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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

Motion (Kinematics)

Paper 2 — Theory Worksheet (topical compilation)

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The City School

PAF CHAPTER

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KINEMATICS P2 (worksheet # 2

Question # 1: May June 2004/P2/Q1

Fig. 1.1 shows a free-fall parachutist falling vertically downwards. Fig. 1.2 shows how the speed of the parachutist varies with time.

Fig. 1.1

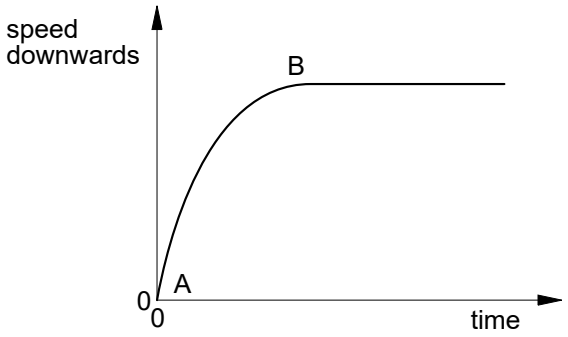


Fig. 1.2

(a) (i) State the name of the downward force acting on the parachutist.

.....

(ii) State the name of one upward force acting on the parachutist.

.....

[2]

(b) (i) State the initial value of the acceleration of the parachutist. Give the unit of your answer.

.....

(ii) Explain why the acceleration decreases from A to B.

.....

.....

.....

(iii) Explain why the parachutist falls at a constant speed after B.

.....

.....

.....

[4]

Question # 2: May June 2009/P2/Q1

A piece of paper falls from 4.0 m above the ground.
Fig. 1.1 shows how the height *h* above the ground varies with the time *t*.

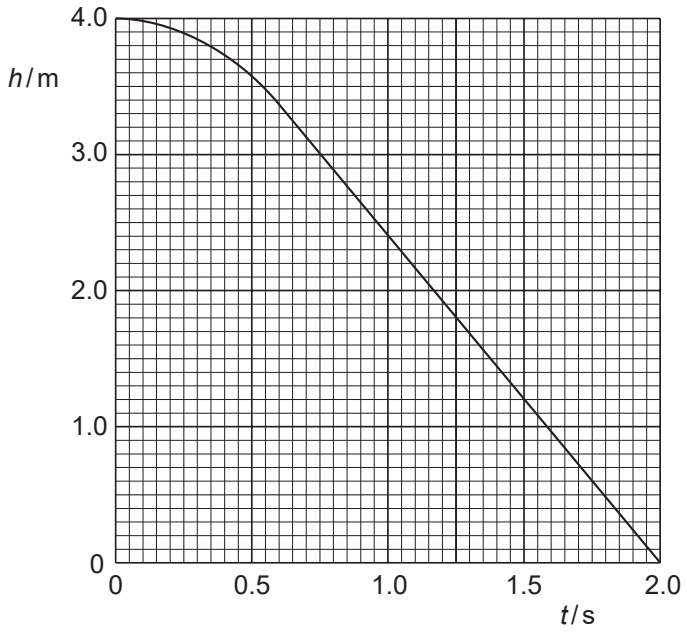


Fig. 1.1

(a) State what happens to the speed of the paper as it falls.

.....

.....

..... [2]

(b) Calculate the speed of the paper at time $t = 1.5$ s.

speed = ... [2]

(c) As the paper falls, energy changes from one form to another.
State the main energy change between $t = 1.0$ s and $t = 2.0$ s.

.....

.....

..... [2]

Question # 3: May June 2010/P21/Q1

Fig. 1.1 shows the speed-time graph of a ball. The ball is dropped at time $t = 0$.

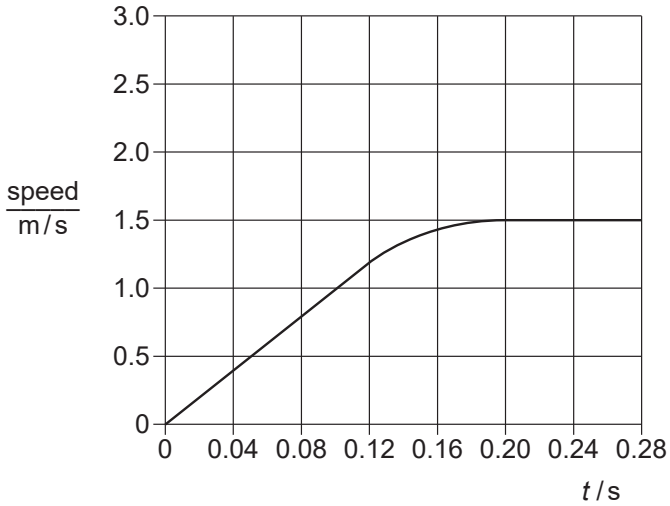


Fig. 1.1

(a) After $t = 0.20$ s, the ball falls at a constant speed.

