass of proton = 1.0078 u

mass of neutron = 1.0087 u

mass of deuteron $^{2}_{1}H$ = 2.0146 u

1 u is equivalent to 931 MeV

Calculate the binding energy per nucleon, in MeV, of a deuteron.

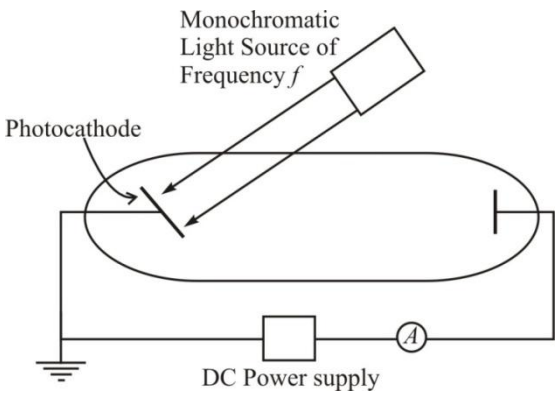
(1) 9.5×10^{-4} (2) 1.9×10^{-3} (3) 8.8×10^{-1} (4) 9.4×10^{2} (5) 1.9×10^{3}

29. Following setup of apparatus is used to study the Photoelectric effect.

In this apparatus, the potential V of the anode is measured relative to the ground. Initially it is at zero the then increase or decrease monotonically. The effect is described by Einstein's photoelectric equation

$|eV| = hf - W$

When the photoelectric equation is satisfied and applied to this situation V is the,



(1) negative value at which the current stops.
(2) negative value at which the current starts.
(3) positive value at which the current stops.
(4) positive value at which the current starts.
(5) voltage induced when the light is on.

30. An Object A, with heat capacity C_A and initially at temperature T_A, is placed in thermal contact with an object B, with heat capacity C_B and initially at temperature T_B. The combination is thermally isolated. If the heat capacities are independent of the temperature and no phase changes occur, the final temperature of both objects is:

(1) $\frac{C_A T_A - C_B T_B}{C_A + C_B}$ (2) $\frac{C_A T_A + C_B T_B}{C_A + C_B}$ (3) $\frac{C_A T_A - C_B T_B}{C_A - C_B}$ (4) $\frac{C_A - C_B}{T_A - T_B}$ (5) $\frac{C_A + C_B}{T_A - T_B}$

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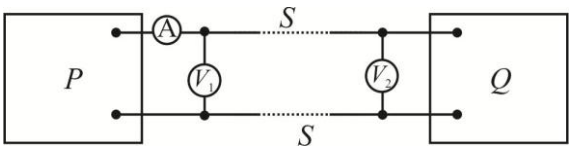
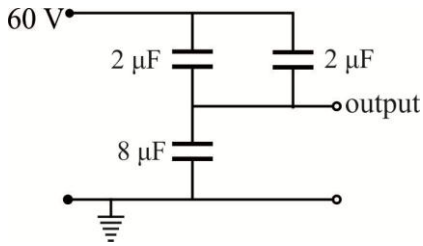
31. The figure shows a power lines S between a power house P and a consumer Q, voltmeter V_1 at the P reads 600V, voltmeter V_2 at Q reads 580 V, and ammeter A reads 100 A. The power wasted in the transmission line connecting the power house to the consumer is:



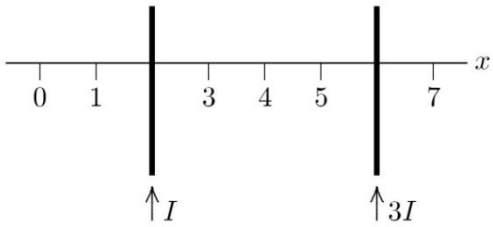
(1) 1 kW (2) 2 kW (3) 58 kW (4) 59 kW (5) 60 kW

32. Three capacitors are connected to a 60 V supply as shown in the above circuit. The voltage at the output is



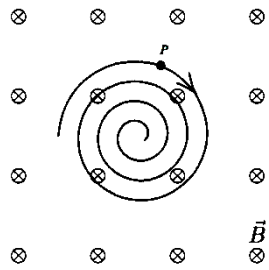
(1) 5 V (2) 15 V (3)20 V
(4) 30 V (5) 40 V

33. Two long straight current-carrying parallel wires cross the x axis and carry currents I and $3I$ in the same direction, as shown. At what value of x is the net magnetic field zero? (neglect the earth magnetic field)



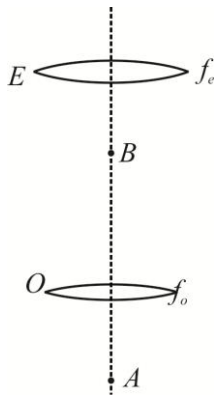
(1) 0 (2) 1 (3) 3 (4) 5 (5) 7

34. A uniform magnetic field is directed into the page. A charged particle, moving **in the plane** of the page, follows a clockwise spiral of decreasing radius as shown. A reasonable explanation is:



(1) the charge is positive and slowing down
(2) the charge is positive and speeding up
(3) the charge is negative and speeding up
(4) the charge is negative and slowing down
(5) none of the above is a reasonable explanation.

35. The diagram represents a microscope with the object at A. O and E are objective and eyepiece of the microscope. The image of A is formed at B by the objective. f_o and f_e are the focal lengths of objective and eyepiece respectively. Which of the following statement/statements is/are correct?



(A) AO is less than f_O.
(B) BE is less than f_e.
(C) The image at B is real.

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

36. The root-mean-square speed of a sample of helium gas molecules, each of mass m, is c. Which of the following deductions is correct?
(1) The percentage of molecules travelling at speed c is greater than at other speeds.
(2) Half of the molecules travel at a speed higher than c.
(3) All molecules travel randomly with speed c.
(4) The average speed of the molecules is c.
(5) The average kinetic energy of the molecules is $\frac{1}{2}mc^2$.

