

Answer **all** the questions in the spaces provided.

- 1 (a) Derive the SI base unit of force.

SI base unit of force = ..... [1]

- (b) A spherical ball of radius  $r$  experiences a resistive force  $F$  due to the air as it moves through the air at speed  $v$ . The resistive force  $F$  is given by the expression

$$F = crv,$$

where  $c$  is a constant.

Derive the SI base unit of the constant  $c$ .

SI base unit of  $c$  = ..... [1]

- (c) The ball is dropped from rest through a height of 4.5 m.
- (i) Assuming air resistance to be negligible, calculate the final speed of the ball.

speed = .....  $\text{m s}^{-1}$  [2]

- (ii) The ball has mass 15 g and radius 1.2 cm.

The numerical value of the constant  $c$  in the equation in (b) is equal to  $3.2 \times 10^{-4}$  when measured using the SI system of units.

Show quantitatively whether the assumption made in (i) is justified.

[3]

Answer **all** the questions in the spaces provided.

For  
Examiner's  
Use

- 1 (a) (i) Define *pressure*.

.....  
..... [1]

- (ii) State the units of pressure in base units.

..... [1]

- (b) The pressure  $p$  at a depth  $h$  in an incompressible fluid of density  $\rho$  is given by

$$p = \rho gh,$$

where  $g$  is the acceleration of free fall.

Use base units to check the homogeneity of this equation.

.....  
.....  
.....  
..... [3]

Answer **all** the questions in the spaces provided.

For  
Examiner's  
Use

- 1** A student takes readings to measure the mean diameter of a wire using a micrometer screw gauge.

**(a)** Make suggestions, one in each case, that the student may adopt in order to

**(i)** reduce a systematic error in the readings,

.....  
 .....

**(ii)** allow for a wire of varying diameter along its length,

.....  
 .....

**(iii)** allow for a non-circular cross-section of the wire.

.....  
 .....

[3]

**(b)** The mean diameter of the wire is found to be  $0.50 \pm 0.02$  mm. Calculate the percentage uncertainty in

**(i)** the diameter,

uncertainty = ..... %

**(ii)** the area of cross-section of the wire.

uncertainty = ..... %  
 [2]