Explain, using ideas about forces, why the speed of the ball is constant after time $t = 0.20$ s.

.....

.....

.....[1]

(b) At $t = 0$, a different ball is dropped from rest. Until $t = 0.20$ s, this ball has a constant acceleration equal to the acceleration of free-fall. After $t = 0.20$ s, its acceleration decreases.

(i) State the value of the acceleration of free-fall.

.....[1]

(ii) Determine the speed of the second ball at $t = 0.20$ s.

speed = ...[2]

(iii) On Fig. 1.1, draw the speed-time graph for the second ball from $t = 0$ to $t = 0.28$ s.

[2]

Question # 4: May June 2011/P21/Q2

Fig. 2.1 shows a sky-diver falling vertically downwards at terminal velocity.

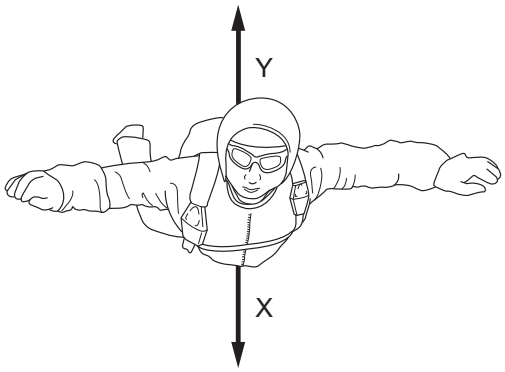


Fig. 2.1

Arrows X and Y show the two main forces acting on the sky-diver.

(a) (i) State the name of force X and the name of force Y.

X .....

Y .....
[1]

(ii) Explain why force Y acts upwards.

.....

..... [1]

(b) When the sky-diver first started to fall, forces X and Y were unbalanced.

(i) Describe and explain the effect of the unbalanced forces on the motion of the sky-diver.

.....

.....

..... [2]

(ii) State what happened to the size of force X and the size of force Y as the sky-diver fell and reached terminal velocity.

.....

..... [2]

Question # 5: May June 2012/P21/Q1

An astronaut standing on the Moon throws a stone vertically upwards. The stone leaves his hand at time $t = 0$. The line on Fig. 1.1 shows how the velocity v of the stone varies with time t until $t = 2.0$ s.

