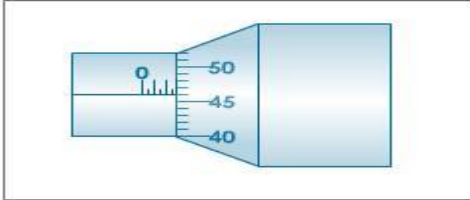


Marking scheme

SECTION A (25 MARKS)

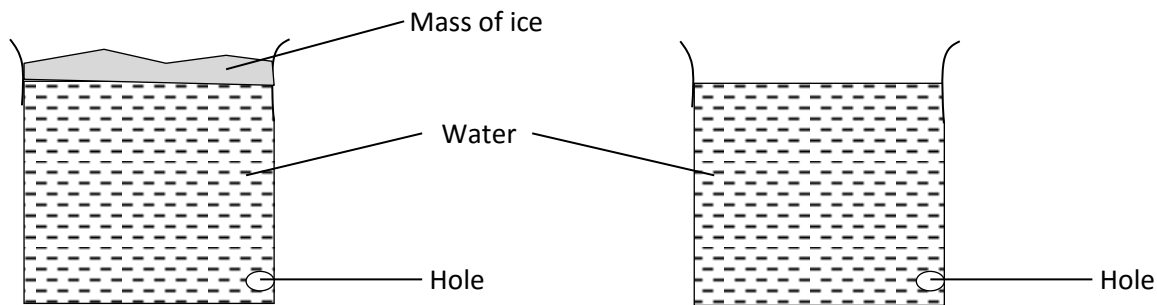
1. (2mrks)



$$\begin{aligned} \text{sleeve scale reading} &= 2.5\text{mm} \\ \text{thimble scale reading} &= 0.46\text{mm} \\ \text{screw guage reading} \\ &= 2.96\text{mm actual diameter} \\ &= 2.96 - 0.25 = 2.71\text{mm} \end{aligned}$$

2. When washing clothes, it is easier to remove the dirt using soap in warm water than cold water. Explain. (2mrks)

Warm water lowers the surface tension of water making the molecules loose for the soap to act on the dirt molecules



i) (2mrks)
 Hole on A throws water farther than the hole on B

ii) (3mrks)

$$\begin{aligned} P_A &= \rho g h + \text{pressure due to the mass of ice} \\ &= 0.421 \times 1000 + \frac{0.24}{\frac{22}{7} \times 0.105 \times 0.105} \\ &= 421 + 6.926 \\ &= 421.6926 \text{Nm}^{-2} \end{aligned}$$

3. When a litre of milk is poured in 20 litres of water, the colour changes to white. Explain (1mrk)

The molecules of milk diffuse in the water until it is homogeneously distributed

4. Give a reason why alcohol in glass thermometer cannot be used when boiling water is to be used in an experiment. (1mrk)

The alcohol in the thermometer vaporizes long before the water boils. (it has a lower boiling point)

5. (2mrks)

During the day the land gets heated faster than water body, air above the land becomes less dense and rises. Cold air from the sea flows to the land to occupy the space left which contributes to the breeze.

6. Kariuki identifies an abandoned circular water well of diameter 2.1m as a breeding zone for mosquitoes. He intends to use engine oil to control the breeding by pouring it on the surface of the water. Given that the thickness of a molecule in the oil is 1.635×10^{-9} , determine the minimum volume of oil he requires.

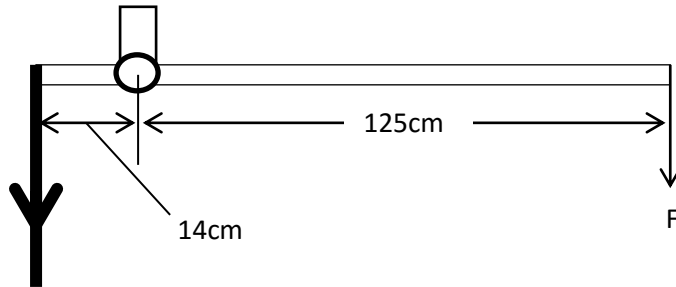
(3mrks)

$$V = \pi r^2 t$$

$$= \frac{22}{7} \times 1.05 \times 1.05 \times 1.635 \times 10^{-9}$$

$$= 5.665 \times 10^{-9} m^3$$

7. The figure below represents the arm of a lift pump with a force F being applied by the person drawing water. Determine the value of F that just pushes the arm downwards.



