1 Artificial satellites are put into space for scientific research.

The satellites are carried into space by rockets.

(a) A rocket accelerates steadily from rest and reaches 8000 m/s after travelling 1 680 000 m. Calculate the time, in minutes, it takes the rocket to reach this speed.

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answer ..... minutes **[3]**

(b) **(i)** The rocket is now in a stable orbit.
To keep the rocket in this orbit its speed needs to stay at 8000 m/s.
Suggest, by using ideas about gravitational and centripetal forces, why this speed needs to be maintained to keep it in this stable orbit.

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

(ii) The rocket re-enters the Earth's atmosphere safely.

In the final part of the descent its speed reduces steadily from 2000 m/s to 120 m/s just before touchdown. This takes place over a distance of 5×10^5 m.

Calculate the average **deceleration** over this distance.

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answer .....m/s^2 **[3]**

(c) The International Space Station (ISS) is an artificial satellite.
The astronauts on the ISS do scientific research.
These astronauts are from different countries that work in teams and publish their results.

(i) Suggest why using teams of scientists on the ISS may be beneficial.

.....

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

(ii) Suggest why it is important for the scientists on the ISS to publish their results.

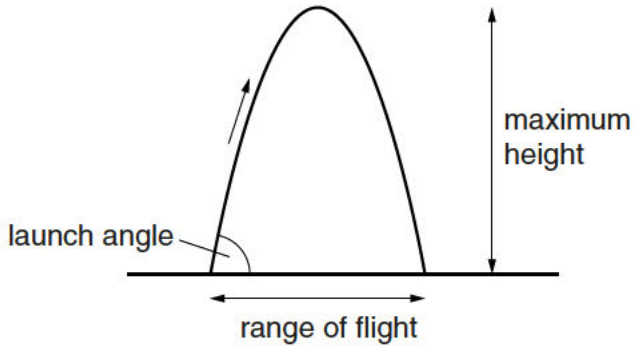
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..... **[1]**

2 Jia makes a model air rocket in school.

She measures the maximum height and the range of flight for different launch angles.

Look at the diagram.



Look at Jia's results.

Launch angle in degrees	Maximum height reached in m	Range of flight in m
30	1.2	8.7
45	2.5	10.0
60	3.7	8.7
75	4.7	5.0

(a) Use the data to describe how the launch angle affects the range of flight of the rocket.

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..... **[2]**

(b) Jia tests one more launch angle.

This angle gives the rocket its greatest maximum height.

Suggest the launch angle she used in this test.

..... degrees **[1]**

(c) Jia's rocket is a projectile and it follows a path.

If there is very little air resistance, the projectile path is very predictable.

(i) Name the shape of the path followed by Jia's rocket.

..... [1]

(ii) How does the force of gravity affect the vertical velocity and vertical acceleration as the rocket rises?

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..... [2]

(iii) How does the force of gravity affect the horizontal velocity of the rocket?

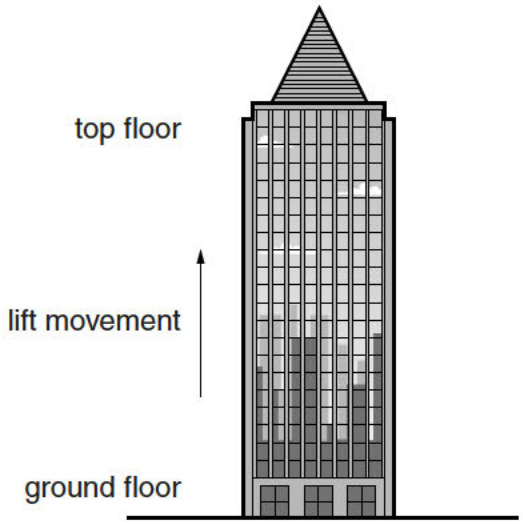
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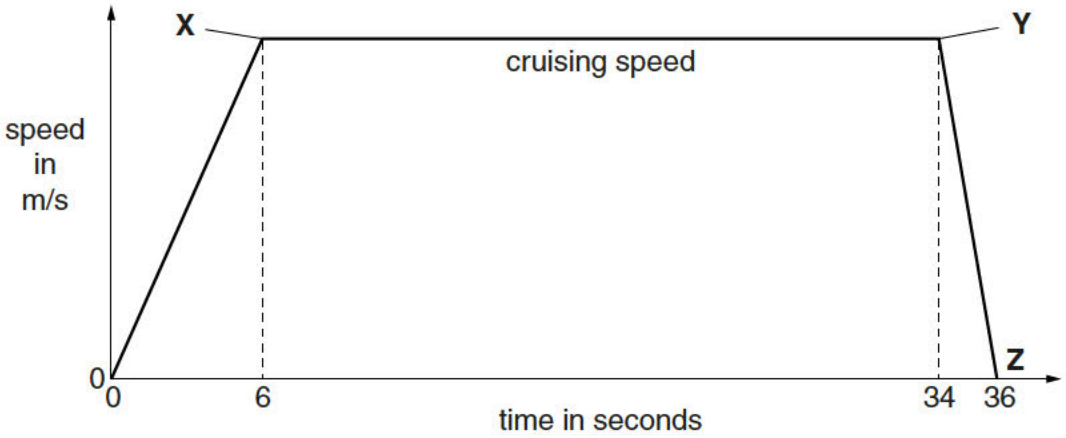
[Total: 7]

3 Samuel is investigating the movement and forces in tall buildings (skyscrapers).

Skyscrapers have lifts or elevators to transport people up and down.



Look at the speed-time graph for **part** of the journey of a lift up a skyscraper.



(a) The lift travels 30 m before it reaches its cruising speed (at point **X**).

Samuel thinks that the cruising speed is 5 m/s. Use a calculation to explain if he is correct.

calculation .....

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.....

answer ..... m/s

How does this compare to what Samuel thinks?

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

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(b) The lift begins to slow down at point **Y** on the graph.

Compare the acceleration between points **0** and **X** with the acceleration between points **Y** and **Z**.

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..... **[2]**

(c) **(i)** When the lift is moving at its **cruising speed** work is done by the motor pulling the lift.

There are 8 people in the lift. The average weight of **each** person is 600 N.

The weight of the lift is 6000 N.

Calculate the power needed to move the lift and the 8 people at cruising speed.

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..... W **[2]**

(ii) Calculate the total **mass** of the lift and the people in it.

The value of gravitational field strength = 9.8 N/kg.

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Give your answer to **2** significant figures.

answer ..... kg **[2]**

[Total: 9]