

- 1 (a) It is suggested that the mass flow rate  $Q$  of grains through a hopper can be given by

$$Q = C\rho\sqrt{g}(D - kd)^{3/2}$$

where  $C$  and  $k$  are constants,  $\rho$  is the density of the grains,  $D$  is the diameter of the aperture of the hopper,  $d$  is the diameter of the circular grain and  $g$  is the acceleration due to free fall.

Determine the units of  $C$  and  $k$  in terms of the SI base units

units of  $k$  = .....

units of  $C$  = .....

[3]

- (b) The mass of a steel ball is  $(500 \pm 1)$  g. The density of steel is  $(7.75 \pm 0.01)$  g cm<sup>-3</sup>. Calculate the radius of the steel ball with its associated uncertainty.

$$\text{radius} = \dots \pm \dots \text{ cm} \quad [3]$$

- (c) A small car of mass 800 kg is moving in the north-east direction with a speed of  $20.0 \text{ m s}^{-1}$ . At a bend in the road, the car took 3.0 s to turn and move off with a speed of  $25.0 \text{ m s}^{-1}$  towards the east after the turn. Calculate the magnitude of the average force experienced by the car in those 3.0 s.

$$\text{force} = \dots \text{ N} \quad [3]$$

[Total: 9]