Weight of parts
= 600N

sum of clockwise moments = sum of anticlockwise moments

$$F \times 1.25 = 0.14 \times 600$$

$$F = \frac{0.14 \times 600}{1.25} = 67.2N$$

8. Water flows along a horizontal pipe of cross sectional area $48cm^2$ which has a constriction of cross-sectional area $12cm^2$ at one place. If the speed of water at the constriction is $4ms^{-1}$, calculate the speed in the wider section.

(2mrks)

$$A_1 v_1 = A_2 v_2$$

$$v_1 = \frac{12 \times 4}{48}$$

$$= 1ms^{-1}$$

9. Determine the extension produced by a pair of parallel identical springs each of constant $1000Nm^{-1}$ when a mass of 0.2kg is hung below them.

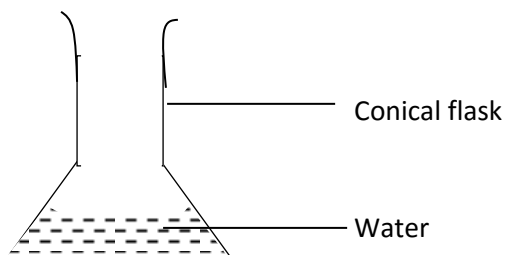
(2mrks)

$$F = ke,$$

$$e = \frac{F}{k} = \frac{2}{1000}$$

$$= 0.002m$$

10. The figure below shows a conical flask with some water to the level indicated.



- a) State the change in the stability of the flask when more water is added to it. (1mrk)
It becomes less stable

- b) Give a reason for your answer in a) above. (1mrk)
 The position of centre of gravity is raised

SECTION B (55MARKS)

11. a)

- i) the time taken (2mrks)

$$v = u + at$$

$$15 = 10 + t$$

$$t = 5s$$

- ii) The distance travelled during the acceleration. (3mrks)

$$s = ut + \frac{1}{2}at^2$$

$$= 10 \times 5 + \frac{1}{2} \times 125$$

$$= 50 + 12.5$$

$$= 62.5m \text{ or}$$

$$v^2 = u^2 + 2as$$

$$15^2 = 10^2 + 2 \times 1 \times S$$

$$225 - 100 = 2s$$

$$s = 62.5m$$

- iii) The velocity reached 100m from the place where the acceleration began. (3mrks)

$$v^2 = u^2 + 2as$$

$$= 100 + 2 \times 1 \times 100$$

$$= 300$$

$$v = \sqrt{300}$$

$$= 17.32ms^{-1}$$

- i) Initial velocity of the car (2mrks)

$$u = \frac{s}{t}$$

$$= \frac{5}{5} = 1ms^{-1}$$

- ii) Final velocity of the vehicle just before it ran out of fuel (1mrk)

$$v = \frac{50}{5} = 10ms^{-1}$$

- iii) The acceleration of the car. (2mrks)

