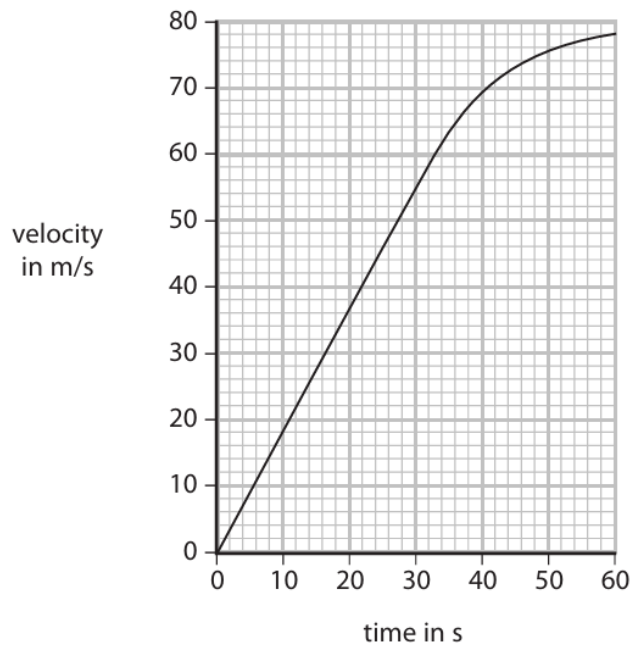**1**   The graph shows how the velocity of an aircraft changes as it accelerates along a runway.

(a) Use the graph to find the average acceleration of the aircraft.

(3)

Acceleration = ... m/s^2

(b) Explain why the acceleration is not constant, even though the engines produce a constant force.
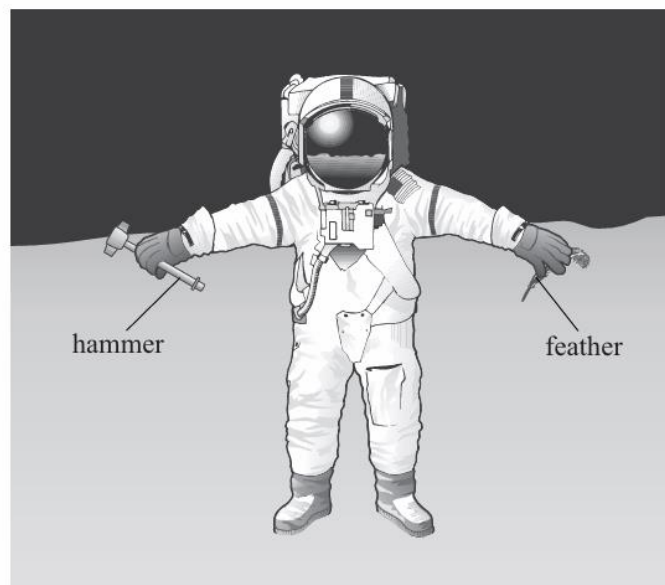
(3)

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Total for question 1 = 6 marks

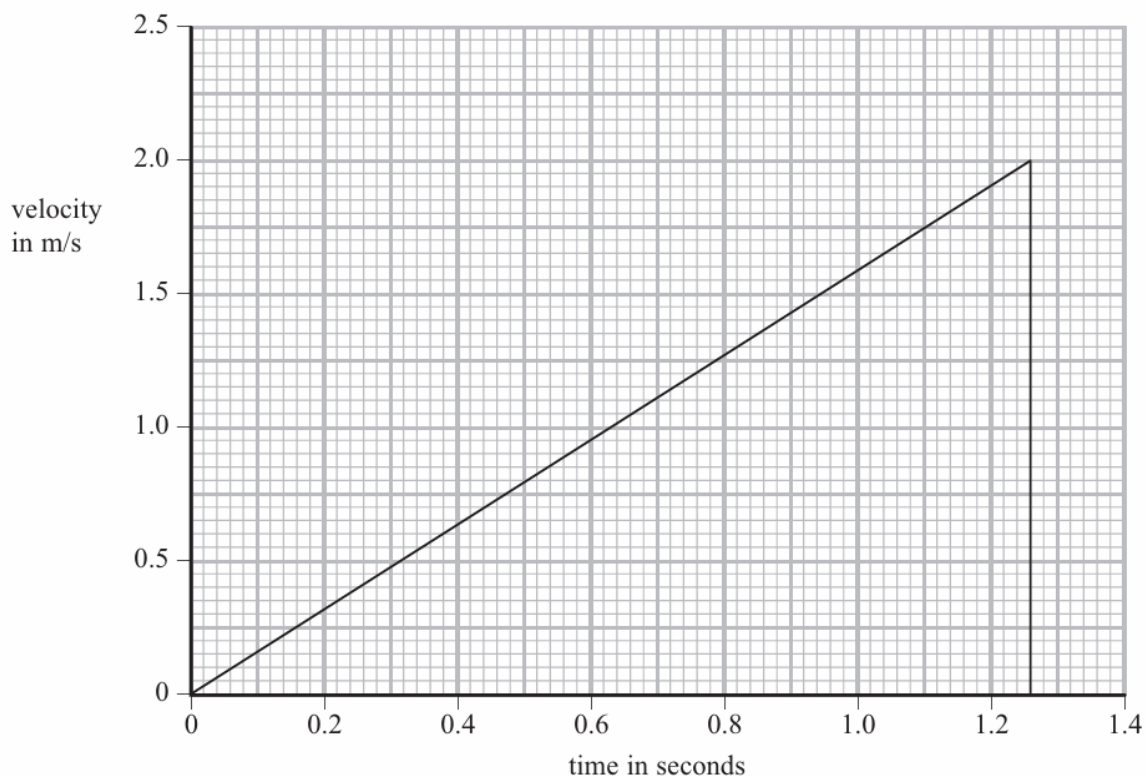**2** The Apollo 15 mission landed on the Moon in 1971.