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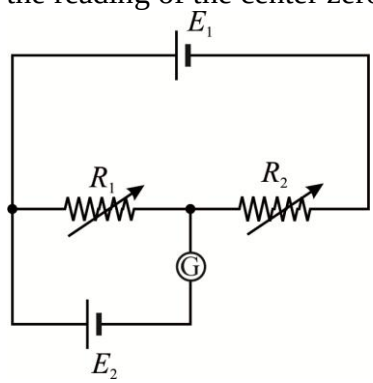
37. An astronomical telescope has an angular magnification of magnitude 5 for distant objects. The separation between the objective and the eyepiece is 36 cm and the final image is formed at infinity. The local length f_o of the objective and f_e of the eyepiece respectively are

(1) 45 cm and 9 cm (2) 9 cm and 45 cm (3) 30 cm and 6 cm
(4) 6 cm and 30 cm (5) 36 cm and 6 cm

38. A constant external torque τ is applied to a flywheel which is initially at rest. The angular speed of the flywheel increases to a certain value after 21 s. If the external torque were doubled, the flywheel would acquire the same angular speed after 9 s. Find the average frictional torque exerted at the bearings of the flywheel.

(1) $\frac{1}{2}\tau$ (2) $\frac{3}{7}\tau$ (3) $\frac{7}{10}\tau$ (4) $\frac{4}{7}\tau$ (5) $\frac{1}{4}\tau$

39. The given diagram shows how two cells of e.m.f. E_1 and E_2, of negligible internal resistance, are connected with two variable resistors. When the reading of the center zero galvanometer G is zero, values of the resistances are R_1 and R_2. Then the ratio of $\frac{E_1}{E_2}$.

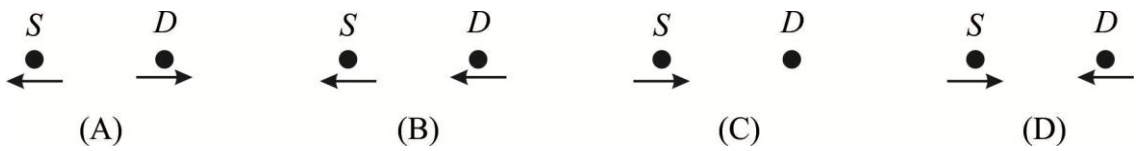


(1) $\frac{R_1}{R_2}$ (2) $\frac{R_1}{R_1+R_2}$ (3) $\frac{R_2}{R_1+R_2}$
(4) $\frac{R_1+R_2}{R_2}$ (5) $\frac{R_1+R_2}{R_1}$

40. A stone is projected at an angle of 45° to the horizontal with an initial kinetic energy E. Neglecting air resistance, when the stones are halfway up, its kinetic energy is

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

41. The diagram shows four situations in which a source of sound S with variable frequency and a detector D are either moving or stationary. The arrows indicate the directions of motion. The speeds are all the **same**. Detector at (C) is stationary. The frequency detected by D is the same in all situations. situations according to the ascending order of frequency of the source is,



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

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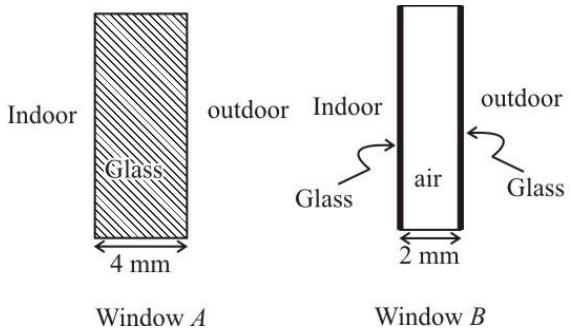
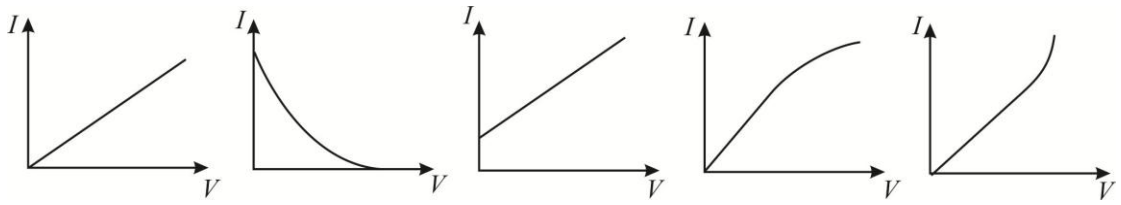
42. Figure (A) is a window glass of 4 mm thick and Figure (B) is a sandwich consisting of two extremely thin layers of glass separated by an air gap of 2 mm thick use as a window glass. If thermal conductivities of glass and air are 0.8 W m^{-1} $°C^{-1}$ and 0.025 W m^{-1} $°C^{-1}$ respectively, then the ratio of the heat flow through window *A* to the heat flow through window *B* is



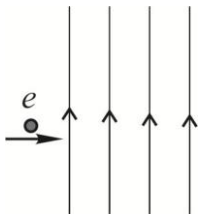
(1) 2 (2) 4 (3) 8 (4) 16 (5) 32

43. Which of the following graphs best represents the current-voltage relationship of an incandescent light bulb (filament bulb)?



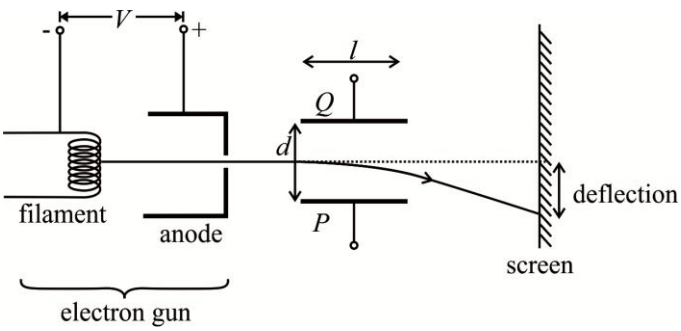
(1) (2) (3) (4) (5)

44. The figure shows an electron entering a uniform field which may be electric or magnetic. Which of the following descriptions about the subsequent motion of the electron is correct?



(1) Only in a magnetic field the electron can be deflected by more than 90°.
(2) Only in an electric field does the force depend on the magnit ude of the charge on the electron.
(3) Whether the field is electric or magnetic, the speed of the electron will increase.
(4) Whether the field is electric or magnetic, the magnitude and direction of the force acting on the electron are constant.
(5) If it is an electric field, electron continue to move in a straight line.

45. In a cathode ray tube, the beam of electrons from the electron gun is deflected vertically when a potential difference is applied between the deflection plates, *P* and *Q*, of length *l* and separation *d*. For a given potential difference across the deflection plates, which of the following changes will increase the deflection of the beam?



