OPENER EXAMINATION: TERM 2 2024
FORM THREE

PHYSICS

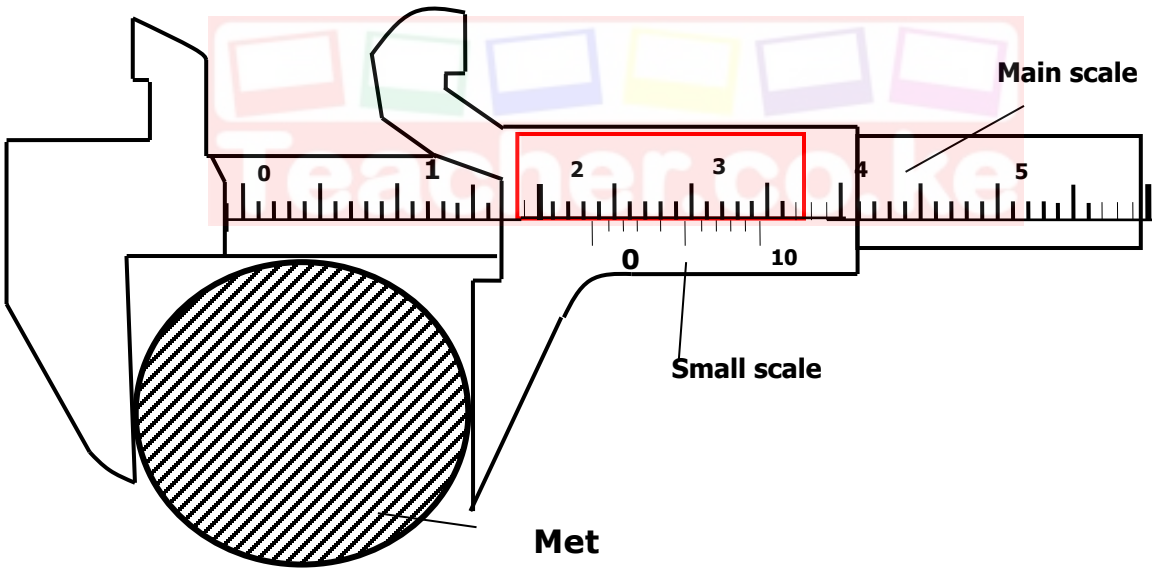
MARKING SCHEME

INSTRUCTION TO THE TEACHER:

This marking scheme may not be the final draft. The author acknowledges that there could be other perspectives of facts and so the teacher concerned is highly encouraged to adapt it accordingly.

SECTION A (25 MARKS)

1. The figure below shows a vernier caliper being used to measure the diameter of a cylindrical metal of mass **250g** and length **20cm**. The reading on the calipers when the jaws were fully closed without the metal was **+ 0.08cm**.



(a) What is the diameter of the cylindrical metal? **(2mk)**

Reading on Vernier caliper = 2.44 Cm
Actual diameter = 2.44 – 0.08
= 2.36 Cm

(b) Calculate the volume of the cylindrical metal. **(2mk)**

Volume = 3.142 × 1.18 × 1.18 × 20
= 87.50 Cm³

2. State **one** factor that affects the turning effect of a force on a body.
(1 mark)

- **Magnitude of the force**
- **Perpendicular distance between pivot and line of action of force**

1-mark max. (mark only the first response of the learner)

3. **Figure 2** shows some air trapped by mercury in a glass tube. The tube is inverted in a dish containing mercury.

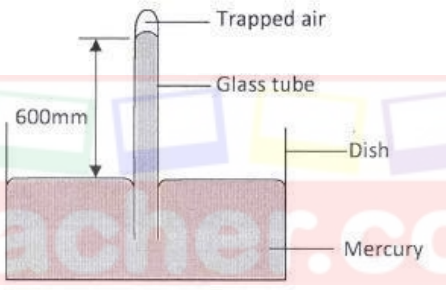


Figure 2

Given that the atmospheric pressure is 760 mmHg and the height of mercury column in the tube is 600 mm, determine the pressure of the air trapped in the tube in mmHg.