The astronaut David Scott dropped a hammer and a feather.

They were released from rest at the same time and from the same height.

The hammer and the feather landed at the same time.

(a) The graph shows how the velocity of the hammer changed with time.

(i) Use the graph to calculate the acceleration due to gravity on the Moon.

Give the unit.

(3)

Acceleration = ... Unit ....

(ii) Use the graph to calculate the height the hammer was dropped from.

(2)

Height = ... m

(b) The gravitational field strength is smaller on the Moon than on the Earth.

Suggest why.

(1)

....

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(c) If the same experiment is carried out on Earth, air resistance affects both objects.

The feather reaches the ground after the hammer, even though the force of air resistance is smaller on the feather than on the hammer.

Explain why the feather reaches the ground after the hammer.

(4)

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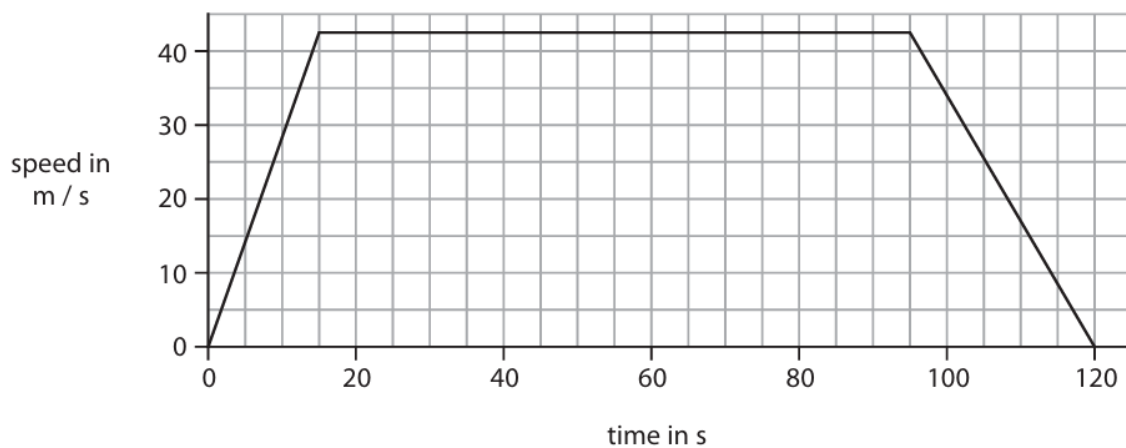
Total for question 2 = 10 marks

3 An aeroplane takes two minutes to travel the short distance between airports on two islands.

The graph shows how the speed of the aeroplane changes as it

- takes off
- flies across the sea
- lands on the other island

When it is flying across the sea, the aeroplane travels at a constant speed.

(a) Use the graph to answer the following questions.

   (i) State the value of the constant speed.

                                                   (1)

speed .... m/s

(ii) Calculate the acceleration of the aeroplane at the start of the journey and give the unit.

(3)

acceleration = ... unit ....

(iii) Calculate the total distance that the aeroplane travels.

(3)

(b) Each airport has a runway that is about 500 m long.

When it lands, the speed of the aeroplane is 40 m/s.

