TWENTY FIRST CENTURY
science

Module P4

EXPLAINING MOTION

Practice test

FOUNDATION

Name: .....

Form/teaching set: .....

Answer all of the questions.

Write your answers in the spaces provided on this paper.

Useful relationships

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

momentum = mass $\times$ velocity

change in momentum = resultant force $\times$ time for which it acts

work done by force = force $\times$ distance moved by force

change in energy = work done

change in GPE = weight $\times$ vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times (\text{velocity})^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage in primary coil}}{\text{voltage in secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

power = potential difference $\times$ current

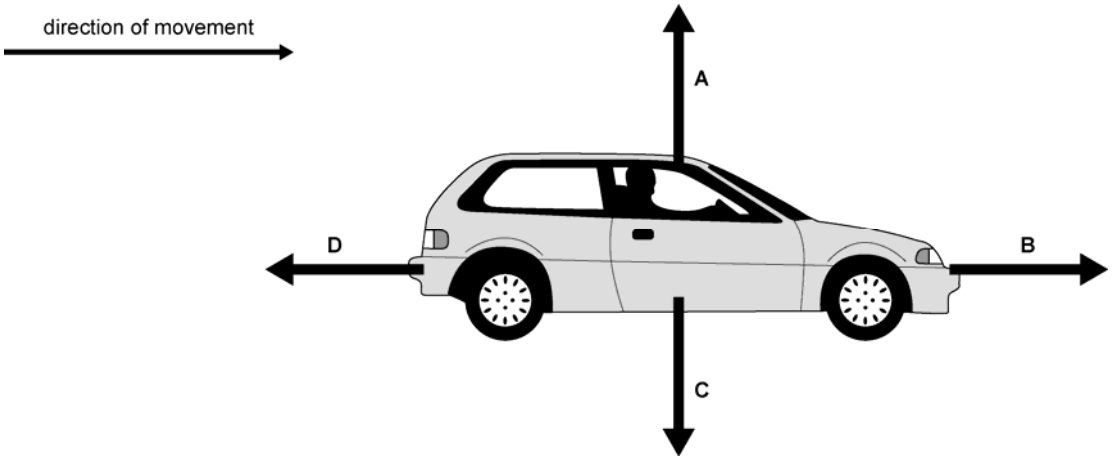
energy transferred = power $\times$ time

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}}$$

wave speed = frequency $\times$ wavelength

1 A car is travelling at a steady speed on a straight motorway.

There are 4 forces acting on the car.



(a) Write down the letter A, B, C or D which shows each of the following forces.

(i) weight .....

(ii) reaction .....

(iii) friction ..... [3]

(b) Write down the letters of two forces which must be equal in size.

..... and ..... [1]

(c) The car travels 140 km in 2 hours.

(i) Write down the formula that relates average speed, distance and time. [1]

(ii) Calculate the average speed of the car.

speed = ...km/hour [1]

[Total marks: 6]

2 **(a)** A car has a mass of 800 kg and it is travelling at 10 m/s.

Calculate its momentum.

momentum = ...kg m/s [1]

(b) Sam makes three journeys in his car one morning, all on the same straight road at the same speed.

Journey	Description of Sam's journey
A	The car is full with 3 friends and their luggage going on holiday.
B	The car is empty as Sam goes home.
C	Sam has his dog in the car.

(i) In which journey will Sam's car have the greatest momentum?

journey ..... [1]

(ii) Which two reasons best explain your answer to **b)(i)**?

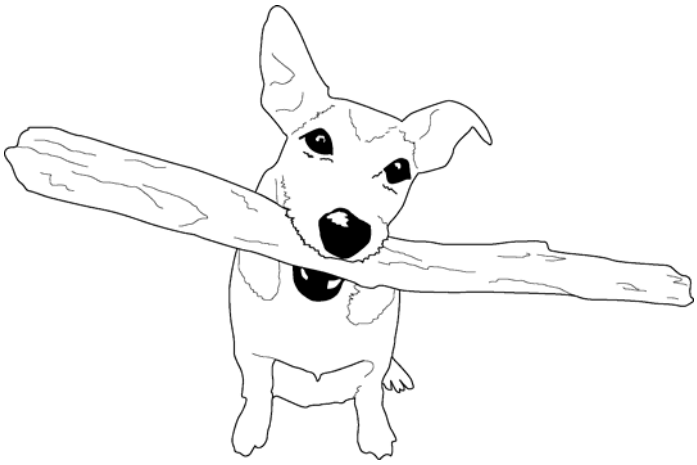
Put ticks (✓) in the **two** correct boxes.

