1.1 Motion

MCQ

Easy

1

1 mark

Physical quantities may be vectors or scalars.

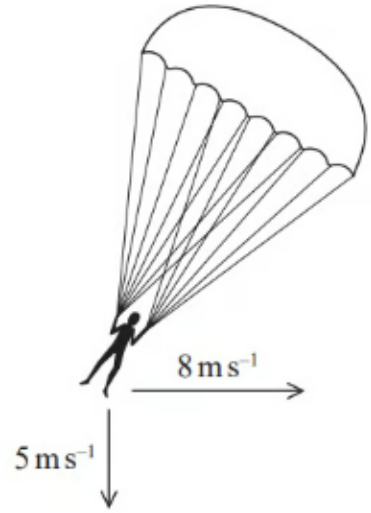
Which row of the table is correct?

	Force	Mass	Acceleration
A	scalar	vector	scalar
B	scalar	scalar	vector
C	vector	vector	scalar
D	vector	scalar	vector

2

1 mark

The diagram shows a student during a parachute jump on a windy day. The vertical component of her velocity is 5.0 m s^{-1}. The horizontal component of her velocity is 8.0 m s^{-1}. She descends at an angle θ to the vertical.



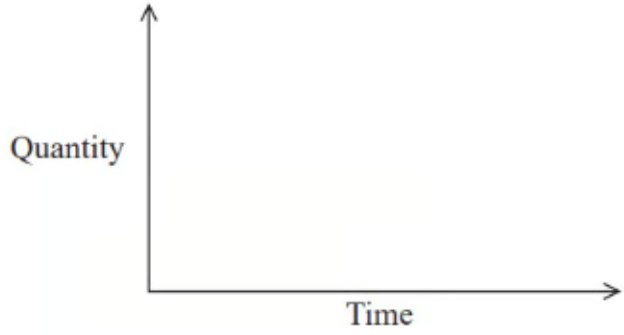
Which row of the table gives expressions for the magnitude and angle of the student's resultant velocity?

	Magnitude / m s^{-1}	θ / °
A	$\sqrt{8^2 - 5^2}$	$\tan^{-1}\frac{8}{5}$
B	$\sqrt{8^2 - 5^2}$	$\sin^{-1}\frac{5}{8}$
C	$\sqrt{8^2 + 5^2}$	$\tan^{-1}\frac{8}{5}$
D	$\sqrt{8^2 + 5^2}$	$\sin^{-1}\frac{5}{8}$

3

1 mark

Graphs can be used to represent the motion of an object.



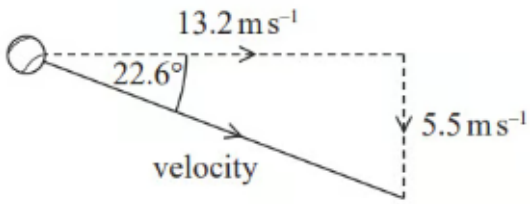
Which row in the table gives a quantity plotted on the y-axis and the corresponding quantity represented by the gradient of the graph?

		Quantity plotted on y-axis	Gradient of graph
☐	**A**	displacement	acceleration
☐	**B**	velocity	acceleration
☐	**C**	acceleration	velocity
☐	**D**	acceleration	displacement

4

1 mark

A tennis ball is moving through the air. The diagram shows the horizontal and vertical components of its velocity.



Which of the following expressions gives the magnitude of the velocity in $\mathrm{m\ s^{-1}}$?

