Constant Acceleration 1ii

A Level

P P P

A particle leaves a point A with speed $1\,\mathrm{m\,s^{-1}}$ and travels with constant acceleration in a straight line to a point B, taking $50\,\mathrm{s}$. The distance AB is $200\,\mathrm{m}$.

Part A Acceleration

Find the acceleration of the particle.

Part B Speed at mid-point

Find the speed of the particle as it passes through the mid-point of AB.

Constant Acceleration 2ii

A Level

A particle P is projected vertically downwards from a fixed point O with initial speed $4.2\,\mathrm{m\,s^{-1}}$, and takes $1.5\,\mathrm{s}$ to reach the ground.

Part A Speed 1

Calculate the speed of P when it reaches the ground. Give your answer to 3 significant figures.

Part B Height of O

Calculate the height of O above the ground to 3 significant figures

Part C Speed 2

Calculate the speed of P when it is $5\,\mathrm{m}$ above the ground to 3 significant figures.

Gameboard:
STEM SMART Single Maths 5 - Kinematics (Motion)

General Kinematics 2ii

A Level

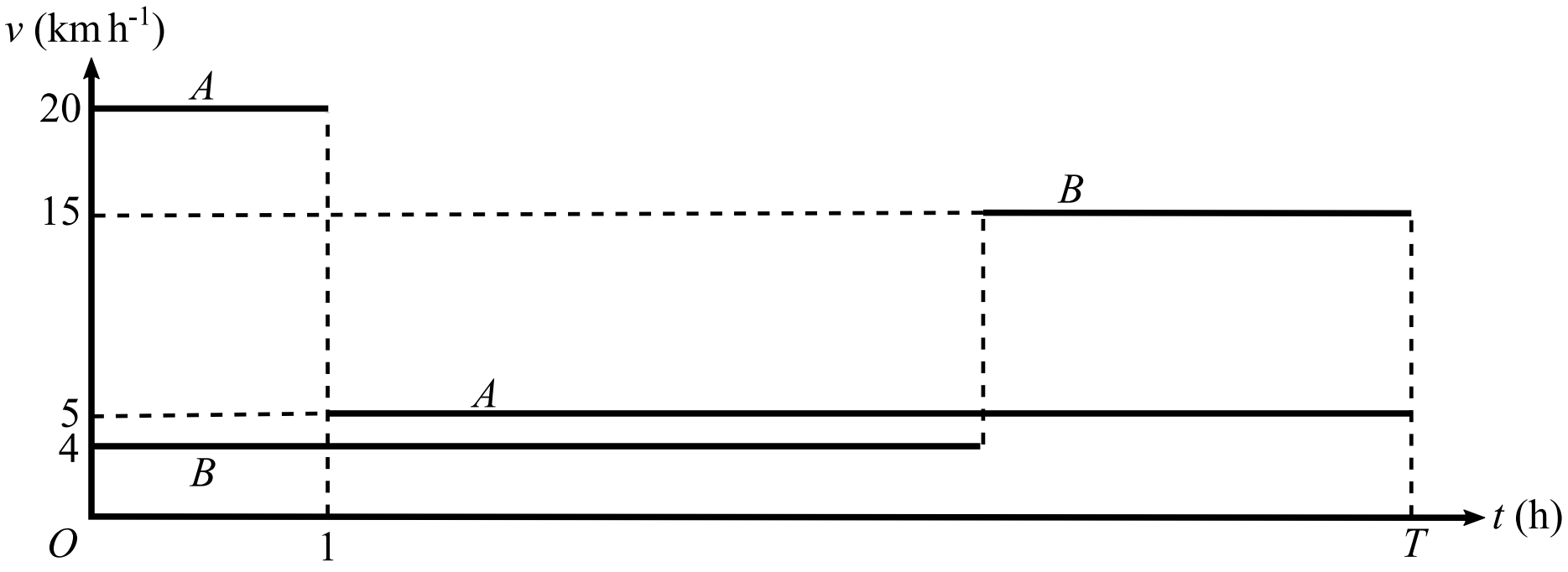

Figure 1: Velocity-time graph of two travellers A and B along a long straight road.