(2 marks)

$atm.\ pressure = liquid\ pressure + air\ pressure$ **formula/sub**

$760 = 600 + air\ pressure$;

Therefore, air pressure = $760 - 600 = 160mmHg$; **correct answer with units**

4. Figure 3 shows drops of mercury and water on a glass surface, Explain the difference in the shapes of the drops.

(2marks)

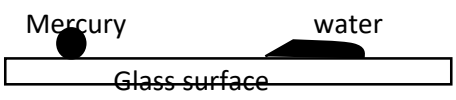


Figure 3

Cohesive force among mercury molecules is stronger than adhesive force between mercury and glass molecules; in water, adhesive force between water and glass molecules is stronger than cohesive force between water molecules;

5. A ball is thrown from the top of a cliff 20m high with a horizontal velocity of $10ms^{-1}$. Calculate the distance from the foot of the cliff to where the ball strikes the ground.

(3 marks)

$h = \frac{1}{2}gt^2 \equiv 20 = \frac{1}{2} \times 10 \times t^2 \rightarrow t = 2\ seconds$ **; award for time**

$R = ut \rightarrow R = 10 \times 2; = 20m;$ **formula/sub and the correct answer with units**

6. Explain one advantage of mercury over alcohol as a thermometric liquid. (1mark)

Higher boiling point so it can measure higher temperature than alcohol;
Expand and contract uniformly
Opaque hence viscible
Does not stick to glass

7. A body of mass **M** is allowed to slide down an inclined plane. State **two** factors that affect its final velocity at the bottom of the inclined plane. (2marks)

- **Angle of inclination of the plane**
- **Vertical Height of the inclined plane**
- **Length of the plane**
- **Frictional force between the plane and the body**

Maximum of two marks but consider **only the first two** responses of the learner

8. A stopwatch reads 08:10:84 and 09:10: 90 before and after an experiment respectively. Determine the duration of the event in SI units.

(2marks)

$final\ time = (9 \times 60) + 10.90 = 550.$ **award for either final/initial time** **Initial time = $(8 \times 60) + 10.84 = 490.84s$;**

Time taken = 60.06 seconds ; **correct answer with units**

9. Explain the meaning of thermodynamics as a branch of physics. (1 mark)

The study of heat and its transformation to and from other forms of energy;

10.

a. State the Hooke's Law.

(1mark)

For an elastic material, extension is directly proportional to the stretching force provided elastic limit is not exceeded;

b. **Figure 4** shows identical spiral springs supporting a load of 90N. Each spring has a spring constant k = 200N/m

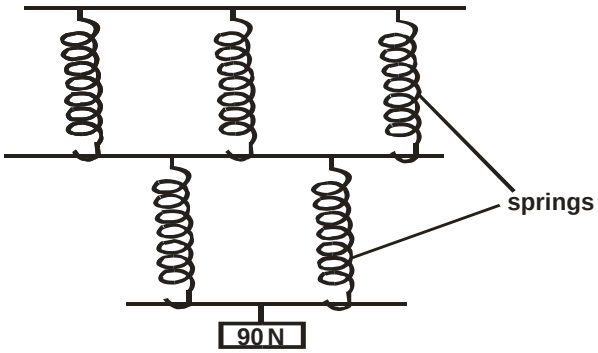


Figure 4

Determine the total extension of the system (take the weight of the cross bars and springs to be negligible)
(2 marks)

$K_1 = 3 \times 200 = 600Nm^{-1}$; so extension is: $\kappa^F = \frac{90}{600} = 0.15m$

$K_2 = 2 \times 200 = 400Nm^{-1}$ –so extension is: $\kappa^F = \frac{90}{400} = 0.225m$

award for either combined spring constant $total\ extension = 0.15 + 0.225 = 0.375m$;
correct answer with units

11. **Figure 5** shows a rectangular loop with a thin thread loosely tied and dipped into a soap solution. Draw on the space provided what is observed when point **A** is punctured.

(1 mark)

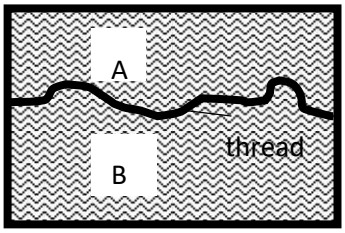
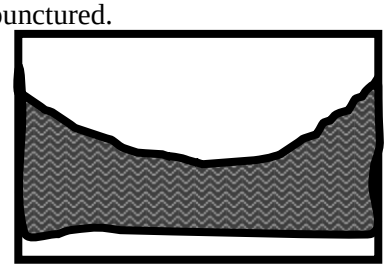


Figure 5



12. Two horizontal strings are attached to a block, resting on a frictionless surface, as shown in figure 6.

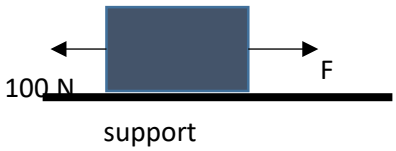


Figure 6

A force of 100N pulls on one string. The block does not move. Find the value of the force, F on the other string.