(A) Reducing the p.d. *V* between the filament and the anode.
(B) Reducing the separation *d* between the deflection plates.
(C) Reducing the length *l* of the deflection plates.

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

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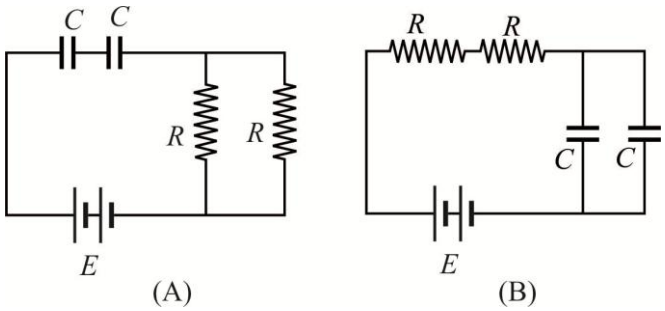
46. An electrician has only two resistances. By using them, he is able to obtain resistances of 3 Ω, 4 Ω, 12 Ω and 16 Ω. The two resistances are
(1) 4 Ω and 12 Ω (2) 4 Ω and 16 Ω (3) 7 Ω and 9 Ω
(4) 6 Ω and 10 Ω (5) 7 Ω and 12 Ω

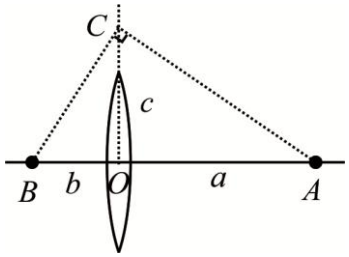
47. Two circuits, (A) and (B), each connect two identical capacitors with a d.c. supply of e.m.f. E and two identical resistors as shown.



The ratio of the total electrical energy stored in the capacitors in circuit (A) to that in circuit (B) when a steady state is reached.

(1) 2 : 1 (2) 1 : 2 (3) 4 : 1 (4) 3:1 (5) 1 : 4

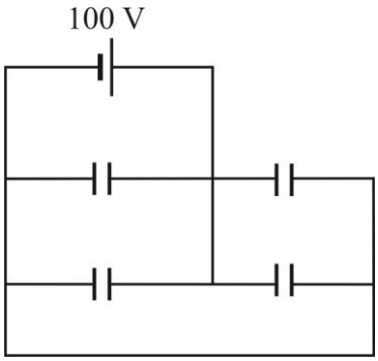
48. An object is placed at A in front of a convex lens of focal length f. Its image is formed at B. O is the center of the lens and OC is perpendicular to AB. $OA = a$, $OB = b$ and $OC = c$. Then which of the following is the correct expression for f?



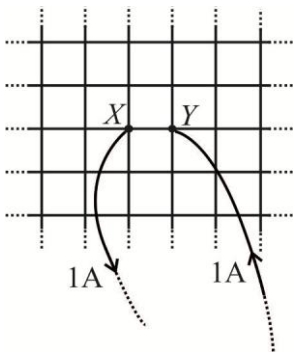
(1) $\frac{c^2}{a+b}$ (2) $\frac{c}{(a+b)^2}$ (3) $\frac{(c^2+a^2)(c^2+b^2)}{c^2}$

(4) $\frac{(a+b)^2}{c}$ (5) $\frac{c(a+b)}{a+c}$

49. Each of the four capacitors in the given circuit is 50 μF. Then the charge on each capacitor is
(1) 5×10^3 C (2) 5×10^{-3} C
(3) 20×10^{-3} C (4) 2.5×10^3 C
(5) 2.5×10^{-3} C



50. The figure shows an infinitely large wire mesh. 1 A current is fed into the mesh at Y and same current is taken from X. Then the current in the wire XY will be.
(1) 1 A (2) 0.75 A (3) 0.5 A
(4) 0.25 A (5) 0



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Provincial Department of Education – NWP

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Third Term Test - Grade 13 - 2023

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Physics - II

03 hours

Additional Reading Time 10 mn

Index No. : .....

Important :

- *This question paper consists of* **16** *pages.*
- *This question paper comprises of* ***two*** *parts, Part* **A** *and Part* **B**. *The time allotted for* ***both parts*** *is* ***three hours***.
- *Use of calculators is* ***not*** *allowed.*

PART A — Structured Essay :
(pages 2 - 8)

Answer ***all*** *the questions on this paper itself. Write your answers in the space provided for each question. Note that the space provided is sufficient for your answers and that extensive answers are not expected.*

PART B — Essay :
(pages 9 - 16)

This part contains ***six*** *questions, of which,* ***four*** *are to be answered. Use the papers supplied for this purpose.*

- *At the end of the time allotted for this paper, tie the* ***two parts together*** *so that* ***Part A*** *is* ***on top*** *of* ***Part B*** *before handing them over to the Supervisor.*
- *You are permitted to remove* ***only Part B*** *of the question paper from the Examination Hall.*

For Examiners' Use Only

For the second paper		
Part	Question Nos.	Marks Awarded
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9 (A)	
	9 (B)	
	10 (A)	
	10 (B)	
Total		

Final Marks

In numbers	
In words	

Code Numbers

Marking Examiner 1	
Marking Examiner 2	
Marks checked by	
Supervised by	

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PART – A Structural Paper

Answer All four questions on this paper itself

(Acceleration due to gravity , g = $10Nkg^{-1}$)

01. Following set up shows to find density of liquid by using weighted test tube.

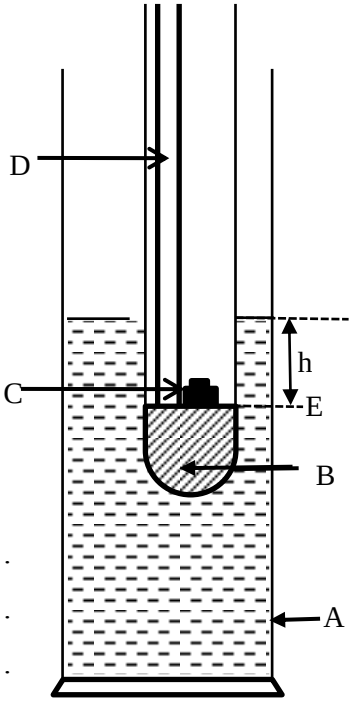
a) Name the following item given in letters

A …….

