PHYSICS FORM 3
MIDTERM 1 EXAMS 2023
MARKING SCHEME
<u>**Attempt all the questions in the spaces provided.**</u>

1. State the reason why electricity transmission cables are left sagging between the pylons.
(1 mk)

  - To allow for contraction and expansion of the cables.

2. 2. the air pressure at the base of the mountain is 75.0cm of mercury while at the top it is 60.0cm.given that the average density of air is 1.25kgm^{-3} and the density of mercury is 13600kg/m^{3}.calculatre the height of the mountain. (3mks)

  $$h_a p_a g = h_m p_m g$$

  $$h_a = \frac{h_m p_m g}{p_a g}$$

  $$= \frac{75 - 60}{100} \quad x \quad \frac{13600 \times 10}{1.2 \times 10}$$

  $$= 15 \times \frac{13600 \times 10}{125 \times 10}$$

  $$= \underline{1632m}$$

3. State two factors that would raise the boiling point of water. (2 mks)
  - presence of impurities
  - increase in pressure

4. The level of water in a burette is 2.5cm^3. 40 drops each of volume 0.05cm^3 are added to the burette. What would be its new reading? (2 mks)
  V of drops = 40 x 0.5
  **   = 2cm^3**
  New reading = 25 – 2
  **   = 23cm^3**

5. Explain how the efficiency of a vacuum flask is affected if the double-walled glass surface is replaced with a double walled metal surface. (2 mks)
  - It would be less efficient. The shinny surface reflects heat back to the liquid hence lost minimized.
  - The metal surface would conduct the heat away from the liquid hence making the liquid lose heat.

6. A body moving at 50m/s decelerates uniformly at 2/ms^2 it comes to rest. What distance

does it cover from the time it starts to decelerate to the time it comes to rest. (3 mks)
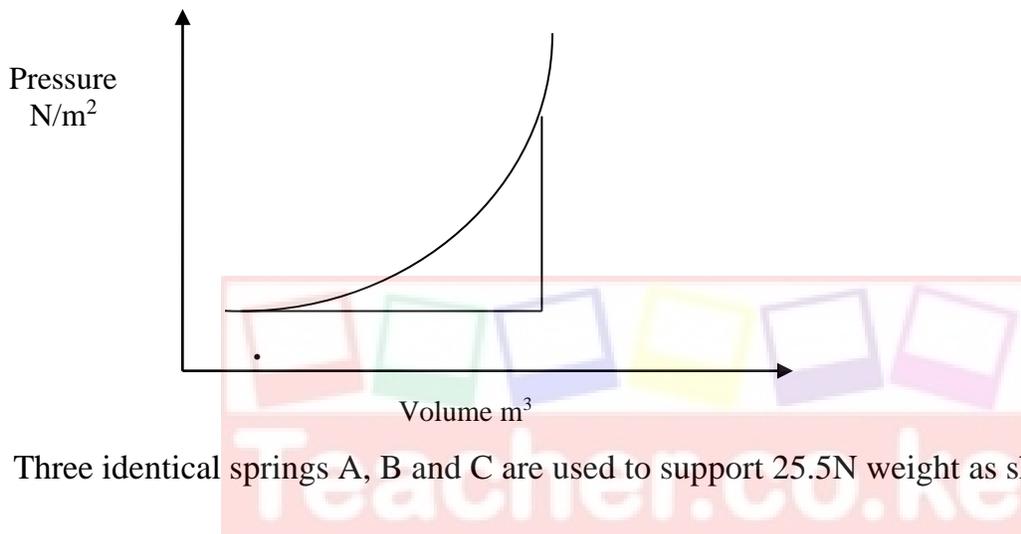
$U = 50/s$ $a = -2m/s^2, v = 0$
$V^2 = U^2 + 2as$
$O^2 = 50^2 + 2x - 2 \times 5$
$O = 2500 - 4s$
$\dfrac{4s}{4} = \dfrac{2500}{4}$

$\underline{S = 625m}$

7. Sketch a graph of pressure vs volume for ideal gas at constant temperature.   (3 mks)

Pressure
N/m^2

Volume m^3

8. Three identical springs A, B and C are used to support 25.5N weight as shown below.

The weight of the horizontal bar is 2.5N, determine the extension on each spring given that 6N causes an extension of 2cm. (2 mks)

Extension for C = $\underline{25.5 \times 2}$ =   8.5cm
                              6
Extension of A = extension of B
                  = $\underline{14 \times 6}$ = 4.667cm
                     6

9. State the two laws of refraction   (2 mks)

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The incident ray ,the refracted ray and the normal at the point of incidence all lie on the same plane.