(1 mark)

$0 = 100N + (-F)$ therefore, F= 100N;

13. A wooden bench feels neither warm nor cold when touched by your bare hands. Explain this observation.

(2 marks)

Wood is a poor conductor of heat; it does not therefore take away heat from the hand hence no change in body temperature;

SECTION B (55 MARKS)

14. **(a)Force=pressure x Area**

P=ɦℓG=20x100x 10=20000 N/m²

$F=20000x\frac{2}{10000} = 4N$

OR

MASS= density x volume

$$= 1000 = 1000x\frac{2}{10000}\ x\ 2 = 0.4kg$$

Force= mass x gravity= 0.4kg x10= 4N

(b) $P=\frac{F}{A} = \frac{2500}{0.25x4} = 25000pa$

(c).A cyclist initially at rest moved down a hill without peddling .He applied brakes and continually stopped. State the energy changes as he cyclist moved down a hill. (1mk)

Potential energy – kinetic energy

d. State the principle of conservation of linear momentum **(1 mark)**

For a sytem of colliding bodies, total linear momentum is conserved unless acted upon by external force

e) State the principle of conservation of linear momentum (1 mark)

For a system of colliding bodies, the total linear momentum before and after the collision remains a constant;

f) A bullet of mass 60g is fired horizontally with a velocity of 200 m/s into a suspended stationary wooden block of mass 2940g. Determine:

i. Common velocity of both the bullet and the block, if the bullet embedded into the block. (2 marks)

$$momentum\ before\ collission = momentum\ after\ collission$$

$(0.06 \times 200) + (2.94 \times 0) = 3V$; **formula or substitution**

$12 = 3V$ therefore, $V = \frac{12}{3} = 4m/s$; **correct answer with units**

ii. Height to which the block rises. (2 marks)

$mgh = \frac{1}{2}mv^2$; $\rightarrow h = \frac{0}{10}\frac{.5\times4^2}{} = 0.8m$; **formula/sub; correct answer with units;**

15. (a) Zero (0) –It is because their velocities are still zero/ They are still stationary

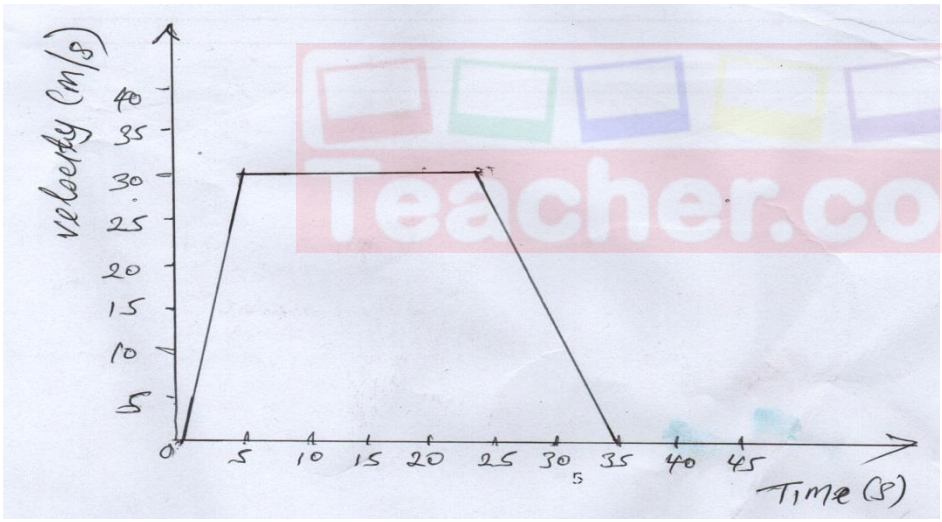
(b) $a = F/M = \frac{4.0}{0.5} = 8.0m/s^2$

(c) $V = \frac{0.9 \times 1.5}{} = 2.7m/s$ to the right

0.5

(d) trolley A, √ because of it moves √with high velocity
(e) Friction force

16.