All the journeys have the same speed.	☐
The car goes faster with less people in it.	☐
The car with the most people has the most mass.	☐
The road was straight.	☐
Sam only has a small dog.	☐

[2]

[Total marks: 4]

3 Kate throws a stick for her dog called Candy.

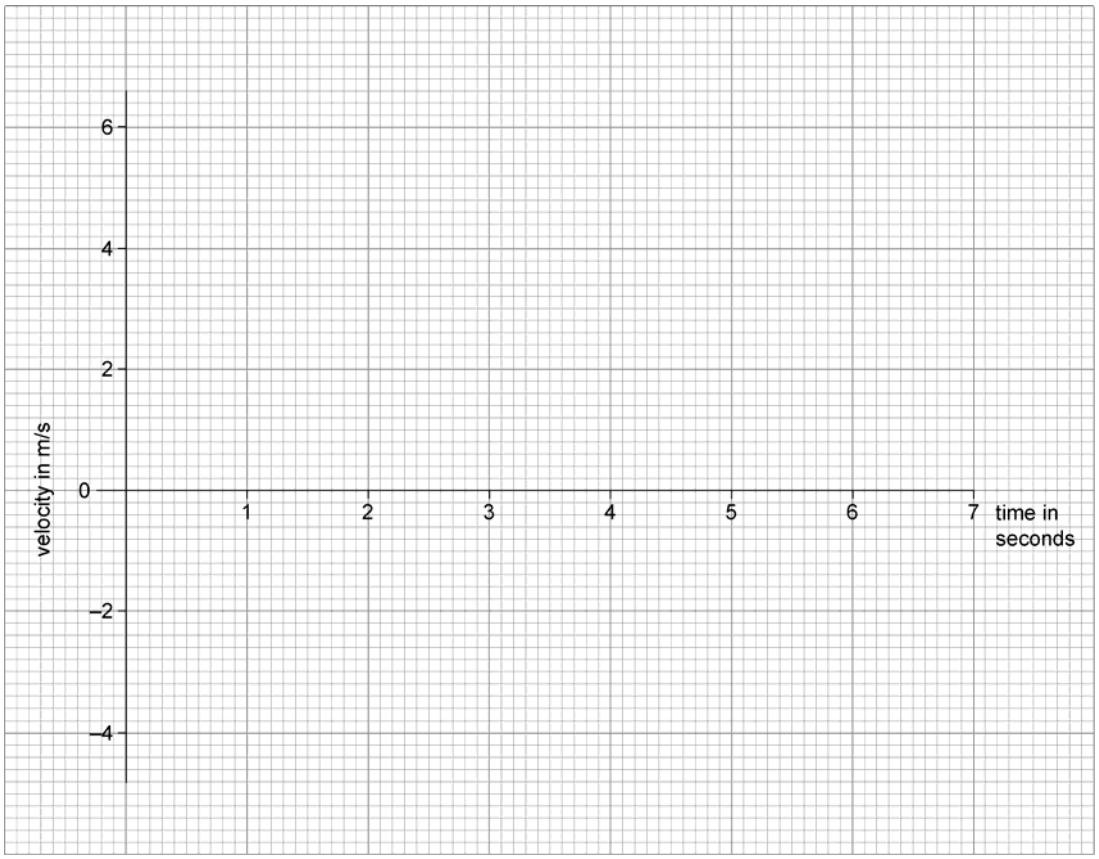


Candy runs after the stick at a steady speed of 6 m/s for 2 seconds.

Candy stops to pick up the stick, which takes 1.5 seconds.

Candy then walks back to Kate at a steady speed of 3 m/s, which takes 4 seconds.

On the graph, draw the **velocity-time** graph for Candy's movement.