A. $\dfrac{13.2}{\sin 22.6^\circ}$

B. $13.2 \times \sin 22.6^\circ$

C. $\dfrac{5.5}{\sin 22.6^\circ}$

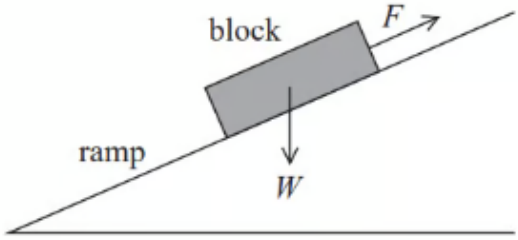
D. $5.5 \times \sin 22.6^\circ$

5

1 mark

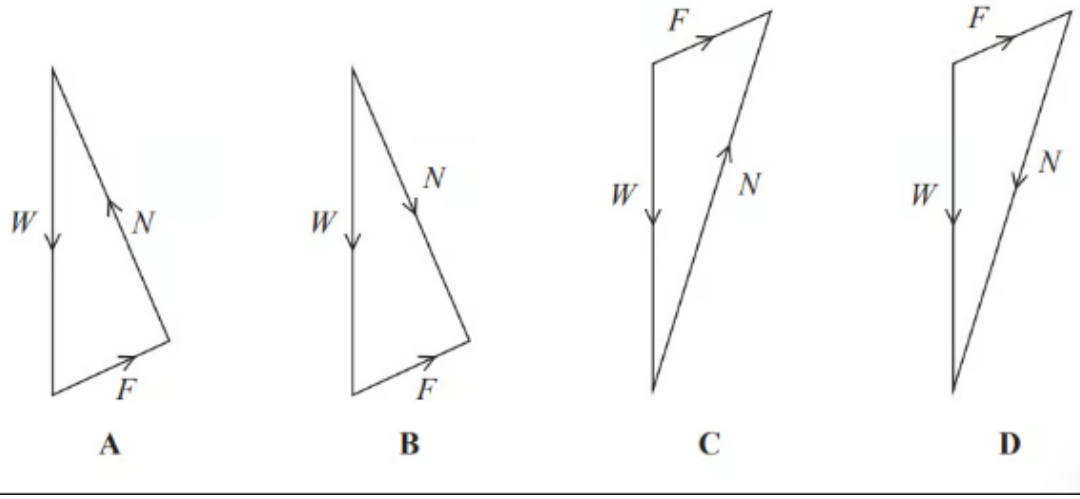
A block of wood is stationary on a frictionless ramp as shown.

The block is held in place by a string. The weight of the block is W. The force applied to the block by the string is F.



A triangle of forces can be used to determine the magnitude and direction of the normal contact force N acting on the block.

Which of the following triangles is correct?

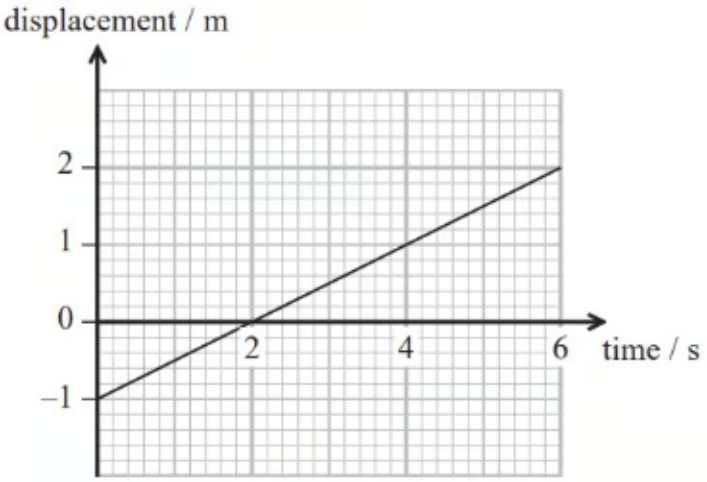


Medium

1

1 mark

A student walks for 6 seconds. The displacement-time graph for the student is shown.



Which row of the table shows the final displacement and velocity of the student?

	Displacement / m	Velocity / m s^{-1}
A	2.0	0.5
B	3.0	0.5
C	5.0	2.0
D	3.0	2.0

2

1 mark

An object on the Moon falls a vertical distance of 0.32 m, from rest, in a time of 0.63 s.

Which of the following expressions gives the acceleration due to gravity on the Moon in m s^{-2}?

A. $\frac{0.32}{2 \times 0.63}$

B. $\frac{0.32}{2 \times 0.63^2}$

C. $\frac{2 \times 0.32}{0.63^2}$

D. $\frac{2 \times 0.32}{0.63}$

3

1 mark

A ball bearing falls vertically from rest through a distance of 50cm in a time of 0.32s.

Which expression gives the acceleration of the ball bearing in m s^{-2}?

A. $1 \div 0.32^2$

B. $0.5 \div 0.32$

C. $100 \div 0.32^2$

D. $50 \div 0.32$

4

1 mark

Which of the following is a scalar quantity?

