

# Physics Higher Level Mechanics and Properties of Matter Practice Unit Assessment

Time 45 minutes

## Read Carefully

- 1 All questions should be attempted.
- 2 Enter the question number clearly beside the answer to each question.
- 3 Care should be taken to give an appropriate number of significant figures in the final answers to calculations.
- 4 The following data should be used when required.

Speed of light in vacuum $c$	$3.00 \times 10^8 \text{ m s}^{-1}$	Planck's constant $h$	$6.63 \times 10^{-34} \text{ J s}$
Magnitude of the charge on electron $e$	$1.60 \times 10^{-19} \text{ C}$	Mass of electron $m_e$	$9.11 \times 10^{-31} \text{ kg}$
Acceleration due to gravity $g$	$9.8 \text{ m s}^{-2}$	Mass of proton $m_p$	$1.67 \times 10^{-27} \text{ kg}$

NOTE: This is a **trial paper** and contains questions **of the type** that will be encountered in the actual unit assessment. The threshold of attainment of the unit assessment (pass mark) is 18 marks.

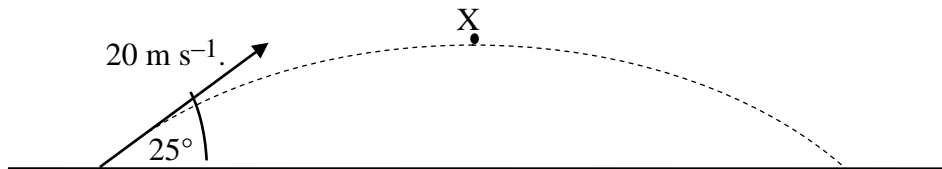
1. During athletics training a runner jogs north along a track for a distance of 40 m. He then turns and jogs east for a distance of 30 m. This takes a total time of 20 s.



- (a) (i) What is the size in metres of the displacement of the runner?  
 (ii) Find the direction of the resultant displacement. 2
- (b) Find his average velocity of the runner during this activity. 2

(4)

2. A projectile is fired with a velocity of  $20 \text{ m s}^{-1}$  at an angle of  $25^\circ$  above the horizontal. Any effect due to air resistance can be ignored.

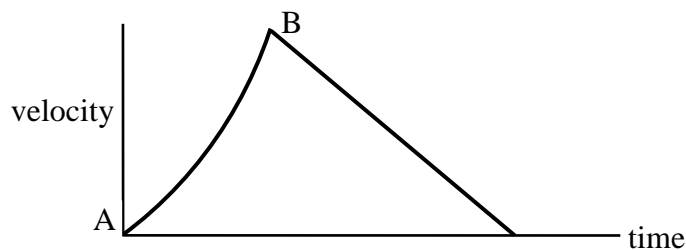


- (a) Calculate:  
 (i) the initial vertical component of the projectile's velocity;  
 (ii) the initial horizontal component of the projectile's velocity. 2
- (b) Calculate the maximum height reached by the projectile at point X. 2

(4)

3. A distress rocket has a total mass of 0.5 kg. When it is fired it produces a total thrust of 45 N.

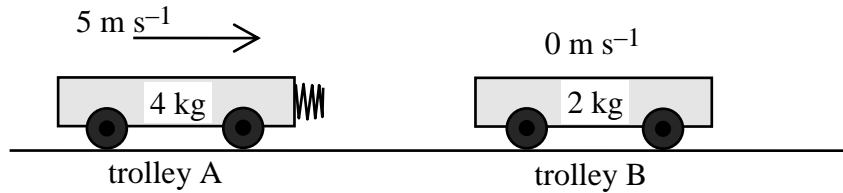
- (a) What is the weight of the rocket just after it is launched? 1
- (b) Calculate the initial acceleration of the rocket. 2
- (c) The graph below represents the velocity of the rocket during its journey to **maximum** height.



Explain why the rate of acceleration increases between A and B. 2

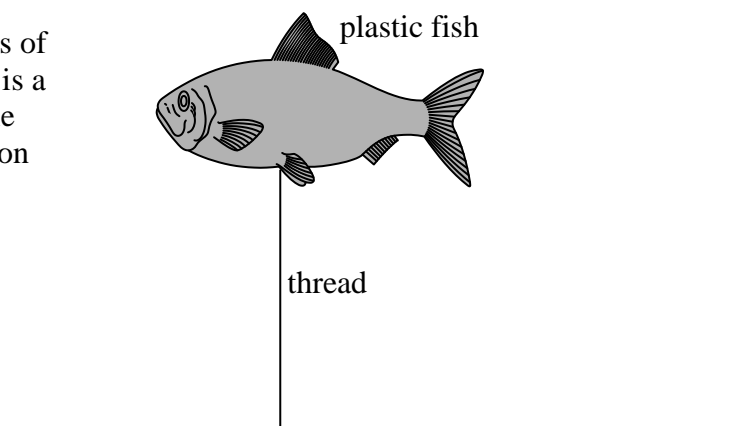
(5)

4. A trolley approaches another trolley head on as shown in the diagram below. Trolley A, with a mass of 4 kg and travelling at  $5 \text{ m s}^{-1}$ , has a spring attached to its front so that when it collides with trolley B they spring apart. The second trolley is stationary and has a mass of 2 kg.