The ratio of the angle of incidence to the sine of the angle of refraction is a constant for a given pair of media . i . e

sin i   **=constant**

sin r

10. Define the following terms:-

(a) **Displacement - Distance moved by a body in a specified direction**   **(1 mk)**

(b) **Speed – Distance covered per unit time.**   **(1 mk)**

(c) **Distance – Length of the path between two points**   **(1 mk)**

(d) **Velocity - The change of displacement per unit time.**   **(1 mk)**

11. State two factors that affect surface tension of a liquid.   (2 mks)
    - **Presence of impurities**
    - **Temperature changes**

SECTION B: (55 MARKS)

Answer all the questions from this section.

12. A stone is projected vertically upwards with a velocity of 30ms^{-1} from the ground. Calculate:-

(a) The time it takes to reach the maximum height.   (2 mks)

$$T = \frac{u}{g}$$

$$= \frac{60}{10} \qquad = 6s$$

(b) the time of flight.   (2 mks)

$$T = 2t$$
$$= 2 \quad 3$$
$$= 6 \text{ sec.}$$

(c) The maximum height reached.   (2 mks)

$$Hm = \frac{u^2}{2g}$$

$$= \frac{60 \times 60}{2 \times 10}$$
$$= 180M$$

(d) The velocity with which it lands on the ground (Take g = 10ms^{-1})   (2 mks)

$$V^2 = U^2 - 2gs$$
    But S = O

3

$$\text{Therefore } V^2 = U^2$$
$$= 60 \times 60$$
$$V = \sqrt{60 \times 60}$$

$$= 60m/s$$

13. Define the following terms:-
   a(i) Critical angle   (1 mk)
      - This is the angle of incidence for which the angle of refraction in air is 90⁰.
   (ii) Refractive index   (1 mk)
   **- Refers to the ratio between angle of incidence and angle of refraction.**

   b(i) Calculate the critical angle of a metal given that its refractive index is 2.42
      $$\textbf{Sin C} = \frac{\textbf{1}}{\textbf{n}}$$

      $$\frac{\textbf{1}}{\textbf{2/42}}$$

      $$\textbf{= 0.4132}$$

      $$\textbf{= 24.4⁰}$$

   (ii) If the critical angle for a liquid is 48.6⁰. Calculate the refractive index of the liquid.
      $$\textbf{n} = \frac{\textbf{1}}{\textbf{sin C}} \hspace{4cm} \textbf{(2 mks)}$$

      $$= \frac{\textbf{1}}{\textbf{Sin 48.6}}$$

      $$= \frac{\textbf{1}}{\textbf{0.7501}}$$

      $$\textbf{= 1.33}$$

   (ii) Determine the critical angle for glass-water interface (refractive indices of glass and
        water are 3/2 and 4/3 respectively)   (3 mks)

   n sin Ө = constant

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$$\frac{3}{2} \sin C = \frac{4}{3} \sin 90$$

$$\text{Sin } C = 0.8889$$
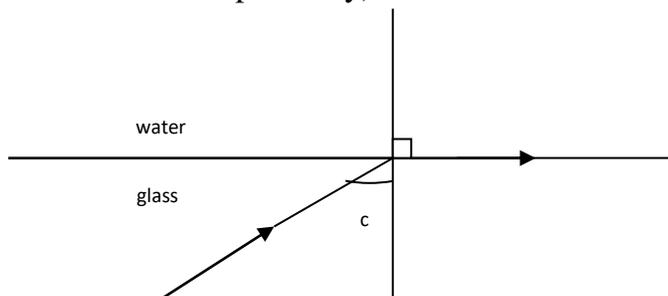
$$C = S^{-1} (0.8889)$$

$$= 62.7°$$

14. (a) State the Newton's second law of motion. (2 mks)

    - The rate of change of momentum of a body is directly proportional to the resultant external force producing the change and takes place in the direction of the force.