A. weight

B. momentum

C. terminal velocity

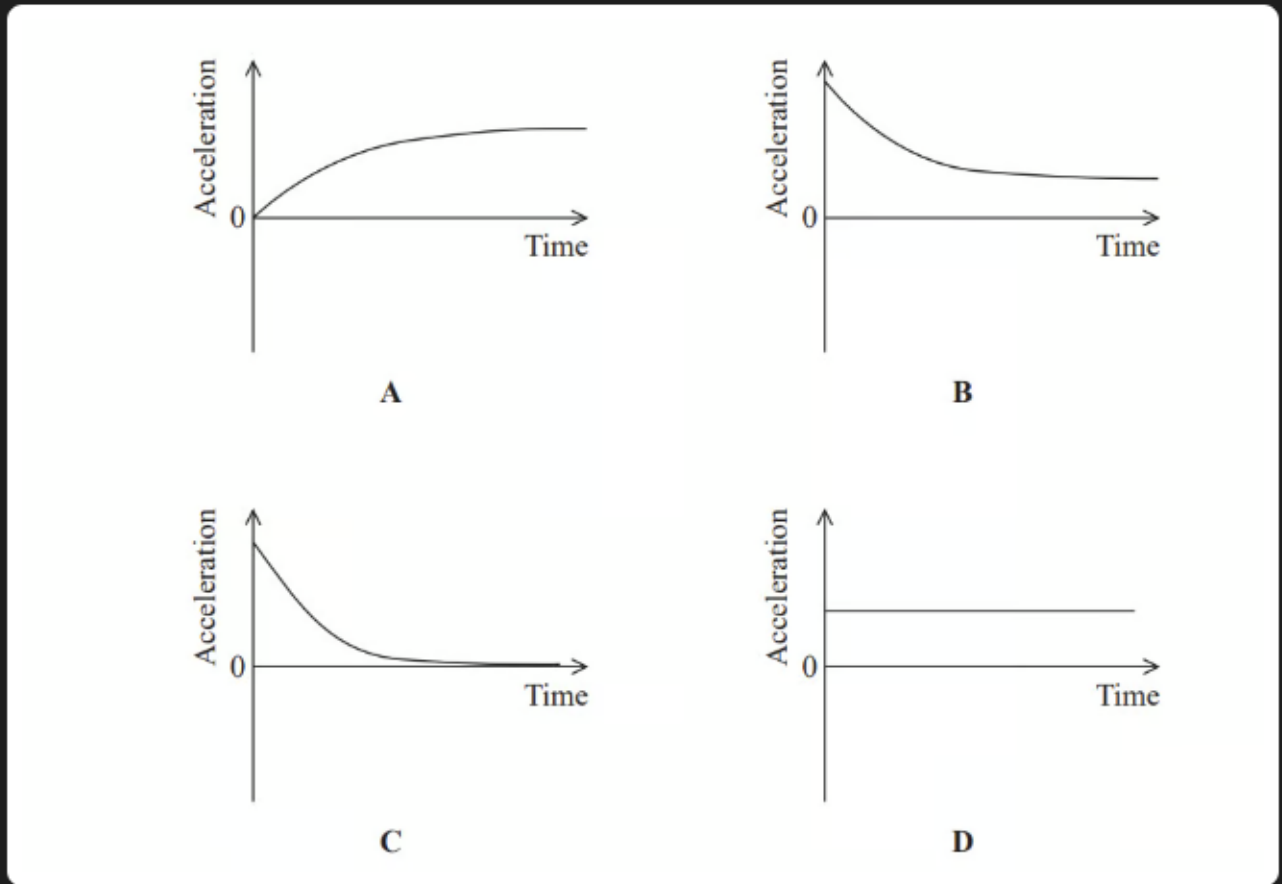
D. kinetic energy

5

1 mark

A constant forward force acts on a car. The car accelerates along a straight road. After a while, the speed of the car reaches a constant value.

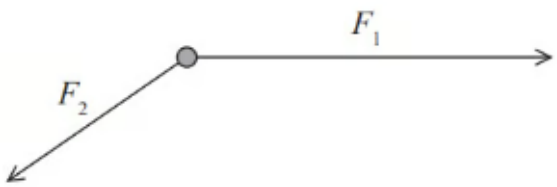
Which graph shows the variation of acceleration with time for the car?



6

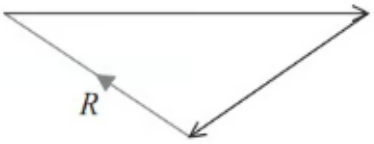
1 mark

Two forces F_1 and F_2 act on an object, as shown.

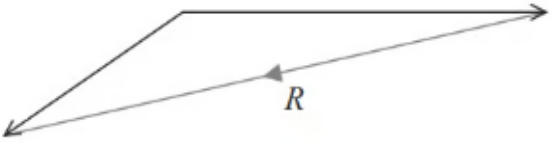


Which of the following is a correctly drawn scaled vector diagram for the resultant R of the forces F_1 and F_2?