B……..

C……..

D……..



b) Consider volume of the part B is V, mass of the tube with its contents M, external cross sectional area of the tube is **a**, mass of additional weights insert into the tube is m, density of the liquid is d, height of the liquid column above the E level is h.

i. Write down the principle using here

……

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……..

ii. What is the reason measuring the height h from E level

……

iii. How to make the part B

……

……

……..

iv. What is the benefit of part B

……...

c) i. Write down the expressions for equilibrium of tube using above data.

……

ii. Re arrange the above equation to find the density of d using graphical method.

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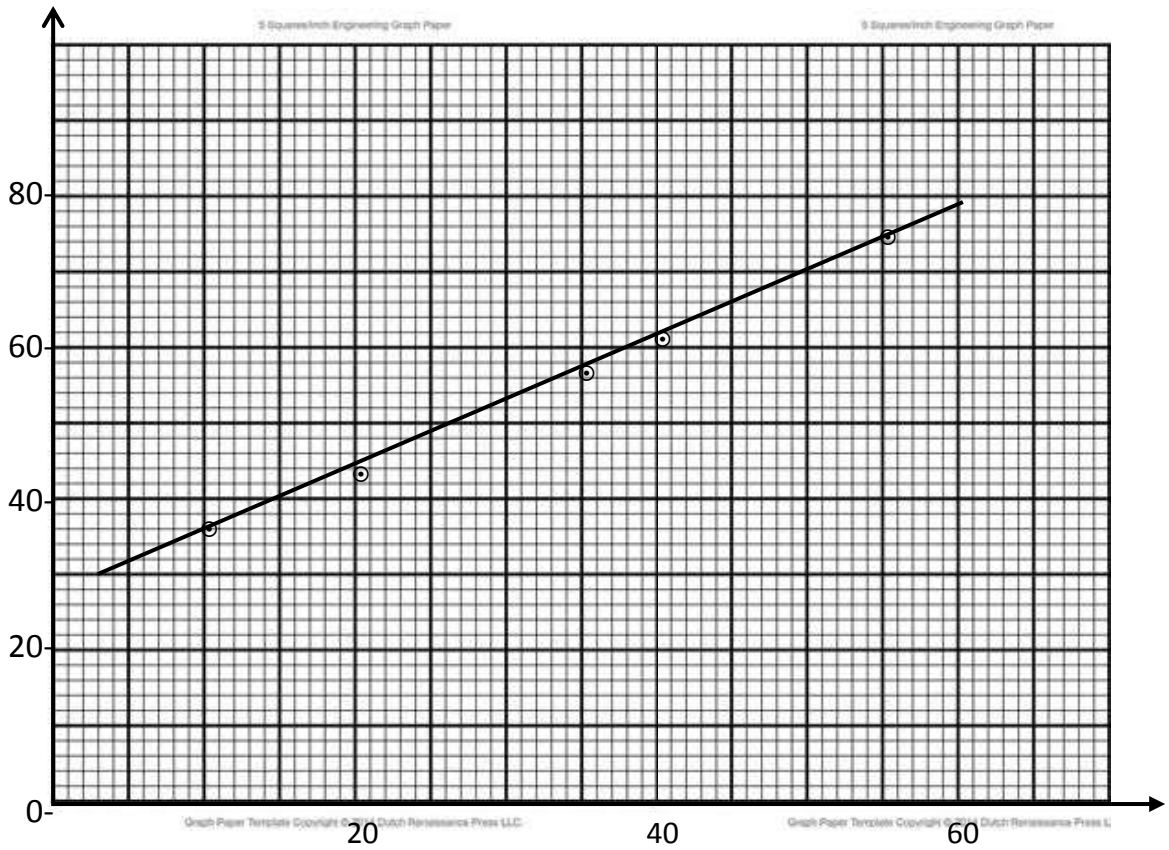
d) By experiment data a student is drawn following graph

- 

- i. Label the axis with unit.

  ii. Choose only the most suitable two point. Find the gradient of the graph (sufficient keeping fractions)

  ……

  ……

  ……

  ……

  iii. What is the other reading to find the density of the liquid. (d)
  What instrument you used to get that reading.

  ……

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  iv. If external diameter of the tube is 7 cm^2 , find the density of the liquid (give the first decimal point)

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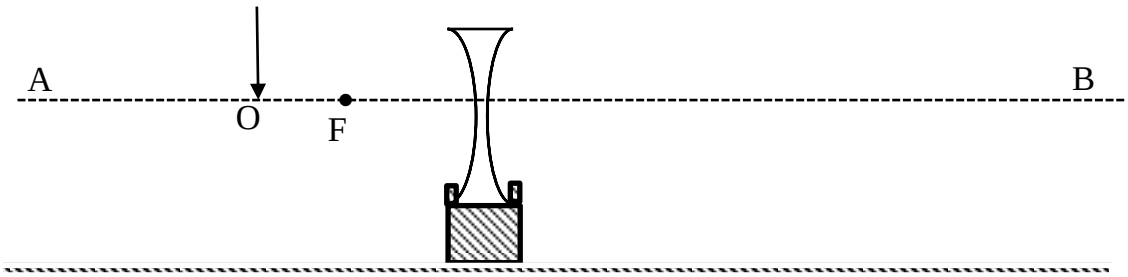
02. An experimental set up is shown below. For the determination of the focal length of a concave lens , O is the object pin.



a) You are provided two optical pins, a plane mirror strip, a meter ruler and background screen

i. What is the AB line

……

ii. Keep the background screen (S) on suitable place in the given diagram

iii. Determine the position of image (I) by using the rays in above diagram .

iv. What is the nature of the image and give the reason

……

……

b) i. Draw the eye on the most suitable place to observe the image in above diagram.

ii. Can't be see the observe image in middle area of the lens. How do you correct it.

……

……

iii. Position of the image can find or not by the parallax method, give the reason,

……..

iv. To find the position of the image keep the plan mirror strip (M) and locating pin (P) , suitable place on the above diagram.

v. To find the I draw the locating pin (Q) on the above diagram,

vi. How do you make sure that image coin side with Q

……

……

vii. If distance between M and lens is distance between M and P is y obtain the expressions for image distance V.

