

- 2 (a) State what is meant by *kinetic energy*.

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.....[1]

- (b) A cannon fires a shell vertically upwards. The shell leaves the cannon with a speed of  $80 \text{ ms}^{-1}$  and a kinetic energy of  $480 \text{ J}$ . The shell then rises to a maximum height of  $210 \text{ m}$ . The effect of air resistance is significant.

- (i) Show that the mass of the shell is  $0.15 \text{ kg}$ .

[2]

- (ii) the movement of the shell from the cannon to its maximum height, calculate

1. the gain in gravitational potential energy,

gain in gravitational potential energy = ..... J [2]

2. the work done against air resistance.

work done = ..... J [1]

- (iii) Determine the average force due to the air resistance acting on the shell as it moves from the cannon to its maximum height.

force = ..... N [2]

- (iv) The shell leaves the cannon at time  $t = 0$  and reaches maximum height at time  $t = T$ .

On Fig. 2.1, sketch the variation with time  $t$  of the velocity  $v$  of the shell from time  $t = 0$  to time  $t = T$ . Numerical values of  $v$  and  $t$  are not required.

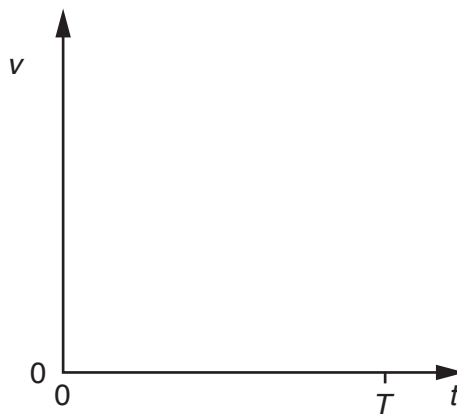


Fig. 2.1

[2]

- (v) The force due to the air resistance is a vector quantity.

Compare the force due to the air resistance acting on the shell as it rises with the force due to the air resistance as it falls.

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.....[2]

[Total: 12]