Two travellers A and B make the same journey on a long straight road. Each traveller walks for part of the journey and rides a bicycle for part of the journey. They start their journeys at the same instant, and they end their journeys simultaneously after travelling for T hours. A starts the journey cycling at a steady $20\,\mathrm{km\,h^{-1}}$ for 1 hour. A then leaves the bicycle at the side of the road, and completes the journey walking at $5\,\mathrm{km\,h^{-1}}$. B begins the journey walking at a steady $4\,\mathrm{km\,h^{-1}}$. When B finds the bicycle where A left it, B cycles at $15\,\mathrm{km\,h^{-1}}$ to complete the journey.

Part A Distance cycled and time

Calculate the distance A cycles.

Hence, find the period of time, in hours, for which B walks before finding the bicycle.

Part B Completion time

Find T in hours.

Part C Total distance

Calculate the distance A and B each travel.

Used with permission from UCLES, A-level, June 2015, OCR M1, Question 3

Gameboard:

STEM SMART Single Maths 5 - Kinematics (Motion)

Constant Acceleration 3ii

A Level

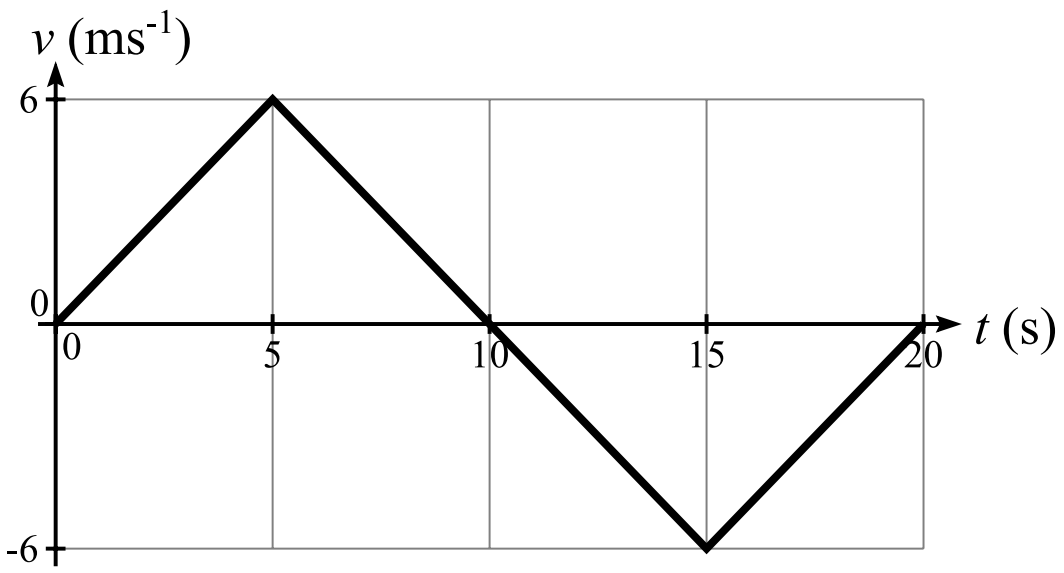

Figure 1: (t, v) graph for the motion of the athlete.

An athlete runs in a straight line from point A to point B, and back to point A. **Figure 1** shows the (t, v) graph for the motion of the athlete.

Part A Initial acceleration

Calculate the initial acceleration of the athlete.

Part B Total distance

Calculate the total distance the athlete runs.

Part C Velocity at $t = 17$

Calculate the velocity of the athlete when $t = 17$.