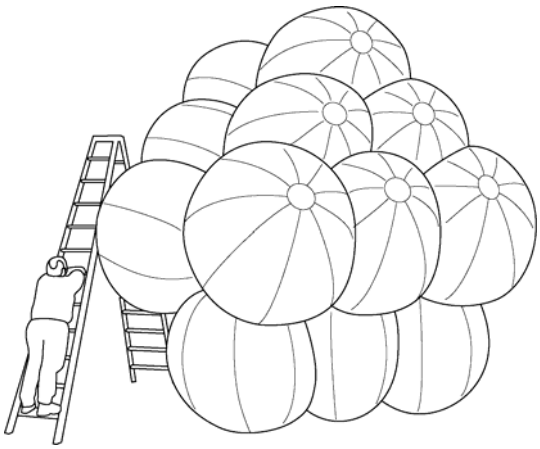


[4]

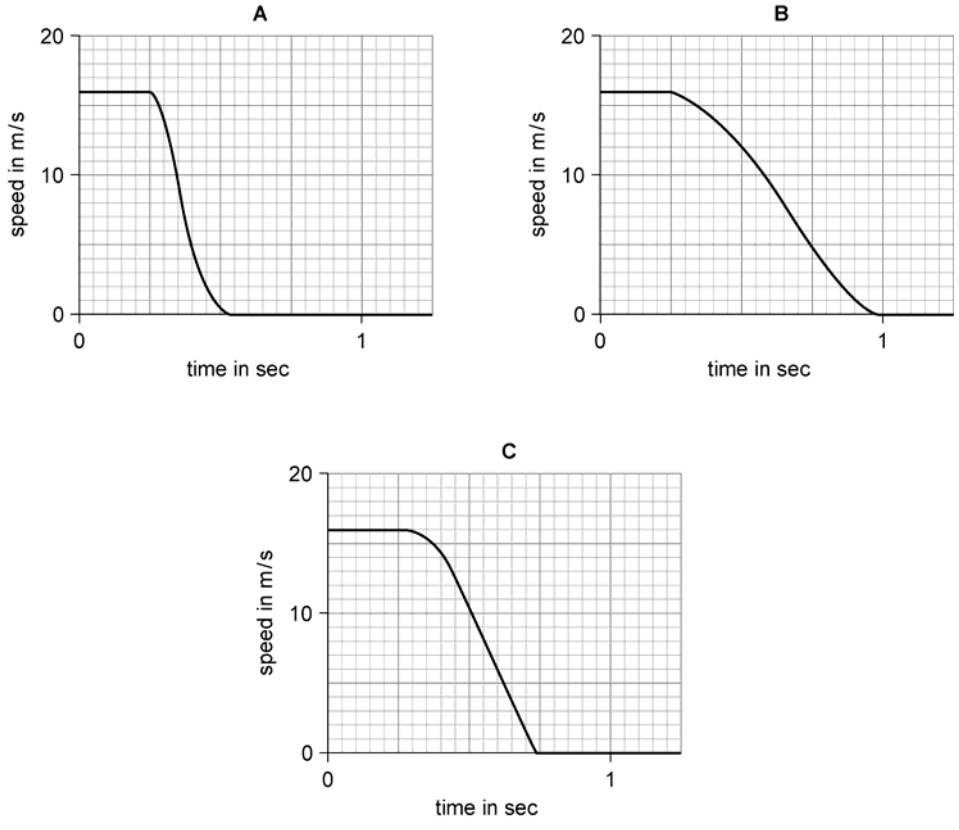
[Total marks: 4]

4 Large airbags are used for landing spacecraft on Mars.

The spacecraft lands with the airbag underneath it. This slows down the landing.
In tests, scientists used airbags with large holes in them, because this gave a smaller momentum change when the airbags bounced.



The graphs **A**, **B** and **C** show what happens to the speed of the spacecraft as three different airbags hit the ground.



(a) (i) Use a graph for airbags **A**, **B** or **C** to find the speed of the spacecraft just before the airbag touches the ground.

speed = ... m/s [1]

(ii) Which airbag **A**, **B** or **C** makes the landing last the longest?