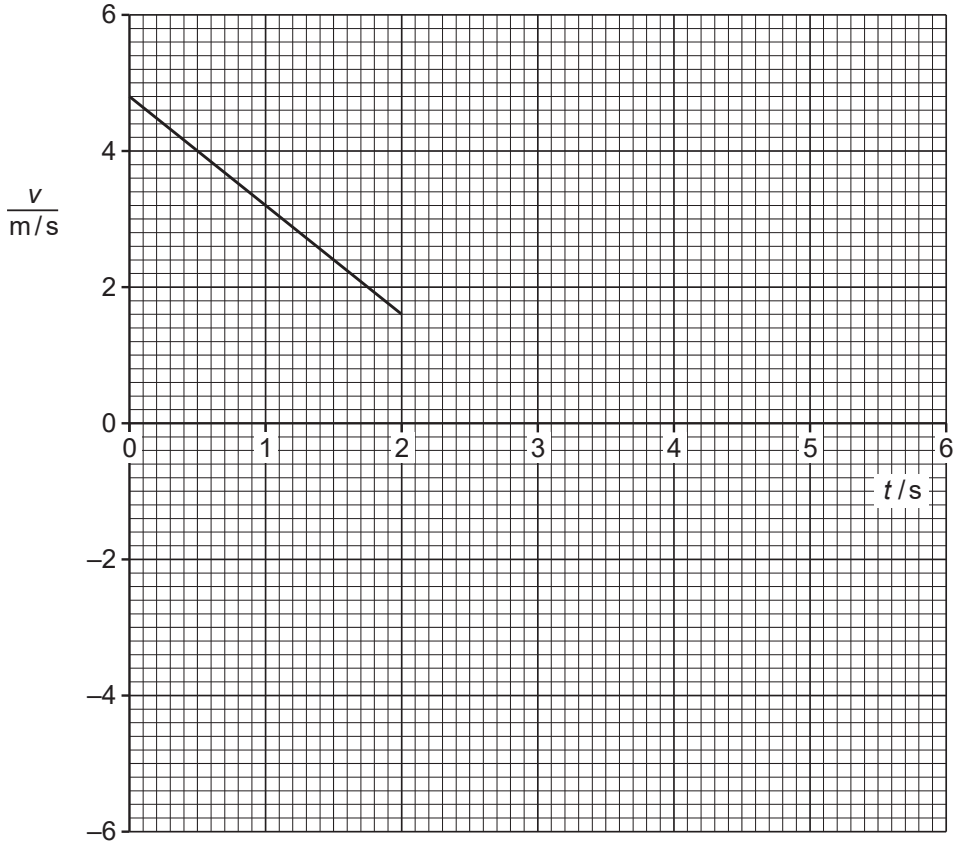


Fig. 1.1

(a) After rising, the stone falls. The astronaut catches the stone at $t = 6.0$ s.
There is no air resistance on the Moon.

(i) Complete Fig. 1.1 until $t = 6.0$ s. [1]

(ii) State the value of t when the stone is at its highest point.

.....[1]

(b) Calculate the acceleration of the stone between $t = 0$ and $t = 2.0$ s.

acceleration = ...[2]

(c) A stone is thrown vertically upwards on the Earth with the same initial velocity.
State two ways in which the velocity-time graph for this stone differs from Fig. 1.1.

1. .....

2. .....

[2]

Question # 6: May June 2013/P22/Q1

A ball rolls down a slope, as shown in Fig. 1.1.

The metre rule shows the position of the ball at times t = 0, 1.0 s, 2.0 s and 3.0 s.

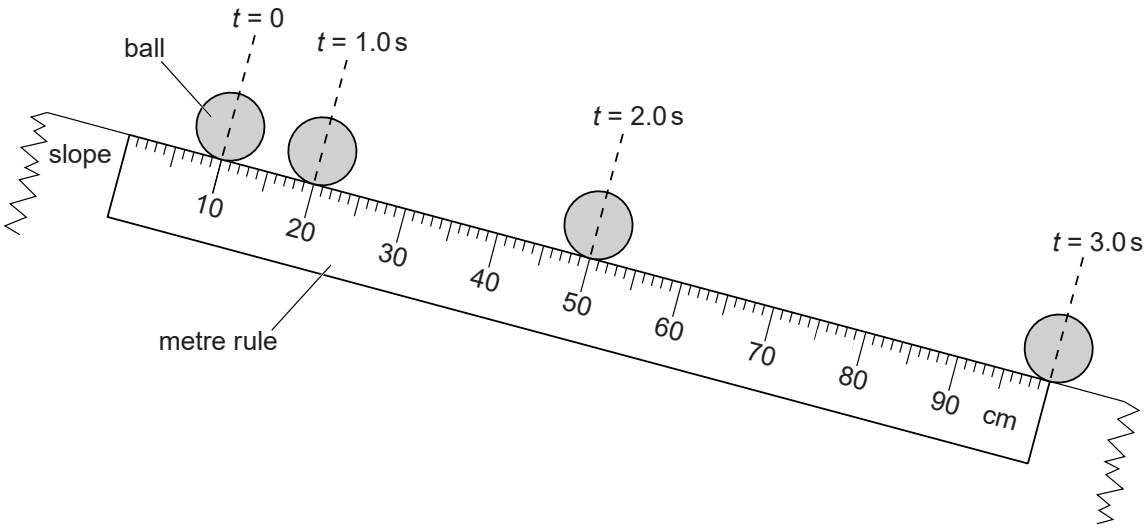


Fig. 1.1

(a) Explain how Fig. 1.1 shows that the ball is accelerating.

.....

..... [1]

(b) Calculate the average speed of the ball between t = 1.0 s and 3.0 s.

average speed = ... [2]

(c) Two of the forces that act on the ball are air resistance and weight.

State what, if anything, happens to these forces as the ball accelerates.

air resistance: .....

weight: .....