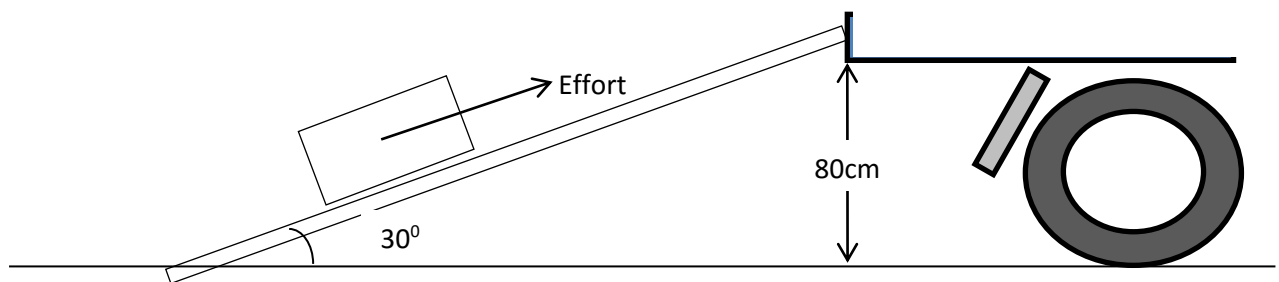
$$a = \frac{v - u}{t}$$

$$= \frac{10 - 1}{20}$$

$$= 0.45ms^{-2}$$

12. a) state the law of conservation of energy (1mrk)

The sum of kinetic energy and potential energy of a system is constant



- i) The length of the wooden bar (2mrks)

$$l = \frac{80}{\sin 30^\circ} = 160\text{cm}$$

- ii) Useful work done on the refrigerator (3mrks)

$$\begin{aligned} W &= P.E \\ &= mgh \\ &= 71 \times 10 \times 0.8 = 5680\text{J} \end{aligned}$$

- iii) Work done by Simon in moving the refrigerator along the wooden bar when he applies a force of 4000N. (3mrks)

$$\begin{aligned} W &= F \times d = 4000 \times 1.6 \\ &= 6400\text{J} \end{aligned}$$

Efficiency of the inclined plane (2mrks)

$$\begin{aligned} \text{efficiency} &= \frac{\text{work output}}{\text{work input}} \times 100 \\ &= \frac{5680}{6400} \times 100 = 88.75\% \end{aligned}$$

- iv) Account for the value of efficiency obtained in iv) above. (1mrk)
It is not 100% since some energy is lost when overcoming friction

13. a) state newton's second law of motion (1mrk)

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

- b.i) the recoil velocity of the gun (3mrks)

momentum before firing = momentum after firing

$$\begin{aligned} m_1 u_1 + m_2 u_2 &= m_1 v_1 + m_2 v_2 \\ 0 &= 0.04 \times 300 + 30 \times v_2 \\ -12 &= 30v_2 \\ v_2 &= -0.4\text{ms}^{-1} \end{aligned}$$

- c) the force with which the bullet hits the wooden block (3mrks)

$$\begin{aligned} s &= ut + \frac{1}{2}at^2 \\ 30 &= 300 \times 0.5 + \frac{1}{2} \times a \times 25 \\ 30 &= 15 + 12.5a \\ 15 &= 12.5a \quad a = 1.2\text{ms}^{-2} \end{aligned}$$