Used with permission from UCLES, A Level, June 2008, OCR M1

Gameboard:

STEM SMART Single Maths 5 - Kinematics (Motion)

General Kinematics 3i

A Level

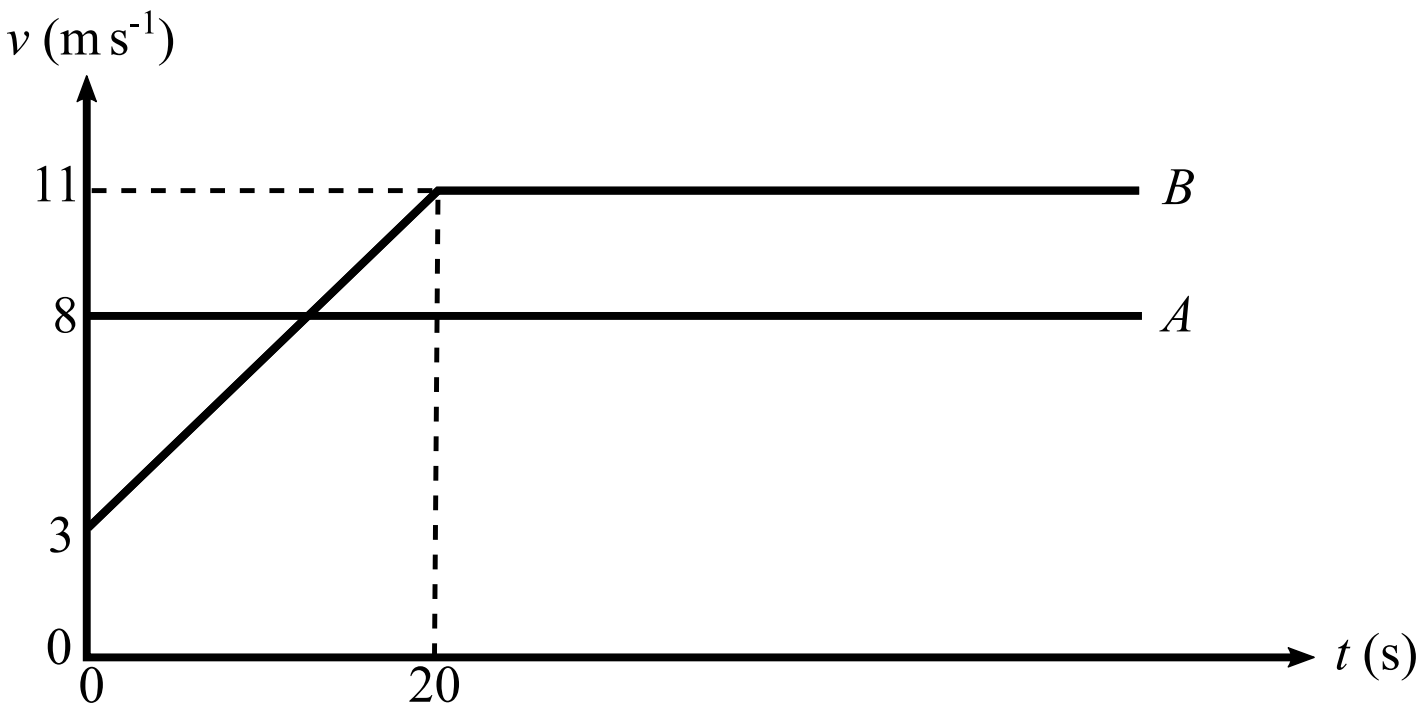

Figure 1: Velocity-time graph of the motion of two cyclists A and B racing.

Figure 1 shows the motion of two cyclists A and B who are travelling along a horizontal straight road. At time $t = 0$, A, who cycles with constant speed $8\,\mathrm{m\,s^{-1}}$, overtakes B who has initial speed $3\,\mathrm{m\,s^{-1}}$. From time $t = 0$, B cycles with constant acceleration for $20\,\mathrm{s}$. When $t = 20$ her speed is $11\,\mathrm{m\,s^{-1}}$, which she subsequently maintains.

Part A Same speed

Find the value of t when A and B have the same speed. Give your answer to 2 significant figures.

Part B Time of overtaking

Calculate the value of t when B overtakes A. Give your answer to 2 significant figures.

Part C Distance time graph

On a single diagram, sketch the (t, x) graphs for the two cyclists for the time from $t = 0$ until after B has overtaken A.

Easier question?