[2]

(d) Explain why, if the slope is long enough, the ball eventually reaches a constant speed.

.....

..... [1]

Question # 7: May June 2016/P21/Q1

A sky-diver jumps from a stationary balloon. His initial downwards acceleration is $10\,m/s^2$.

Fig. 1.1 shows the directions of the air resistance and the weight of the sky-diver.

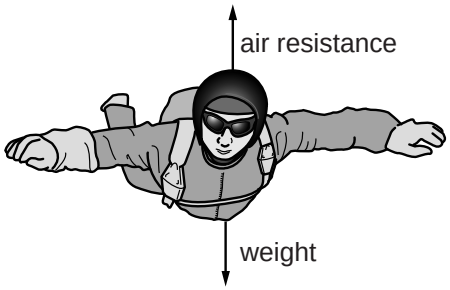


Fig. 1.1

The mass of the sky-diver is 60 kg and his weight is 600 N.

(a) Explain, using ideas about the forces, why his initial downwards acceleration is $10\,m/s^2$.

.....

.....

.....

.....

.....[2]

(b) When the parachute opens, the sky-diver experiences an upward acceleration for a short time.

Explain why.

.....

.....

.....[1]

(c) The total force of air resistance on the sky-diver and open parachute changes with their speed, as shown in Fig. 1.2.

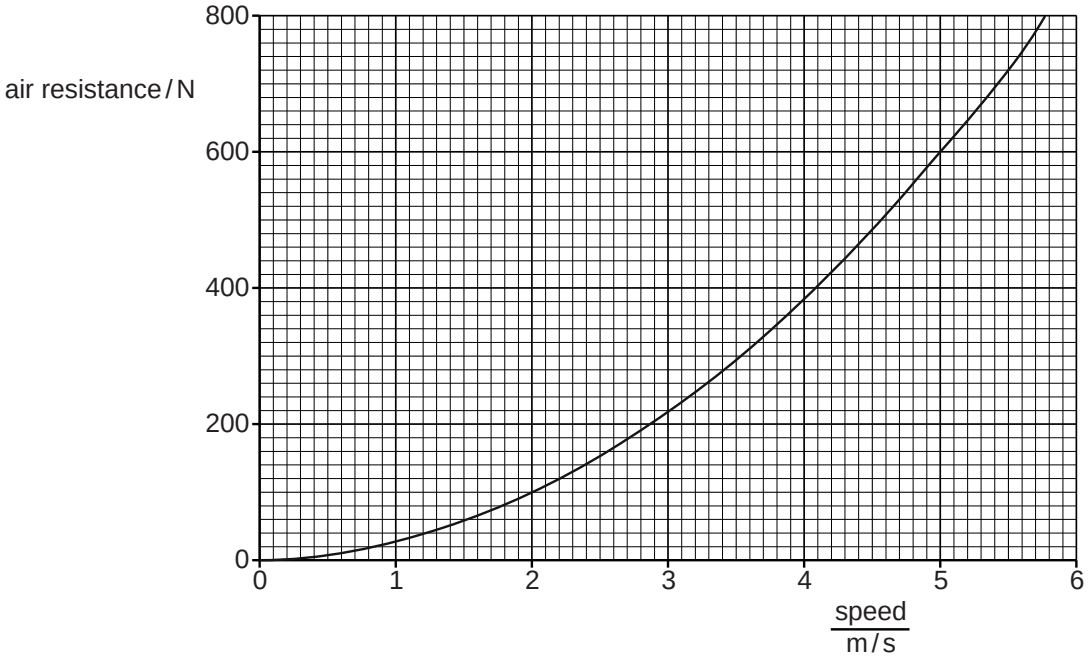


Fig. 1.2

After the parachute opens, the sky-diver slows down to a terminal velocity.

The weight of the sky-diver is 600 N.

(i) Using Fig. 1.2, determine the terminal velocity of the sky-diver.

terminal velocity = ...[1]

(ii) Calculate the resultant force on the sky-diver when his speed is 5.5 m / s.

resultant force = ...[1]

Question # 8: May June 2018/P22/Q1

A student drops a small metal object into a cylinder of oil. The object falls alongside a vertical ruler and a camera records its position at 1.0 s intervals, as shown in Fig. 1.1.