……

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c) i. Get as objective distance u, image distance V and focal length f Build a relation to find the f by using graphical method

……

……

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……

ii. Draw the rough sketch Can be obtained with labeling the axis

iii If gradient of like above graph is 5 x10^{-2} find the focal distance of lens

……

……

……..

iv. State and application of concave lens

……

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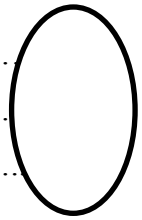
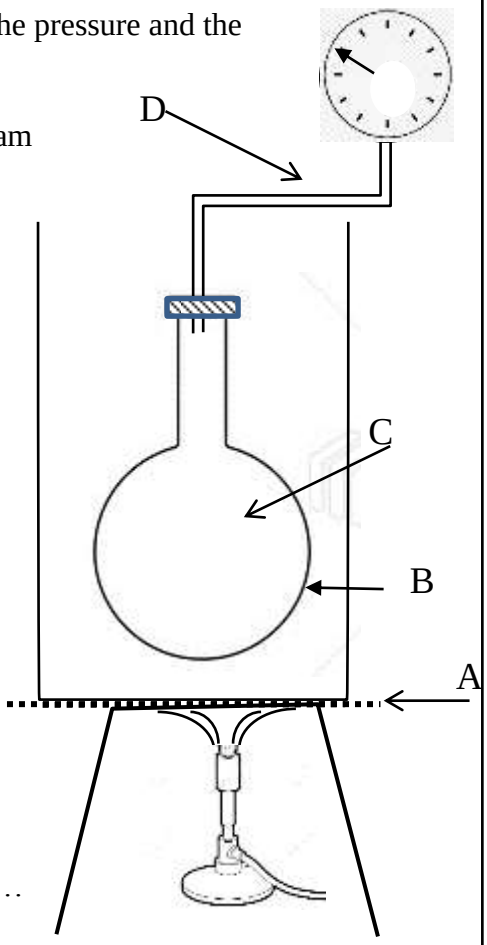


03 Figure shows a set up to verify the relationship between the pressure and the temperature of a gas at constant volume



a) i. Draw the two items not shown in the diagram

ii. Label the part of the given letters shown in the diagram.

A ……

B……..

C ……

D……..

iii. Give the reason using following parts.

A ……

B……..

iv. Clearly make the level of the water must be field in the beaker

v. What is the reason for use to water beaker

……

……

……

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vi. Student says B must be thin wall is it true or false, give the reason.

……

……

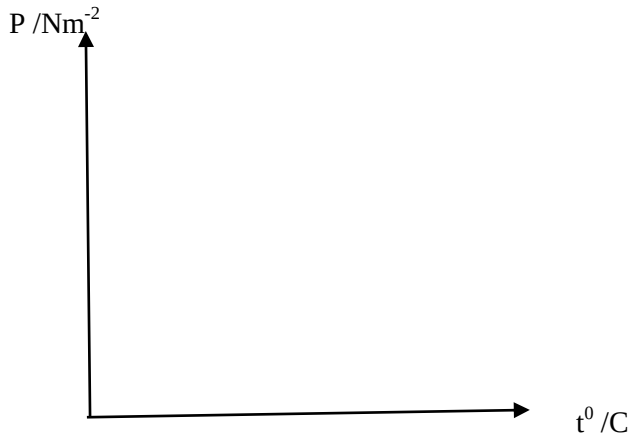
vii. When getting reading, what is the experimental procedure, temperature of the air to very close to readable value

……..

viii. When getting reading how to relevant temperature keep constant

……

b) i. Obtained reading by you draw the rough sketch on the given axis which temperature t/ ^{0}C and pressure P/Nm^{-2}



ii. Extent the above graph to show the temperature when pressure of the air is zero.
Mark the value of that temperature

iii. Give the two reason practically hard to reach that value

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c) Write down the low of air you are studied at above

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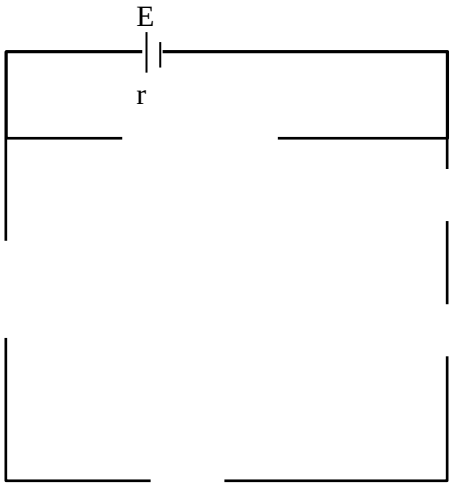
04 Figure shows a un complete circuit to find the internal resistance and the electromotive force of a dry cell



a) i. If you are provided digital voltmeter and a milliammeter connect them suitable position

ii. Provided rheostat and resistor R (10Ω) Connect that suitable places

iii. What is the most suitable key you must connect in here

……

Connect it in suitable place with its symbol

iv. What is the reason for the use of the key that you mention

……

v. Explain with reason accuracy of the reading depend on the person that you use the key(k)

……

……

……

b) i. If electromotive force is E, internal resistance is r, current through the circuit is I, voltage difference between terminal is V, Write down the expressions for E above data

……

ii Re arrange the above expressions to find the r and E by graphical method

……

……

c) i. How do you get the voltmeter reading for minimum ammeter reading

……

……

ii.` What is the benefit of connecting the R resistor

……

……

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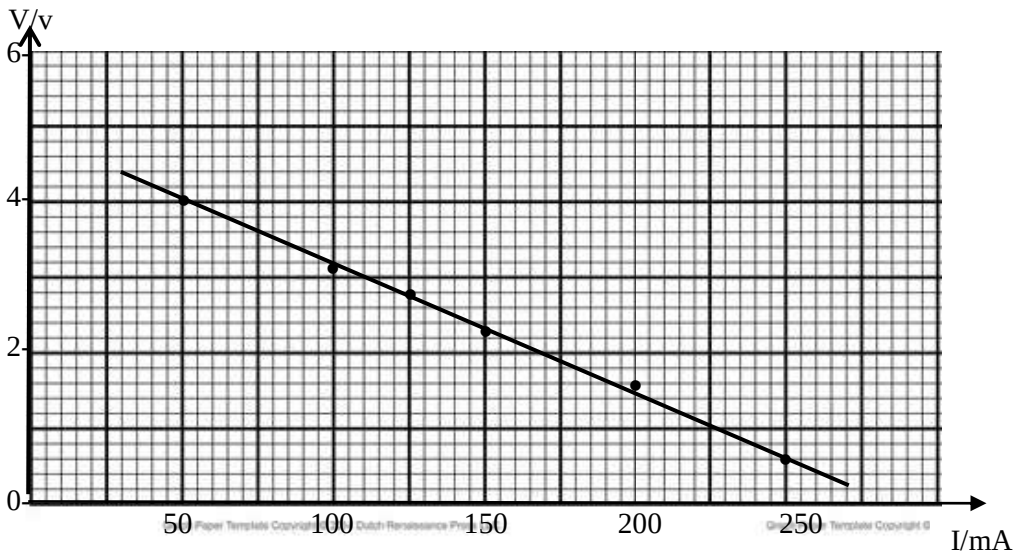
c) Following graph shows the variation of the ammeter reading and the voltmeter reading in above experiment