$$F = ma$$

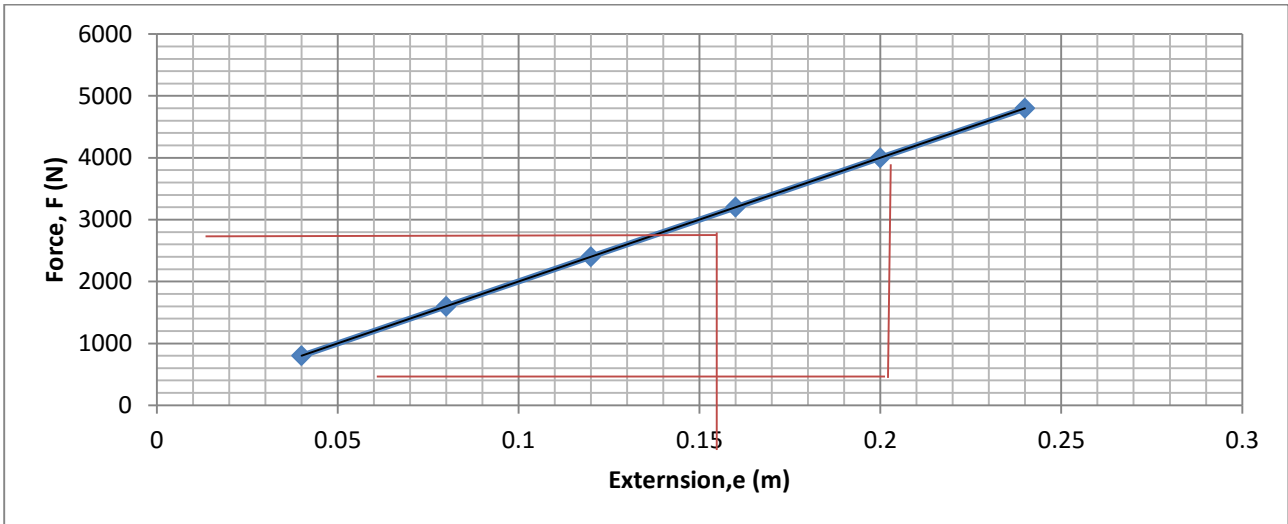
$$= 0.04 \times 1.2 = 0.048N$$

d) the velocity of the bullet just before hitting the block (3mrks)

$$v = u + at$$

$$= 300 + 1.2 \times 0.5 = 300 + 0.6 = 300.6ms^{-1}$$

14. The figure below shows a graph of weights of persons entering a lift against the extension of four springs supporting the lift. From the graph determine,



a) The spring constant of the springs (3mrks)

$$k = slope = \frac{4000 - 1000}{0.2 - 0.05}$$

$$= \frac{3000}{0.15} = 20000Nm^{-1}$$

b) The spring constant of a single spring (1mrk)

$$k = \frac{20000}{4}$$

$$= 5000Nm^{-1}$$

c) The mass of passengers that would cause an extension of 0.6m on a single spring. (3mrks)

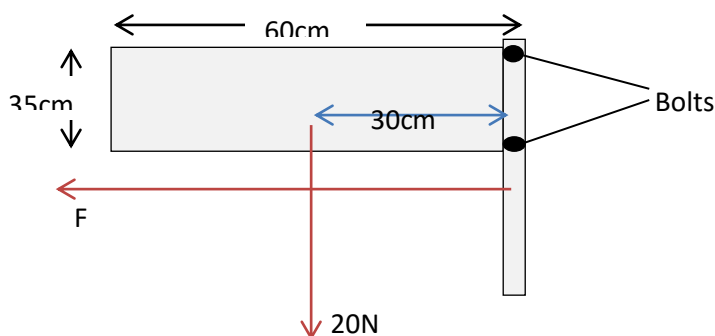
$$four\ springs, e = \frac{0.6}{4}$$

$$F = 3000N, mass = 30kg$$

15. a) define moment of a force (1mrk)

The product of force and the perpendicular distance between the line of action and the point of support

b)



Given that the weight of the board is 20N,

- i) determine the force that the lower bolt applies on the plate to maintain it at horizontal
(3mrks)

sum of clockwise moments = sum of anticlockwise moments

$$F \times 0.35 = 20 \times 0.3$$

$$F = \frac{20 \times 0.3}{0.35} = 17.143N$$

- ii) State one way of reducing the force in i) above. (1mrk)
Use a lighter board
Make the board narrower
Make the board shorter

- c) Explain how the stands of students' lockers that are slightly inclined outwards improve their stability. (2mrks)

Widening at the base increases the base area thus increasing the angle of tilt hence more stable

16. a) A tennis ball is struck such that it backspins at it crosses the net before landing in the court area of an opponent player.

- i) Explain the trajectory of the ball as it rises above the net. (3mrks)

The air currents above the ball increases while those below the ball decrease causing a corresponding decrease in pressure at the top and increase in pressure at the bottom. The pressure difference gives the ball a lift force.

- ii) Give a possible reason that caused the ball to drop in the opponents court instead of rising continuously (1mrk)

The force of gravity acts on the ball thus pushing it down

- b) Explain the following;

- i) Mountain climbers are highly likely to nose bleed when they reach the mountain top (2mrks)

Atmospheric pressure decreases at the top thus greater blood pressure under the nose causes the blood capillaries to rupture

- ii) A bulldozer easily moves on earth roads while a saloon car cannot. (2mrks)

Bulldozer has wider wheels thus they exert a lower pressure on the road than a saloon car that has narrow wheels.