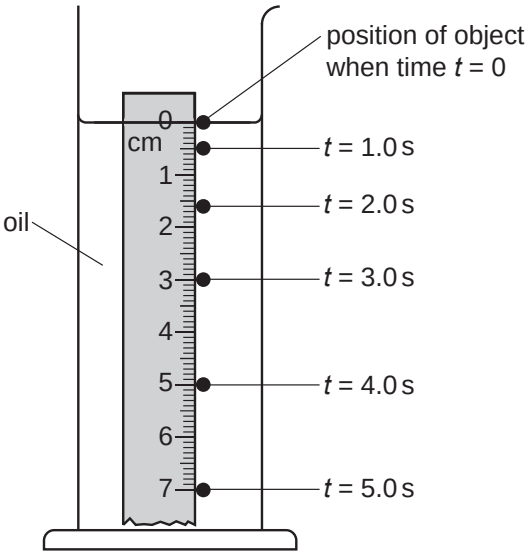


Fig. 1.1

(a) On the grid in Fig. 1.2, plot a distance-time graph for the object.

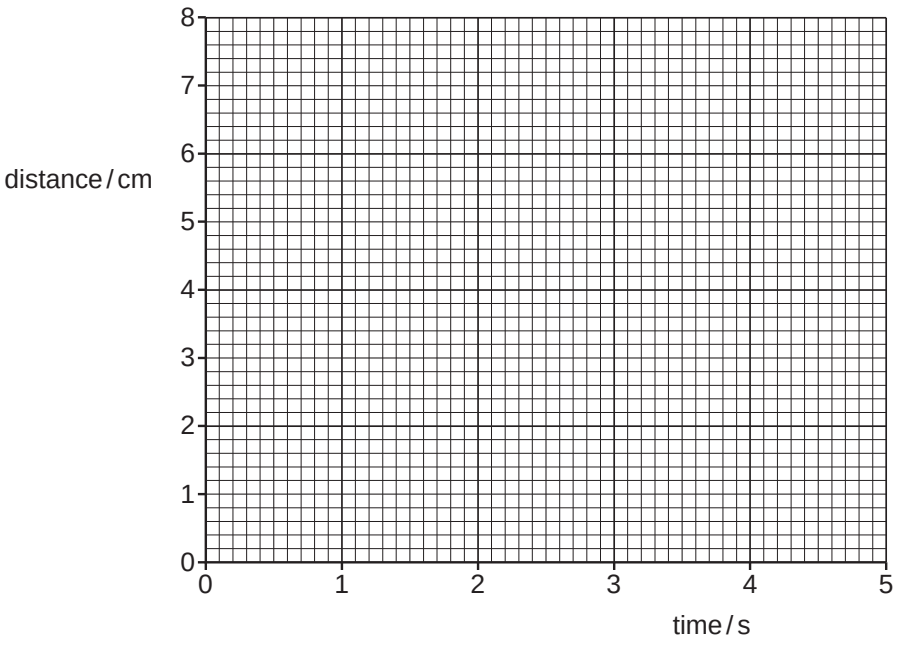


Fig. 1.2

[2]

(b) The object has a constant speed for some of the time.

(i) State and explain how a distance-time graph shows that speed is constant.

.....

.....

.....

.....[2]

(ii) Explain, in terms of the forces acting on the object, how it is able to fall at a constant speed.

.....

.....

.....

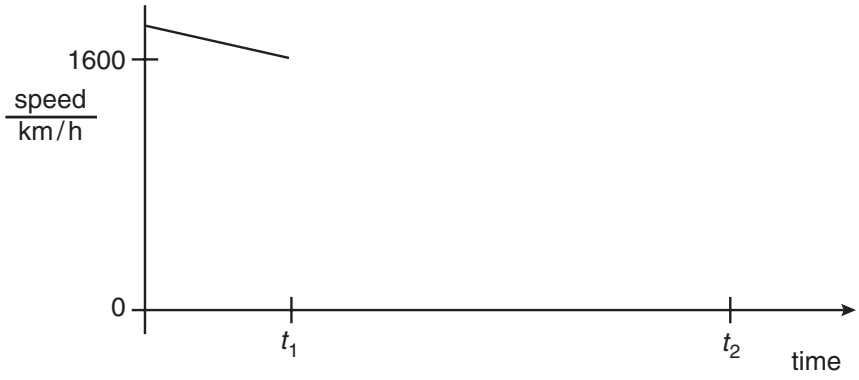
.....[2]

Question # 9: Oct Nov 2003/P2/Q1

A small spacecraft, known as Beagle 2, is to land on the planet Mars.

