

- 2 (a) State Newton's second law of motion.

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 ..... [1]

- (b) A delivery company suggests using a remote-controlled aircraft to drop a parcel into the garden of a customer. When the aircraft is vertically above point P on the ground, it releases the parcel with a velocity that is horizontal and of magnitude  $5.4 \text{ m s}^{-1}$ . The path of the parcel is shown in Fig. 2.1.

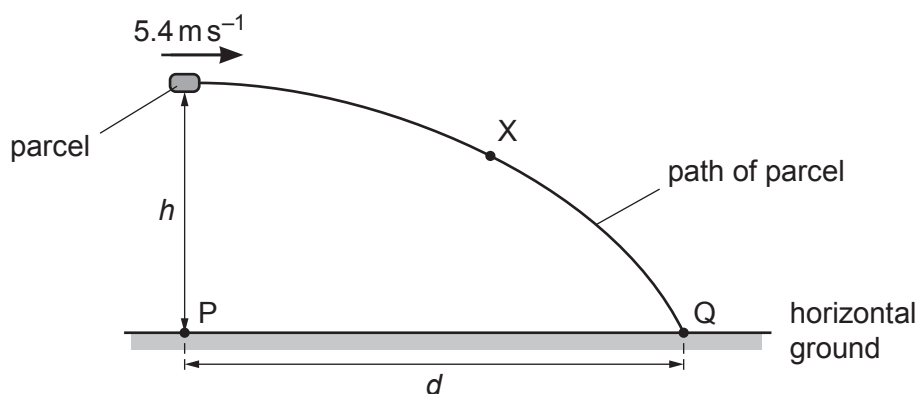


Fig. 2.1 (not to scale)

The parcel takes a time of 0.81 s after its release to reach point Q on the horizontal ground. Assume air resistance is negligible.

- (i) On Fig. 2.1, draw an arrow from point X to show the direction of the acceleration of the parcel when it is at that point. [1]
- (ii) Determine the height  $h$  of the parcel above the ground when it is released.

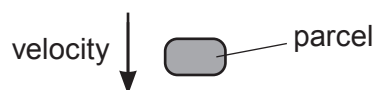
$h =$  ..... m [2]

- (iii) Calculate the horizontal distance  $d$  between points P and Q.

$d =$  ..... m [1]

(c) Another parcel is accidentally released from rest by a different aircraft when it is hovering at a great height above the ground. Air resistance is now significant.

- (i) On Fig. 2.2, draw arrows to show the directions of the forces acting on the parcel as it falls vertically downwards. Label each arrow with the name of the force.



**Fig. 2.2**

[2]

- (ii) By considering the forces acting on the parcel, state and explain the variation, if any, of the acceleration of the parcel as it moves downwards before it reaches constant (terminal) speed.

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- (iii) Describe the energy conversion that occurs when the parcel is falling through the air at constant (terminal) speed.

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[Total: 11]