Used with permission from UCLES, A Level, January 2010, OCR M1, Question 5

Gameboard:

STEM SMART Single Maths 5 - Kinematics (Motion)

General Kinematics 3ii

A Level

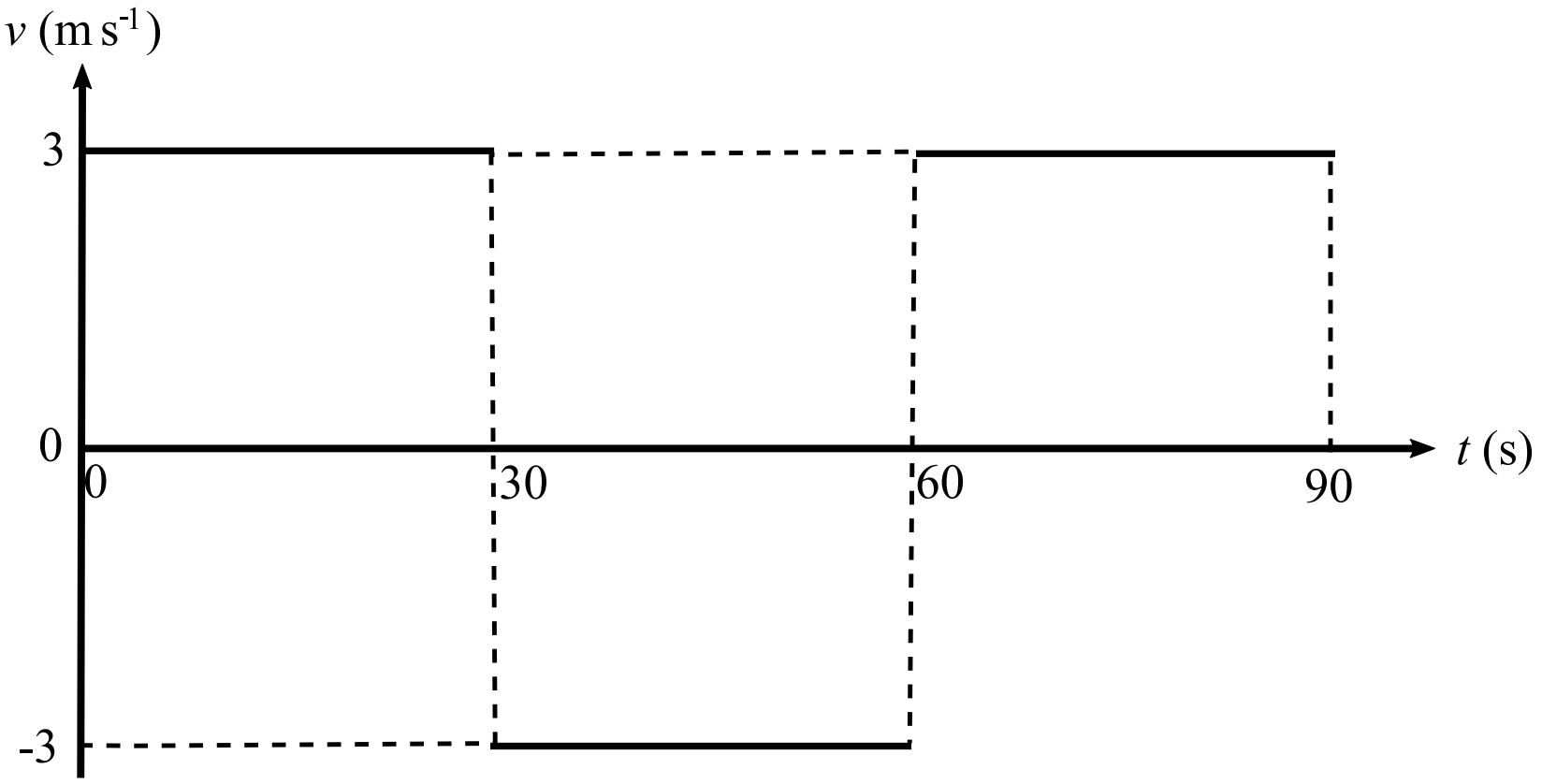

Figure 1: Velocity-time graph of a woman running between A and B.