..... [1]

(iii) Which airbag **A**, **B** or **C** gives the greatest force on the spacecraft?

..... [1]

(b) Which airbag **A**, **B** or **C** would be the best choice for landing on Mars?

(i) Airbag ..... [1]

(ii) Explain your choice.

.....

.....

.....

..... [2]

[Total marks: 6]

[Total marks for the test: 20]

TWENTY FIRST CENTURY
science

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Practice test

HIGHER

Name: .....

Form/teaching set: .....

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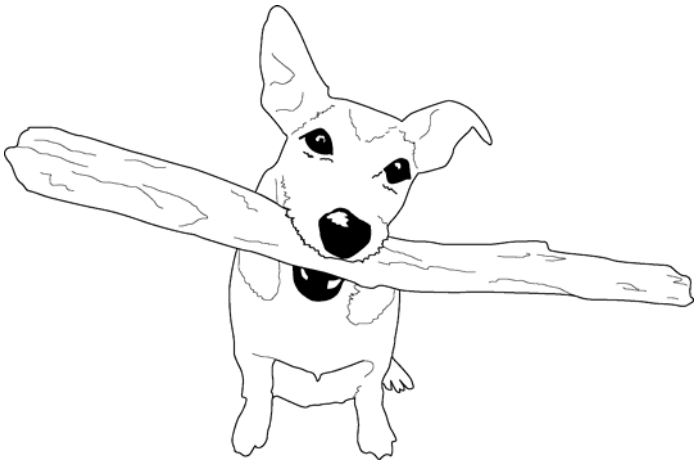

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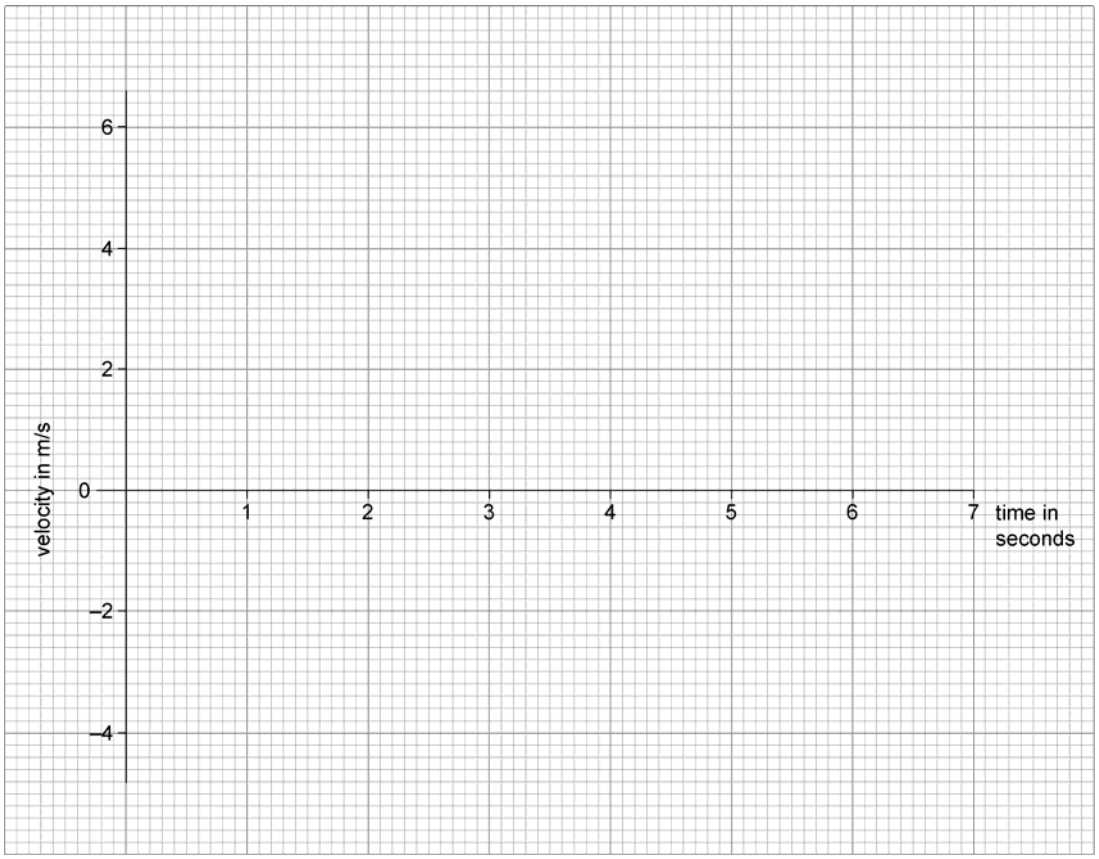