  (b) Determine the change in momentum produced when a force of 3.5×10^3 acts on a body which is at rest for 0.02 seconds. (2 mks)

    Ft = change in momentum = impulse

    = 3.5 x 103 x 0.02

    = 70Ns

  (c) What velocity will be given to the body if it has a mass of 20kg. (3 mks)

    Ft = Mv – mu

    but u = O

    Ft = mu

    v = $\frac{Ft}{m}$

    = 70 ÷ 20

    = 3.5m/s

15. (a) State any three laws of friction. (3 mks)

    - Ke is independent of relative velocity

    - Frictional force is dependent on the nature of the surfaces in contact.

    - Frictional force between 2 surfaces opposes their relative motion.

  (b) A wooden box of mass 60kg rests on a rough floor. The coefficient of friction between the floor and the box is 0.6.

  (i) Determine the force required to just move the box. (3 mks)

    F = UR

    = Umg

    = 0.6 x 60 x 10

    = 360N

  (ii) If a force of 400N is applied to the box, with what acceleration will it move? (Take g = 10m/s) (3 mks)

    Resultant force = 400 – 360

    = 40N

    F = ma

    40 = 60a

    a = $\frac{40}{60}$ **= 0.67m/s**

16. (a) Define the term mass. (1 mk)

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- Mass is the quantity of matter in an object.

(b) The density of mercury is 13.6gcm^{-3}. Find the volume of 2720g of mercury in m^3.

$$V = \frac{m}{d}$$
(3 mks)

$$= \frac{2720cm^3}{136} \qquad = 200cm^3$$

$$1cm^3 = \frac{1}{1000000m^3}$$

Therefore 200cm^3 $= \frac{200}{1000000}$

$$= 0.0002m^2$$

17. How does temperature affect Brownian motion? (2 mks)

- The rate of motion is increased by an increase in temperature due to an increase in the kinetic energy received by air molecules.

18. An object of height 5m is placed 10m away from a pinhole camera. Calculate:

(a) The size of the image if its magnification is 0.01 (3 mks)

Magnification = $\frac{\text{height of image (h}_1)}{\text{Height of object (h}_o)}$
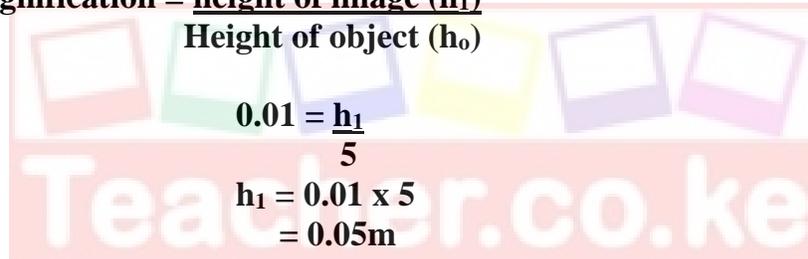
$$0.01 = \frac{h_1}{5}$$
$$h_1 = 0.01 \times 5$$
$$= 0.05m$$

(b) The length of the pinhole camera. (3 mks)

Magnification = $\frac{V}{U}$

$$0.01 = \frac{v}{10}$$
$$V = 0.01 \times 10$$
$$= 0.1m$$
$$= 10cm$$

19. State four methods of magnetizing a magnetic material. (2 mks)

- Induction
- Stroking
- Hammering
- Electrical method

20. (a) State the principle of moments. (2 mks)

- For a system in equilibrium, the sum of clockwise moments about a point is equal to the sum to the sum of anticlockwise moments about the same point.

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(b) A uniform metre rule pivoted at the centre is balanced by a force of 4.8N at 20cm mark and other two forces F and 2.0N at the 66cm and 90cm marks respectively. Calculate the force F.   (4 mks)

Distance of 4.8N from the pivot
= 50 – 20 = 30cm = 0.3m

Distance of F
= 66 – 50 = 16cm = 0.16m
Distance of 2.0N = 90 – 50 = 40cm = 0.4m

Sum of clockwise moments
(F x 0.16) + (2.0 x 0.4) = 0.16F + 0.8

Sum of anti-clockwise
4.8 x 0.3   = 1.44
  Therefore 0.16F + 0.8 = 1.44
  0.16F =
  0.16

  0.64
  0.16

  F = 4.0N