i. Find the gradient of the graph

……

……

……

……

……

ii. What is the internal resistance of the cell

……

iii. What is the electromotive force of the dry cell

……

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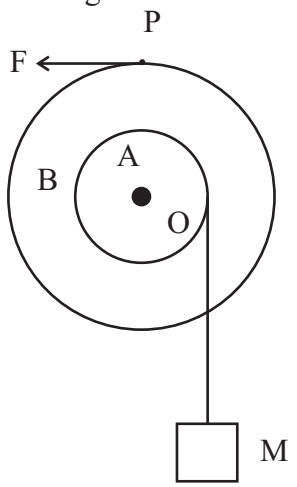
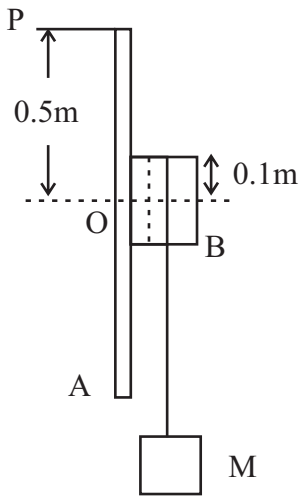
Part - B ESSAY

- ප්‍රශ්න 4 ක් තෝරා පිළිතුරු සපයන්න. 9A /9B සහ 10**A** / 10**B**
  ප්‍රශ්න වලින් එක ප්‍රශ්නය බැගින් තෝරාගත හැකිය.

05. The following figure shows a model of a system arranged for transporting goods to the top of a building.



(1)



A and B are uniform concentric rotating disks of radii 0.1 m and 0.5m, masses 5kg and 10kg respectively. They can rotate on a vertical plane abut a smooth horizontal axis passing through the center, O

A long light inelastic cable is wound around the disk A and connected to it. Its free end is connected to a mass (M) of 20 kg. By applying a tangential force (F) using a handle P, Disk B is rotated in the anticlockwise direction in order to raise the load M. Handle P is rotated by a man.

(i) It the land M is moving vertically upwards with a constant speed of 20 cm^{-1}, Calculate
  (a) (a) angular velocity of disk A
  (b) the tangential speed of the handle P.

(ii) Find the force (F) applied by the man for the above situation.

(iii) Find the rate of work done by the man.

(iv) (a) If he applied the force (F) uniformly within 200(s) what is the increase in potential energy of the load ?
  (b) Hence, find the height he raised the load.

(v) While the load is moving up, suddenly the handle is disconnected from the disk at the above height.
  (a) (The moment of inertia of a disk about an axis passing throgh the centre of it is given by $I = ½ MR^2$)
  (b) Find the acceleration of the load moving down.
  (c) Find the velocity of the load when it hits the ground.

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(06) (a) Give two equal and different characteristics between longitudinal and transverse waves.

(b) Is ultrasound a longitudinal or transverse wave ?

(c) The displacements X_1 and X_2 of vibrating particle in a medium which a wave passes are given by the expressions $X_1 = 1.5 \text{ sing } (\omega t + \frac{\pi}{4})$ and $X_2 = 0.5 \sin(\omega t - \frac{\pi}{4})$. Draw the two wave patterns passing through the medium separately when the particles are oscillating.

(d) What dre the special features of S and P waves generated by an earh quake ?

(e) The magnitude value (R) of the Richter scale s given by $R = \log_{10}\left(\frac{A}{A_0}\right)$, where A = 6.3 m $A_0 = 21$ cm. Calculate R. $\log_{10}3 = 0.4771$.

(f) Calculate the ratio between the intensities of two waves, if they record R = 7 and R = 5.

(g) An earthquake which occured at a certain location generates a P - wave with a velocity of 210ms-1. The 2nd and 3rd vibrations of the P - wave respectively arrive 40 s and 6 min 20s after the 1st vibration at a cortain point in Morokko. How far a way from the point did the earthquake occurs. Give the distance in km. The ratio between the velocities of 2nd and 3 rd waves is 8.

(h) A dog having the lowest intensity level of 20 dB can hear the 1st vibration of the P - wave generated. Calculate the distance between the dog and the location which generates the P - waves with an intensity of 3 Wm^{-2}. $I_0 = 10^{-12}$, $\pi = 3$

(07) (a) (i) Explain the tension of a liquid surface using intermolecular attractive forces.

(ii) Define surface tension.

(iii) Plot the variation of surface tension (T) of a liquid with the temperature (θ).

(b) The expression for the presure difference across a liquid meniscus in a capillary tube is given by $\Delta P = \frac{2T\cos\theta}{r}$ Where T is the surface tension of the liquid, r is the radius of the capillary tube and θ is the angle of contact.

(i) Show that the above equation is dimensionally correct.

(ii) Indicate the contact angles (θ) between the liquids and the horizontal surface shown below.

(iii) The lower end of a capillary tube is vertically dipped in water contained in a beaker. Derive an expression for the capillary rise (h) interns of the density of water (ρ), internal radius of the capillary tube (r), surface tension of water (T) assuming contact angle between water and the glass surface of the capillary tube is zero.