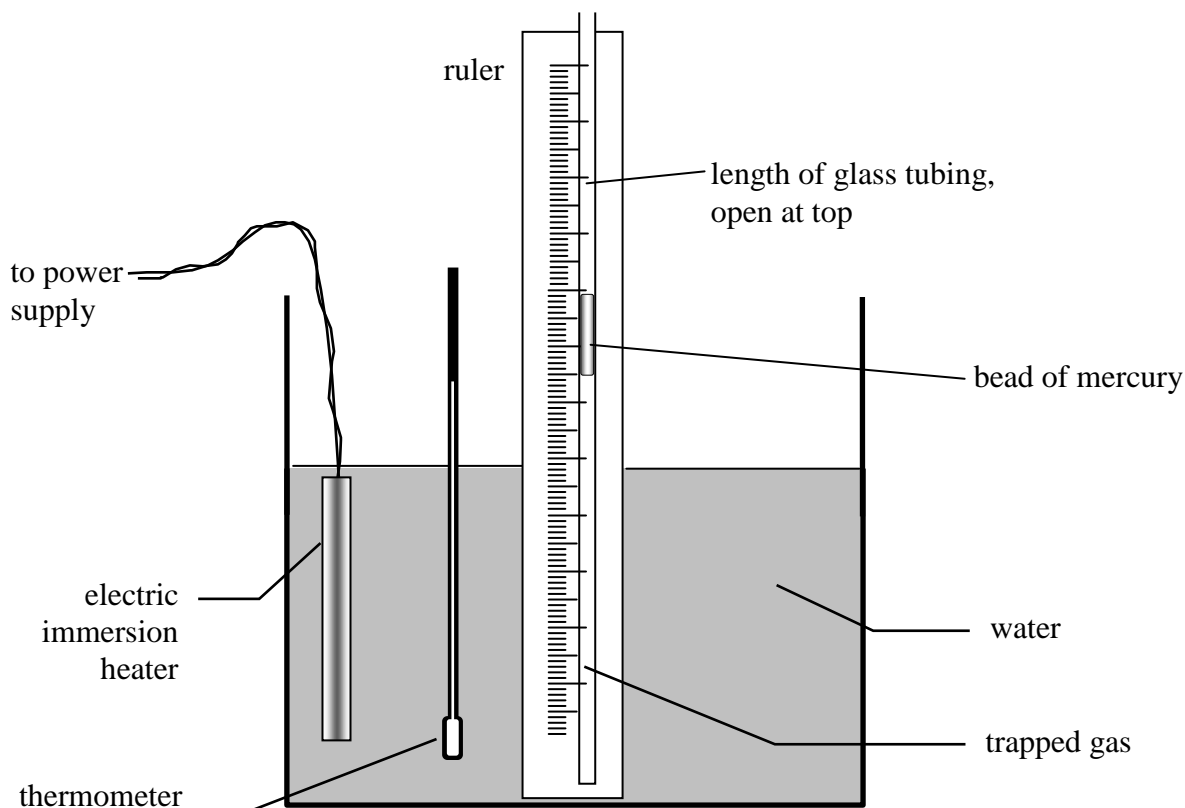
- (a) Use the principle of conservation of momentum to calculate the velocity of trolley B after the collision if trolley A continues to the right at  $2.0 \text{ m s}^{-1}$ . 2
- (b) (i) What is the change in momentum of trolley B as a result of the collision? 1
- (ii) The two trolleys are in contact for 0.4 s. Calculate the average force applied to trolley B by trolley A. 2
- (5)**
5. A beaker of liquid contains  $240 \text{ cm}^3$  of liquid.
- (a) If the density of the liquid is  $1150 \text{ kg m}^{-3}$ , find its mass. 2
- (b) A small quantity of the liquid is converted into vapour. The vapour occupies a volume 1000 times greater than the volume of the liquid. Explain this observation in terms of a particle model. 2
- (5)**

6. An executive toy consists of a tank of water in which is a plastic fish tethered to the base of the tank by a nylon thread.



- (a) Draw a diagram that names and shows all the forces acting on the plastic fish in the vertical direction. 1
- (b) The nylon thread snaps and the fish floats to the surface of the water. Name the force which causes the fish to float upwards and explain how this force is produced. 2
- (3)**

7. An experiment is carried out to investigate the relationship between the volume and temperature of a gas. The apparatus used below is used for this. A column of gas is trapped by a bead of mercury and this is placed in a water bath. As the temperature of the surrounding water increases the water temperature is taken and the length of the trapped gas is recorded. The length of this trapped gas is proportional to its volume.



The results obtained from the experiment are given in the table below.

Length of tube/cm	21.5	22.9	24.4	25.9	27.3
Temperature of water in Kelvin	293	313	333	353	373

- (a) Use all the data given above to show the relationship between the volume and temperature of the gas.
- (b) Suggest **one** improvement that could be made to the apparatus which would improve the accuracy of the results obtained.

3

1

(4)