Explain why the airline should not use an aeroplane that has more mass and needs a higher speed for landing.
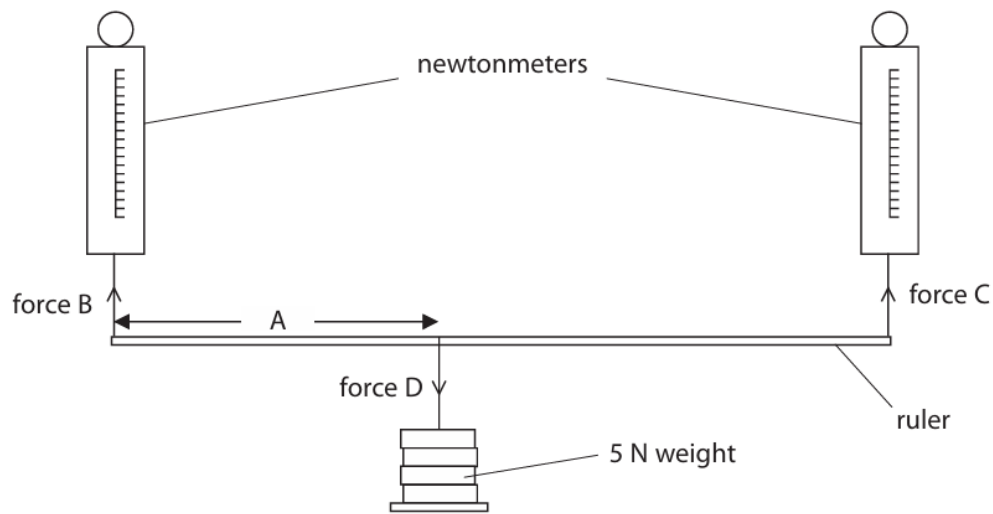
(3)

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Total for question 3 = 10 marks

4 A student investigates the vertical forces acting on the ends of a horizontal ruler when it supports a load.

The ruler hangs from two newtonmeters with a weight suspended from it as shown.

(a) The student moves the weight along the ruler and records forces B and C by taking readings from the newtonmeters.

   (i) Which of these is the independent variable in this investigation?

(1)

   ☒ **A**   Distance A

   ☒ **B**   Force B

   ☒ **C**   Force C

   ☒ **D**   Force D

   (ii) Which of these is a controlled variable in this investigation?

(1)

   ☒ **A**   Distance A

   ☒ **B**   Force B

   ☒ **C**   Force C

   ☒ **D**   Force D

(b) The student records these readings.

Distance A in cm	Reading from newtonmeter of force B in N	Reading from newtonmeter of force C in N
0	5.1	0.4
20	4.0	1.1
40	2.9	2.3
60	2.0	3.3
80	1.1	4.8
100	0.2	5.9

She plots this graph to show how force C changes with distance A.

....

in ....
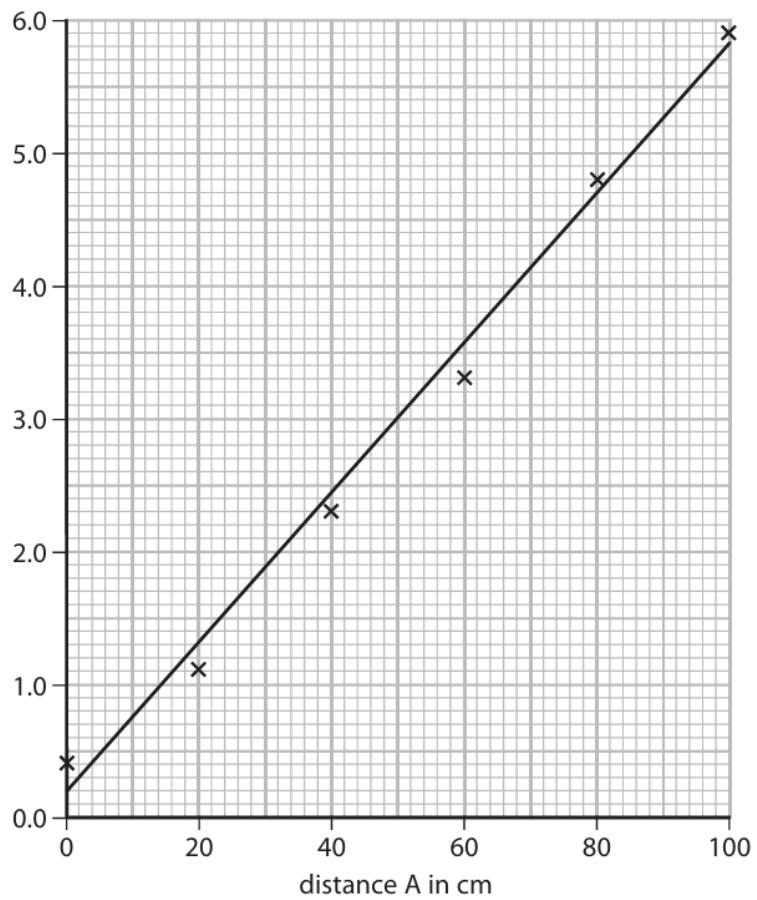
distance A in cm

(i) Complete the student's graph by labelling the vertical axis.

(1)

(ii) Using the same grid and axes, plot a second line to show how force B varies with distance A.

(3)

(iii) Use the lines on the graph to find distance A for which force B and force C are equal.

(1)

Distance = ... cm

(c) Suggest why neither force B nor force C are ever zero during the investigation.

(1)

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Total for question 4 = 8 marks

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