As the spacecraft enters the planet's atmosphere, it slows down. When the speed reaches 1600 km/h, parachutes open and the friction with the atmosphere increases. The spacecraft eventually reaches a steady speed, and then finally it hits the surface.

(a) On the axes of Fig. 1.1, complete the speed-time graph for the spacecraft. The parachutes open at time t_1, and the spacecraft hits the surface of Mars at time t_2.



[2]

Fig. 1.1

(b) The mass of the spacecraft is 65 kg. At one point the gravitational field strength of Mars is 3.0 N/kg and the total upwards force on the spacecraft is 500 N.

Determine

(i) the weight of the spacecraft,

weight = ...

(ii) the resultant force on the spacecraft,

force = ...

(iii) the deceleration of the spacecraft.

deceleration = ...

[4]

Question # 10: Oct Nov 2006/P2/Q2

2 Fig. 2.1 shows apparatus that demonstrates how a coin and a piece of paper fall from rest.

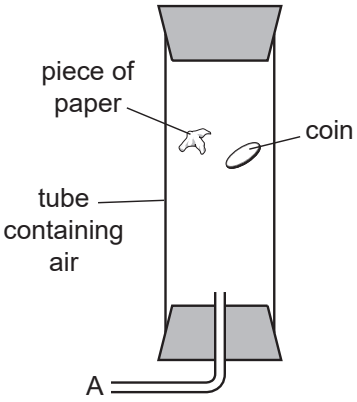


Fig. 2.1

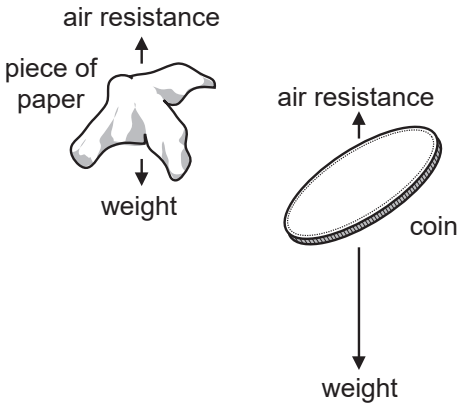


Fig. 2.2

At the positions shown in Fig. 2.1, the coin and paper are falling through air in the tube. The forces on them are shown in Fig. 2.2. The length of an arrow indicates the size of each force.

(a) State the initial value of the acceleration of the coin as it falls.

..... [1]

(b) Explain how Fig. 2.2 shows that

(i) the paper falls with constant speed,

.....

.....

(ii) the coin accelerates.

.....

..... [3]

(c) A vacuum pump is connected to A and the air in the tube is removed.

The coin and paper fall differently in a vacuum from the way they fall in air.

State two of these differences.

1. .....

.....

2. .....

..... [2]

Question # 11: Oct Nov 2007/P2/Q1

A parachutist jumps from an aircraft. Some time later, the parachute opens.

Fig. 1.1 is a graph of the vertical speed of the parachutist plotted against time *t*.

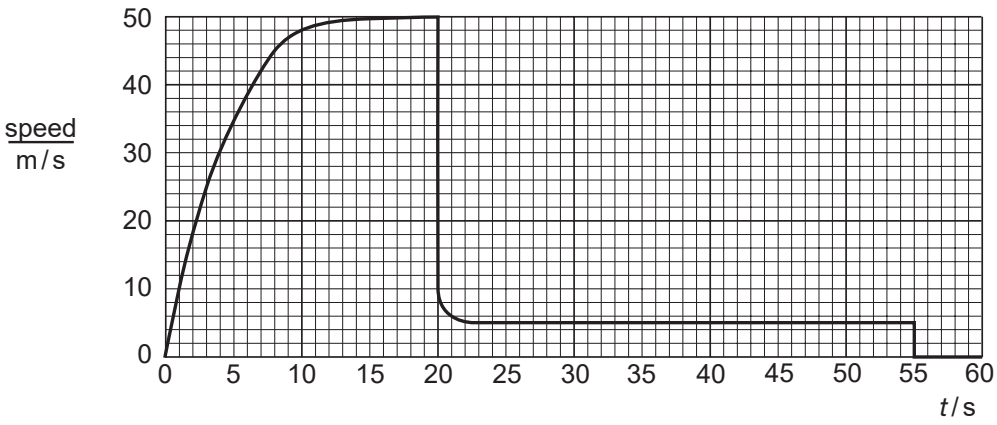


Fig. 1.1

(a) State what happens at $t = 20\,s$ and $t = 55\,s$.

at 20 s .....

at 55 s ..... [1]

(b) Describe the motion of the parachutist between $t = 0$ and $t = 20\,s$.