A woman runs from A to B, then from B to A and then from A to B again, on a straight track, taking $90\,\text{s}$. The woman runs at a constant speed throughout.

Part A Total distance

Find the total distance run by the woman.

Part B Distances

Find the distance of the woman from A when

$t = 50$

$t = 80$

Part C Child's speed

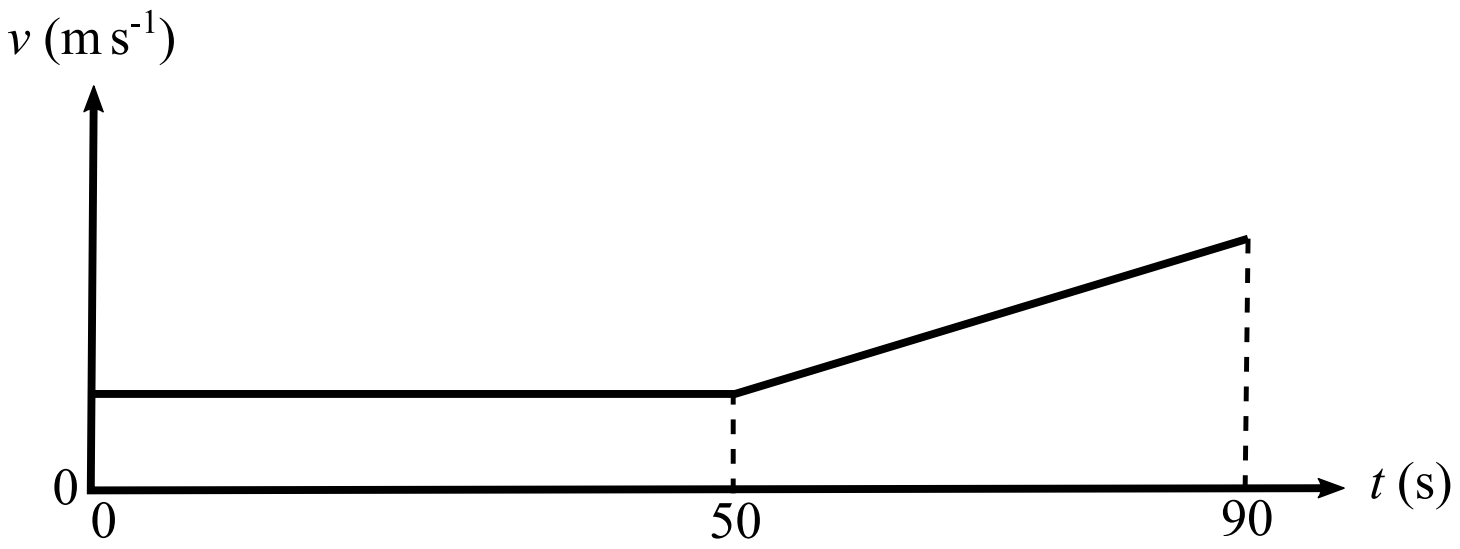

Figure 2: Velocity-time graph of a child moving from A along AB.

At time $t = 0$, a child also starts to move, from A, along AB. The child walks at a constant speed for the first $50\,\mathrm{s}$ and then at an increasing speed for the next $40\,\mathrm{s}$.

At time $t = 50$, the woman and the child pass each other, moving in opposite directions. Find the speed of the child during the first $50\,\mathrm{s}$.

Part D Overtaking

At time $t = 80$, the woman overtakes the child. Find the speed of the child at this instant.

Gameboard:

STEM SMART Single Maths 5 - Kinematics (Motion)