[4]

[Total marks: 4]

2 Sam makes three journeys in his car one morning, all on the same straight road, Sam and the car combined have a mass of 1100 kg.

Journey	Description of Sam's journey
A	Sam gives a lift to 3 friends and their luggage going on holiday. The friends and luggage have a mass of 300 kg. They travel at 11 m/s.
B	The car is empty as Sam goes home at 15 m/s.
C	Sam has his dog, with a mass of 20 kg, in the car. He travels at 14 m/s.

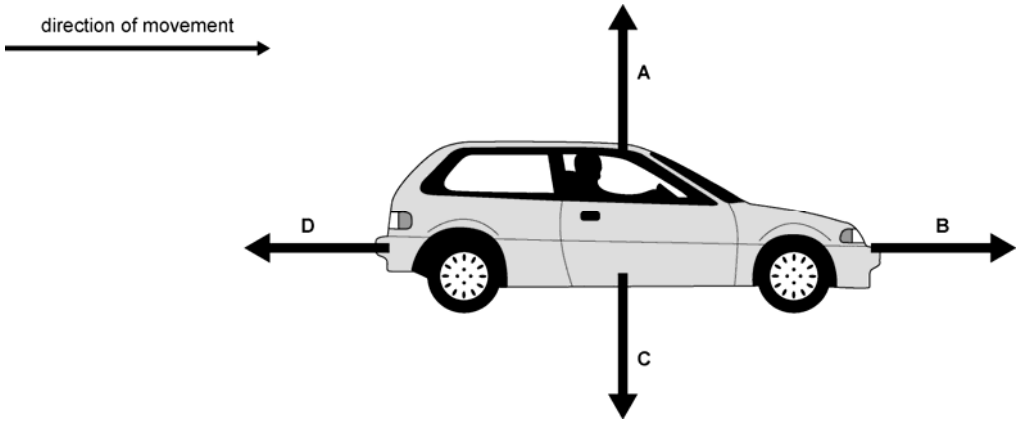
(a) In which journey will Sam's car have the greatest momentum?

journey ..... [1]

(b) Calculate the momentum of the car on journey **B**.

momentum = ... units ..... [2]

(c) Sam is driving on a level road. He is accelerating.



Which of the following statements must be true?

Put a tick (✓) in the one correct box.

A = **C** and **B** is greater than **D** ☐

A = **C** and **B** is less than **D** ☐

B = **D** and **C** is greater than **A** ☐

A = **B** and **C** is greater than **D** ☐

[1]

[Total marks: 4]

3 A moving object has kinetic energy.

kinetic energy = $\frac{1}{2}$ × mass × velocity^2

(a) A dart thrown at a dart board has kinetic energy of 5 Joules.

1.25 J **2.5 J** **5 J** **10 J** **20 J**

Choose from the energies in the list to answer these questions.

(i) What will the kinetic energy be if the mass is halved? ..... [1]

(ii) What will the kinetic energy be if the velocity is doubled? ..... [1]

(b) An arrow weighing 5 N is fired straight up in the air.

The arrow reaches a height of 25 m.

Calculate the increase in gravitational potential energy of the arrow.

gravitational potential energy = ... J [2]

(c) A second arrow of mass 700g is fired upwards with a different bow. It gains 175 J of gravitational potential energy.

Which of the following statements are correct steps in the calculation of the velocity of the arrow when it hits the ground?

You can assume that there is no air resistance.