.....

.....

..... [2]

(c) Explain, in terms of the forces acting, why the speed of the parachutist is constant between $t = 25\,s$ and t = 55 s.

.....

.....

..... [2]

(d) Calculate the distance travelled by the parachutist between $t = 25\,s$ and $t = 55\,s$.

distance = ... [2]

Question # 12: Oct Nov 2016/P22/Q1

A skier sets off from rest and accelerates uniformly at $3.4\,m/s^2$ in a straight line for 5.0 s.

(a) Calculate the speed of the skier after 5.0 s.

speed = ...[2]

(b) At 5.0 s, the skier stops accelerating and travels on for a further 10.0 s at a constant speed.

(i) State the size of the resultant force acting on the skier during these 10.0 s.

.....[1]

(ii) On Fig. 1.1, sketch a speed-time graph for the skier during the whole 15.0 s. [3]

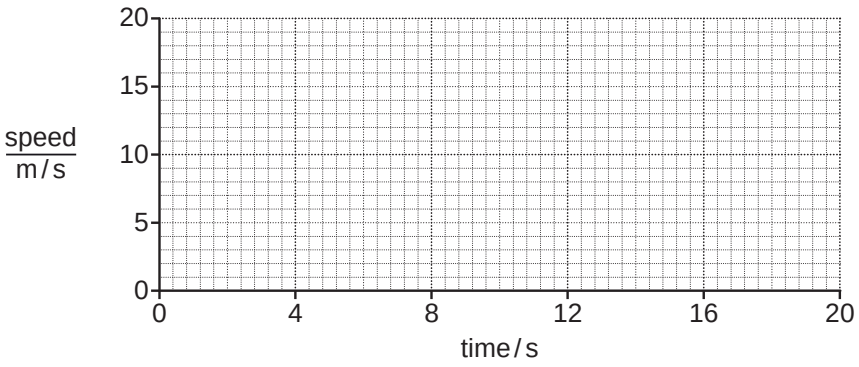


Fig. 1.1

(iii) State how the distance travelled by the skier can be determined using the speed-time graph.

.....

.....[1]

Question # 13: Oct Nov 20_18/P21/Q1

A girl of mass 35 kg, on a bicycle, accelerates from rest and travels down a slope in a straight line. The girl does not use the pedals.

Fig. 1.1 shows that the gradient of the slope is constant.

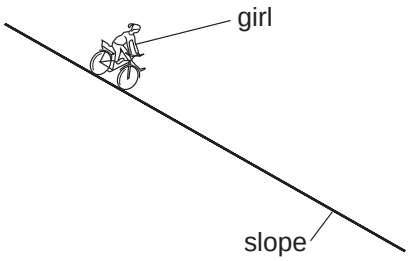


Fig. 1.1

(a) Calculate the resultant force on the girl when she is accelerating at $2.6\,m/s^2$.

resultant force = ... [2]

(b) At first, her acceleration is constant. At time t_1, her acceleration starts to decrease gradually until she is travelling at a constant speed in a straight line.

(i) On Fig. 1.2, sketch a speed-time graph for the girl from when she starts moving until she is travelling at a constant speed. [2]

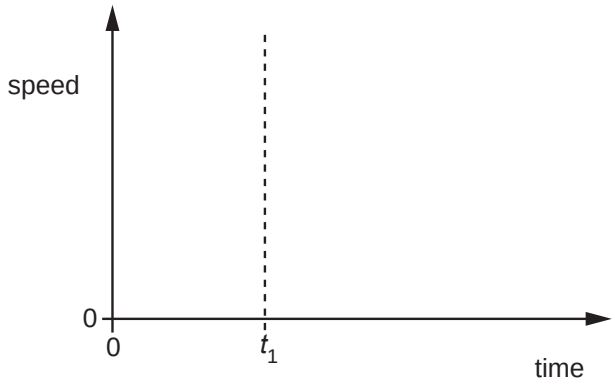


Fig. 1.2

(ii) State how the distance travelled is found from a speed-time graph.

.....

..... [1]