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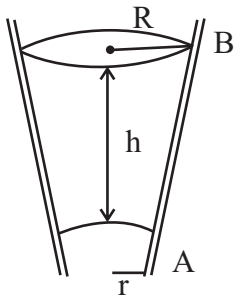
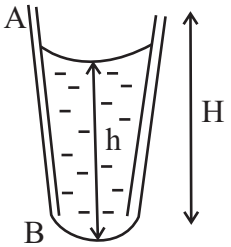
(c) (i) The above figure shows a capillary tube. Its's radius is gradually decreasing along the length. Suppose a liquid column of height h is trapped inside the tube. Assume contact angles of upper and lower liquid menisci are zero. obtain an expression for h interns of R, r, ρ , T and g where R and r are the radii of upper and lower liquid menisci, ρ and T are the density and the surface tension of the liquid and g is the acceleration due to gravity.



(ii)



The liquid column mentioned in c (i) above can stay inside the tube making a convex meniscus at the lower end A as shown in the figure Radius of upper meniscuses of the liquid is1mm. It h = 3cm, T 2.510^{-2} Nm^{-1}, ρ = 1000kgm^{-3} calculate the radius of curvature of the lower meniscus assuming contact angles between the liquid and glass are zero.

(08) A capacitor of capacitance **C** is charged to potential **V** bay connecting it to a battery. Let **q** be the charge on it., **E** the electric field within the plates and **U** the energy stored. when a dielectric of constant **k** is introduced filling completely the space between the plates, how will the following quantities change,

(i) V (ii) E (iii) q (iv) C (v) U

When (a) the battery remains connected and (b) the battery is disconnected / Explain briefly.

(09) A) (a) A the filament bulbs with maximum power rate 240V/ 48W are sued for electric light decoration in a festival season.

(i) What is implied by the maximum power rate 240V/ 48W stated in filament bulb ?

(ii) Calculate the resistance of a filament bulb.

(iii) What is the maximum potential different that can be supplied in between AB such that no bulb is damaged.

(iv) Calculate the power consumed by all the bulbs in the decoration.

(v) When this operates in this way, if the bulb X at the top of the function of the bulbs? Explain you answer.

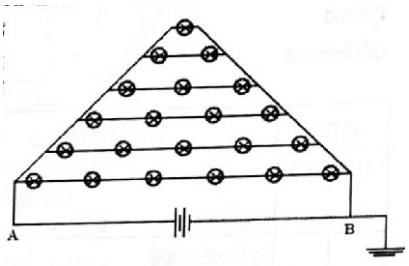
(vi) Consider that decoration shown operates for12 hours per day for 60 days, when the electricity bill is calculated by the electricity boards, it is calculated as follows.

Rs. 7 per units. for units fro, 1 - 50

Rs. 15 per units, for units fro, 51 - 75

Rs. 20 per units, for units from - 76 - 10

Rs. 40 per units, for units higher than 100 units



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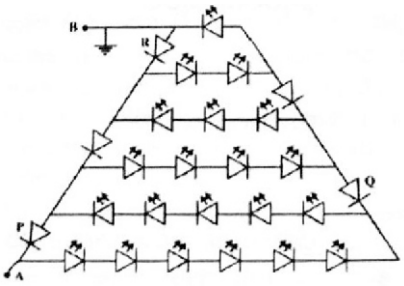
Energy of 1 kilo watt hours is represented by an electrical unit. What will be the electricity bill that has to be paid at the end of 60 days ?

(b) Light power of this decoration has been calculated as 40%. If the same light power is to be obtained using an equal amount of CFL bulbs having twice the value of the light power of a filament bulb, the power of the CFL should be used is.

(c) Later the above setup was redesigned as follows using the LED bulbs. The maximum rate of a CFL bulb used is 0.2A/1.5W.



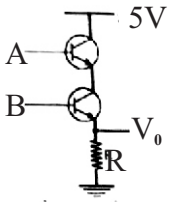
(i) Calculate the maximum potential difference that can be applied across a LED bulb. (Without damaging it.)

(ii) Calculate the maximum potential difference that can be applied in between A and B without damaging any LED bulb.

(iii) When the above calculated potential difference is applied, calculate the backward biased potential across the diodes P, Q and R.

B) (a) When a 5V potential is given to the transistor inputs shown below, it attims the saturated state. Caluclate the values that can be obtained by the output considering the A and B output. Then write the gate relevant to each logic.

(i)

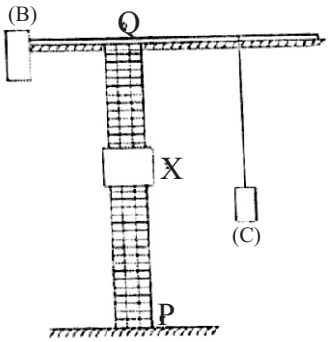


(ii)

A	B	V_0
0	0	
0	5	
5	0	
5	5	

දිශාව : .....

(b) A lifting machine used for construction purposes of very high buildings is shown in the figure. Main chamber is shown by X in the lifting machine and that main chamber go up and down through PQ. Before getting a certain work done through the lifting machine, the main chamber has to be taken to a suitable height. But is it risky to take it higher due to B and C loads at the both sides of the machine not at the suitable values, air traffic signals not working properly and failure of communication with the main control center.



It is required to operate a buzzer when taking the control chamber up when there are risky conditions. The inputs given for the electronic circuits are as follows.

A = 1 Voltage supply for th buzzer give,

A = 0 Voltage supply for the buzzer not given

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B = 1 Control chamber moving up

B = 0 Control chamber not moving up

C = 1 B and C loads at required values

C = 0 B and C loads not at required values

D = 1 Air traffic signals working

D = 0 Air traffic signals not working

E = 1 Having communication with the control center

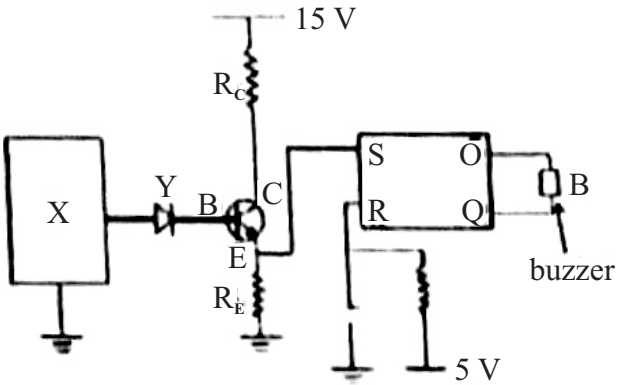
E = 0 Not having communication with the control center

In order for the buzzer to function, voltage supply should be given to it and if the supply has filed, it does not work. When B and C are not at rated values, buzzer should work and although they are at rated value, if the communication with the main control center has lost, buzzer should work if the air traffic signals are not working. Under all the above risky conditions, if the control chamber is not moving up, buzzer should not work.