(i) since U=0,S=1/2g^2 →45=1/2 x10 x t$^{2→}$ t=3s

(ii) S = u t, 50=U x 3 →u=16.7 m/s

(iii)V=u + g t=0+10x3==30m/s

17.

ii) The wire has a greater constant of elasticity √1 than coil of the same material hence greater gradient.

c) K.E of stone = elastic potential energy of catapult

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

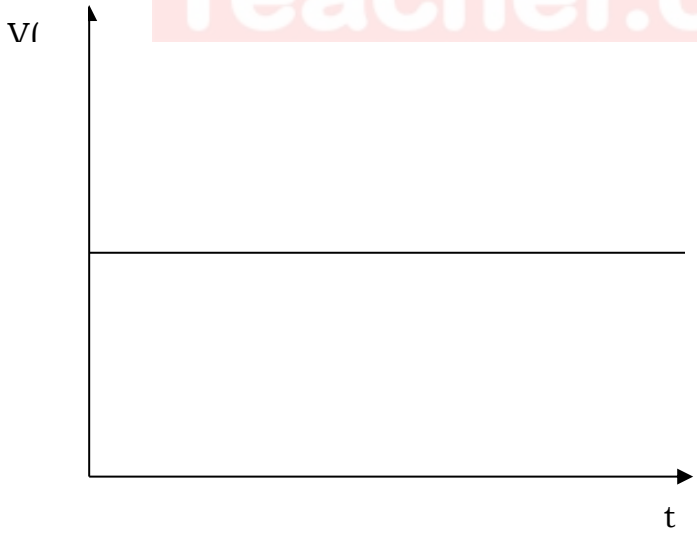
$\frac{1}{2} \times \frac{5}{1000} \times v^2 = \frac{1}{2} \left(\frac{100N}{1/1000}\right) M (10/100)^2 √1$

$\frac{5v^2}{2000} = \frac{1}{2} \times 100 \times 100 \times \frac{10 \times 10}{100 \times 100} √1$

$\frac{5v^2}{100} = 100$

$v^2 = \frac{100}{5} \times 1000 = 20{,}000$

$v = 141\ ms^{-2} √1$



Horizontal velocity remains

√

d) i)

Load	0.00	1.00	2.00	4.00	5.00	6.00	
L	10.00	11.50	13.50	16.00	18.00	24.00	

E	0.00	1.50	3.50	6.00	8.00	14.00	√1

ii) Suitable axes labelled √1

All points correct √1

Suitable line √1

iii) Springs constant K = $\frac{\triangle F}{\triangle e}$ √1

Use students graph

Correct units √1

iv) Energy stored when the length is stretched by 16 cm

Area under the graph √1

Or E = ½ ke²

Use k from graph and e = 16 cm.
K must be correct.

Correct substitution √1

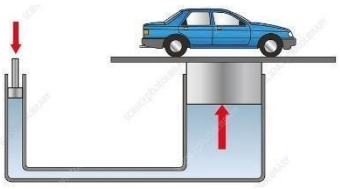
Answer correct unit √1

18.

a) Define the term velocity ratio of a machine (1 mark)

The ratio of effort distance to load distance;

b) The figure 11, below shows part of the hydraulic lift system. State any property of the liquid under which the hydraulic system works (1 mark)



- **Incompressible**
- **High boiling point and low freezing point Non-corrosive**

Award one mark for any correct response

Figure 11

c) The hydraulic lift machine above has velocity ratio 45 and it overcomes a load of 4500 N when an effort of 135 N is applied. Determine:

i. The mechanical advantage of the machine (2 marks)

LOAD **4500**

$M.A = \frac{\text{LOAD}}{\text{EFFORT}} = \frac{}{135} = 33.33$; correct substitution and correct answer

ii. Efficiency of the machine (3 marks)

$\cap = \frac{M.A}{\frac{V.R}{33.33}} \times 100$;

formula

$\equiv \cap = \frac{}{45} \times 100$; substitution

$\rightarrow \cap = 74.07\%$; correct evaluation in %

iii. The percentage of work that goes to waste (1 mark)

$100 - 74.07 = 25.93\%$;

This is the last printed page