Constant Acceleration 3i

A Level

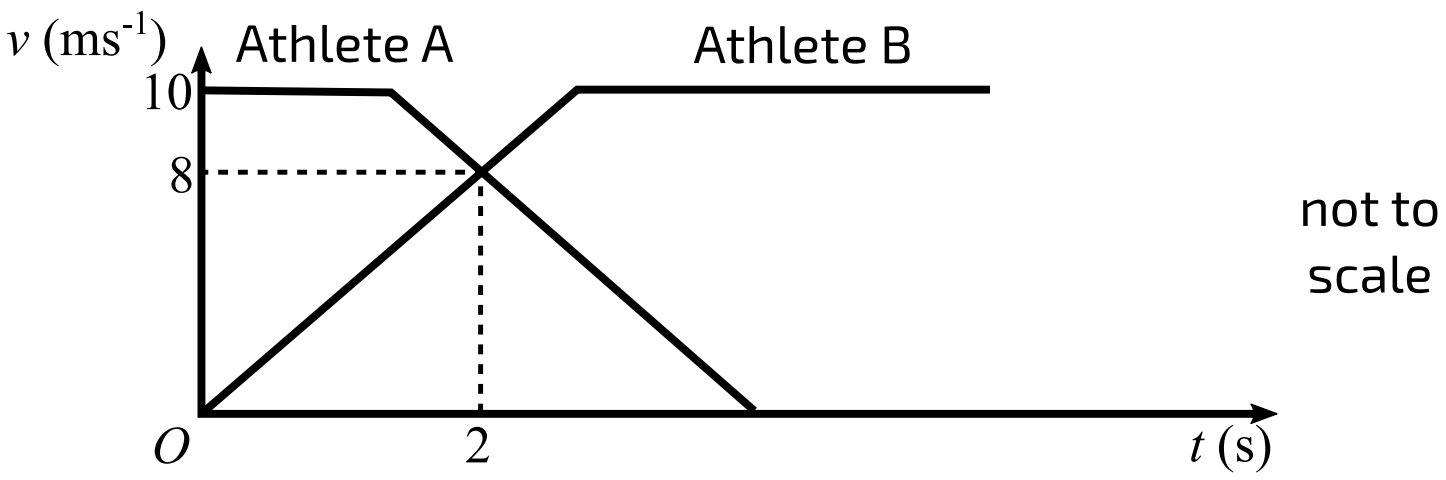

Figure 1: (t, v) graph of athletes A and B running in the same direction.

The diagram shows the (t, v) graphs for two athletes, A and B, who run in the same direction in the same straight line while they exchange the baton in a relay race. A runs with constant velocity $10\,\mathrm{m\,s^{-1}}$ until he decelerates at $5\,\mathrm{m\,s^{-2}}$ and subsequently comes to rest. B has constant acceleration from rest until reaching his constant speed of $10\,\mathrm{m\,s^{-1}}$. The baton is exchanged $2\,\mathrm{s}$ after B starts running, when both athletes have speed $8\,\mathrm{m\,s^{-1}}$ and B is $1\,\mathrm{m}$ ahead of A.

Part A Deceleration

Find the value of t at which A starts to decelerate.

Part B Distance AB

Calculate the distance between A and B at the instant when B starts to run. Give your answer to 3 significant figures.

Gameboard:

STEM SMART Single Maths 5 - Kinematics (Motion)

Projectiles (1D) 1ii

A Level

A particle is projected vertically upwards with speed $7\,\mathrm{m\,s^{-1}}$ from a point on the ground.

Part A Speed $0.4\,\mathrm{s}$ after

Find the speed of the particle $0.4\,\mathrm{s}$ after projection to 3 significant figures.

Part B Distance $0.4\,\mathrm{s}$ after

Find the distance above the ground $0.4\,\mathrm{s}$ after projection to 3 significant figures.

Part C Total distance travelled

Find the total distance travelled by the particle in the first $0.9\,\mathrm{s}$ after projection. Give your answer to 3 significant figures.

Used with permission from UCLES, A Level, June 2012, OCR M1, Question 2

Gameboard:

STEM SMART Single Maths 5 - Kinematics (Motion)

Projectiles (1D) 2ii

A Level

A particle P is projected vertically downwards with initial speed $3.5\,\mathrm{m\,s^{-1}}$ from a point A which is $5\,\mathrm{m}$ above horizontal ground.

Part A Speed before striking

Find the speed of P immediately before it strikes the ground to 3 significant figures.

Part B Speed after leaving

After striking the ground, P rebounds and moves vertically upwards and $0.87\,\mathrm{s}$ after leaving the ground P passes through A.

Calculate the speed of P immediately after it leaves the ground.