(i) Taking X = 1 as the functioning of the buzzer in terms of the above symbols, write a logical expression.

(ii) In order to work the process, of A, B, C, D and E sensors are working design a suitable logic circuit using the logic gates. (Do not use logic gate with more than two inputs.)

(c) The circuit designed using the logic gates above is designed using the integrated circuits and this part is shown by (X) in the circuit. If the control chamber is attempted to take up at the risky condition, it is connected to a flip -flop circuit in such a way that the buzzer works continuously. In order to operate the buzzer at a risky condition. output voltage V_0 is given by the system (X). The diode Y used is a Si diode with forward biased potential 0.7V and the transistor used is a Germanium transistor. A supply voltage should be given to the terminal S of the flip flop circuit in order to operate the buzzer.



(i) If $R_E = 5k\Omega$, suggest a suitable value for R_C Consider that the current drawn o the terminal S and the bas current of the transistor are negligibly small and the transistor operates at a slightly saturated state.

(ii) Calculate the minimum value that V_o should have in order to operate the buzzer B. Consider that $V_{BE} = 0.3V$

(iii) When Q = 1, the buzzer gets the signal to operate, Considering the buzzer does not operate initially, show using the flip - flop diagram that the buzzer works until it is reset when a risky condition comes.

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(10) A) (a) (1) Write down the zeroth law of thermodynamics and first law of thermodynamics

(2) Write down the first law of thermodynamics as a equation using usual symbol and Introduce the symbols.

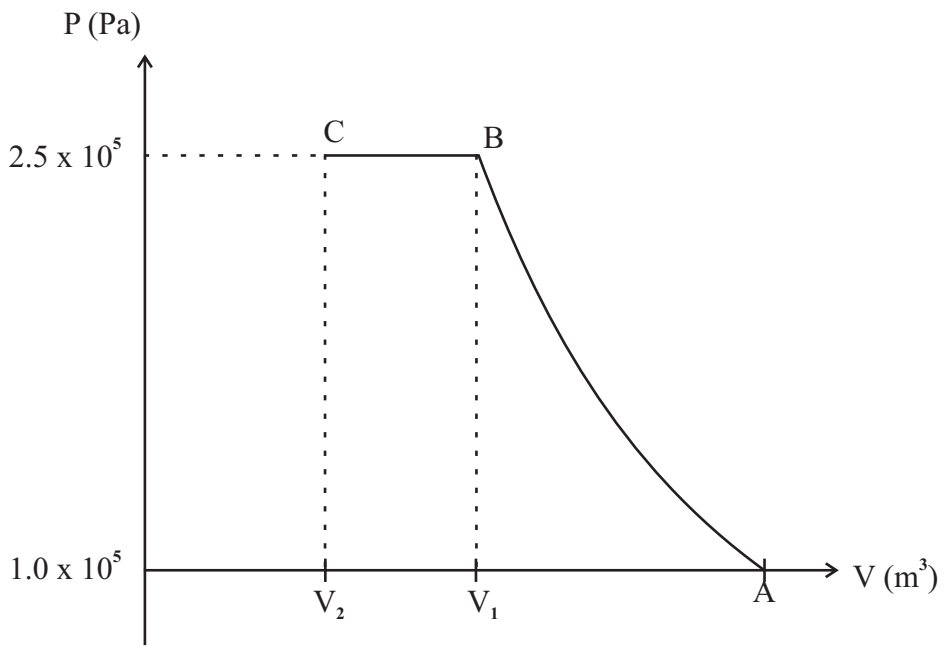
(3) Introduce the isothermal process and adiabatic process. Write down the equation for above process by using the first law of thermodynamics.

(4) Is the works done in isothermal process is greater than less than or equals to the work done in adiabatic process ? Explain it using P - V carves.

(b) An ideal gas that initially at state A with volume 2.0m3, Atmospheric pressure of 1.0×10^5 pa and temperature at $27C^0$ is compressed as adiabatically to state B, where pressure of 2.5×10^5 pa and temperature of 70c0 After that it is cooled to point that is initial temporation at .... under constanl pressure of 2.5x 105 Pa.

[Cosidor molor moss of the gas

$= 3.0 \times 10^{-2}\ kgmol^{-1}, R = 8.31\ Jmol^{-1}\ K^{-1}, \frac{1}{8.31} = 0.12]$



(i) Introduce the terns given in following equation for ideas gas $PM = \rho RT$

(ii) Calculate the volume of air V, at paint A, B, and C.

(iii) Calculate the volume of air V_1 at paints B and volume V_2 at points C.

B) (i) Give three properties of waves.

(ii) State De Broglie's Wave particle duality

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(iii) Which of the followings shows both wave nature and particle nature.

electron beam - (A)

X - ray - (B)

Visible light - (C)

(iv) What should be the size of the slit (d) used to diffract a wave of wave length λ

(v) (a) Show that, De Broglie wave length (λ) is given by $\lambda = \frac{h}{mc}$ using $E = hf$, $E = mC^2$ and $C = C = f\lambda$; C - velocity of light

(b) Show that the above equation is dimensionally correct.

(c) A ball of mass 1 kg is moving with velocity 10ms-1. Find the Be Braglie wave length associated with the ball.

h - plan K' s constant $= 6.6 \times 10^{-34}$ Js.

(d) Wave nature of big pratincoles like ball connoted be observed explain why ?

(e) How to show the wave nature of the electrons

(vi) An election at rest is accelerated by the potent difference V. Show that the final velocity of the electron $U = \sqrt{\frac{2Ve}{m}}$ where m and e are the mass and the charge of the electron.

(b) Obtain an expression for the De Broglie wave length (λ) of the electron. interms of h, e, m and v.

(vii) (a) In graphite, the spacing between the atomi... layers is 1 x 10-10 m. What is the potential difference V required to diffract an electron beam.

$e = 1.6 \times 10^{-19}$ C

$m_e = 9 \times 10^{-31}$ kg

(b) An electron at rest accelerated by the potential difference calculated above enters perpendicular to a uniform magnetic field of flux density 3T. Find the magnetic force on the electron.

(c) Find the radius of the circular path moved by the electron.

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