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

.....

.....[1]

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

(i) Show that the mass of the shell is 0.15 kg.

[2]

(ii) For 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.

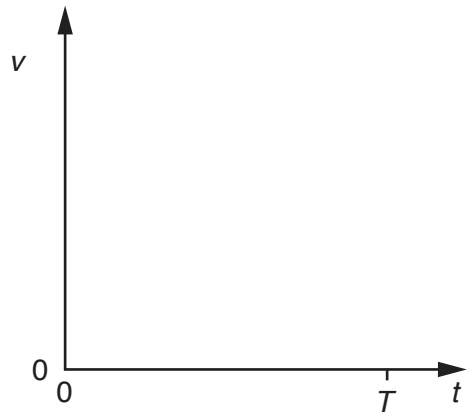

Fig. 2.1

[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]