Put ticks (✓) in the **two** correct boxes.

kinetic energy of the arrow when it reaches the ground is 175 J	☐
velocity = kinetic energy ÷ (0.5 × mass)	☐
mass = 7 kg	☐
velocity^2 = 175/0.35	☐
velocity = 25 m/s	☐

[2]

[Total marks: 6]

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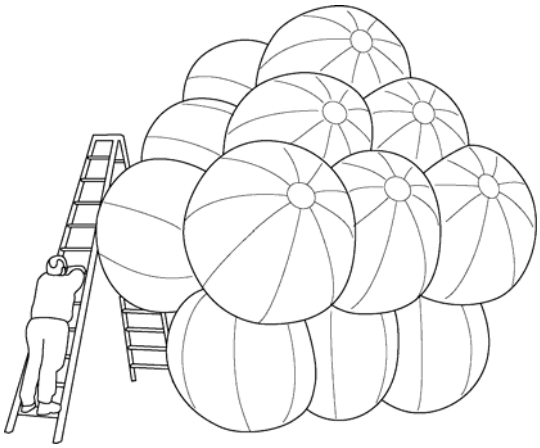
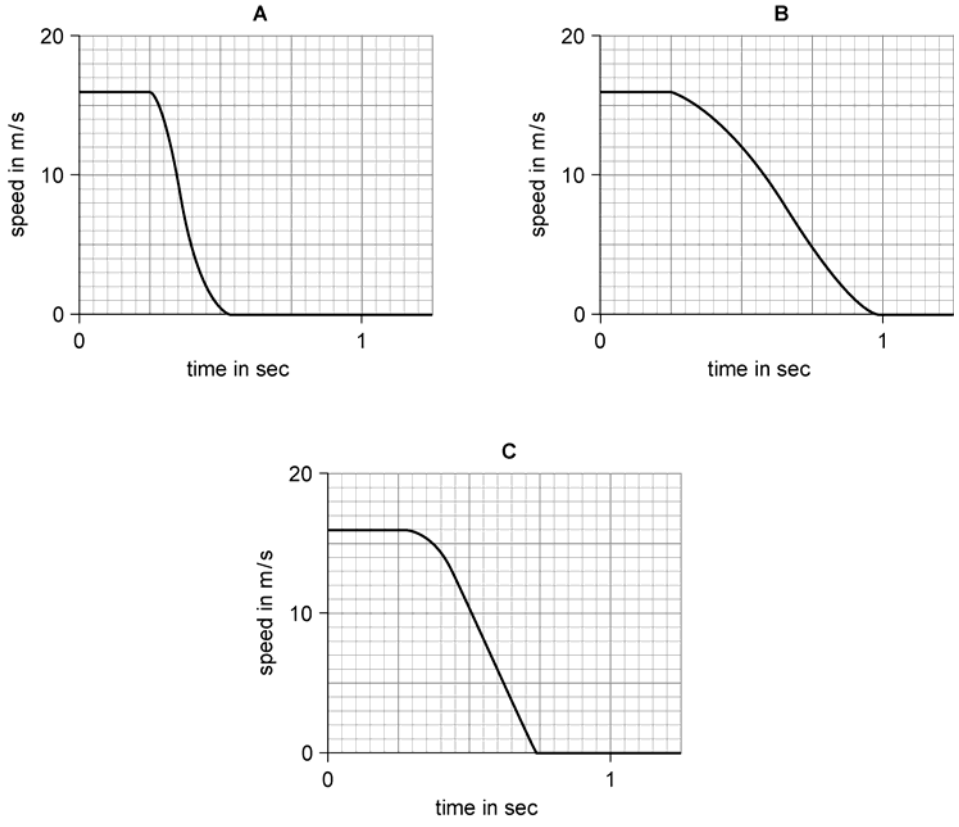


The graphs show what happens to the speed of the spacecraft as the three different airbags hit the ground.



(a) Which airbag **A**, **B** or **C** would be the best choice for landing on Mars?

(i) Airbag ..... [1]

(ii) Explain your choice.

.....

.....

..... [2]

(b) The mass of the test spacecraft was 15 kg.

change in momentum = average force x time

Calculate the average force on the spacecraft in test B.

Use additional data from the graph

average force = ... N [3]

[Total marks: 6]

[Total marks for the test: 20]