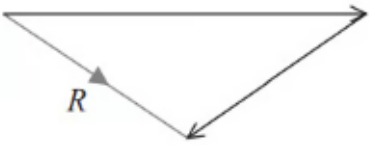
☒ **A**



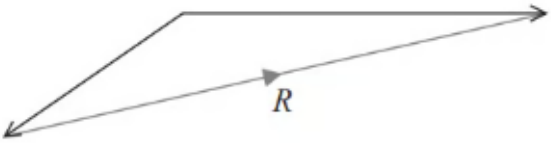
☒ **B**



☒ **C**



☒ **D**

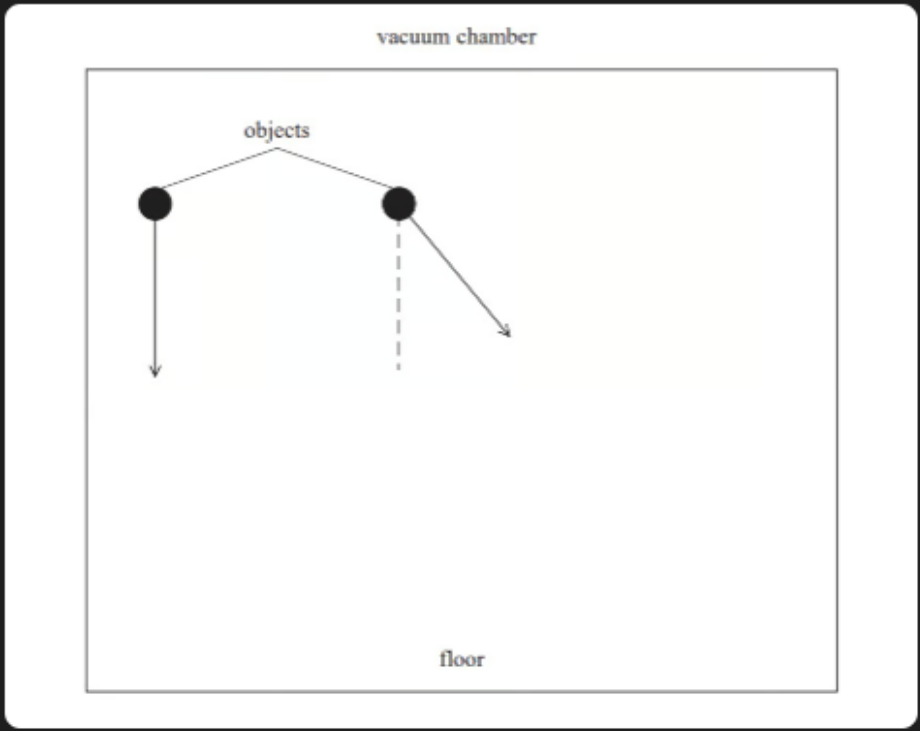


Hard

1

1 mark

Two identical objects with the same initial speed fall from the same height in a vacuum chamber, as shown. The arrows in the diagram show initial directions of travel of the objects.



Which of the following quantities are **not** the same for both objects?

A. The accelerations of the objects during the fall.

B. The velocities of the objects as they reach the floor.

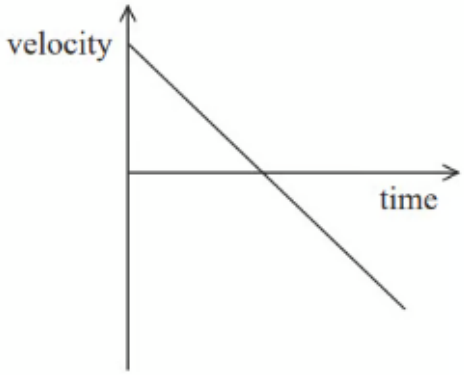
C. The increase in the speeds of the objects during the fall.

D. The kinetic energies of the objects as they reach the floor.

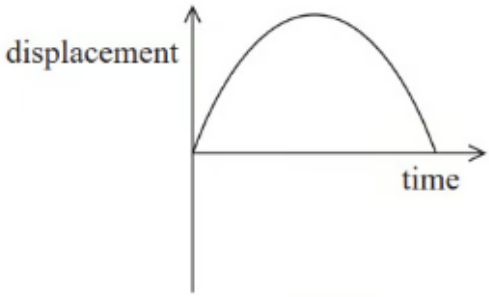
2

1 mark

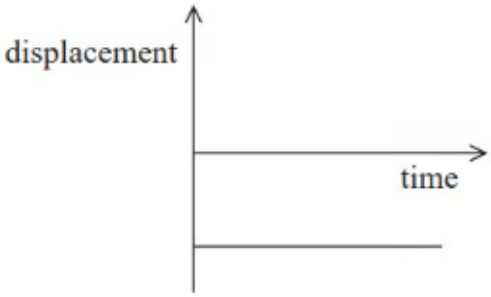
The velocity-time graph for a particle is shown.



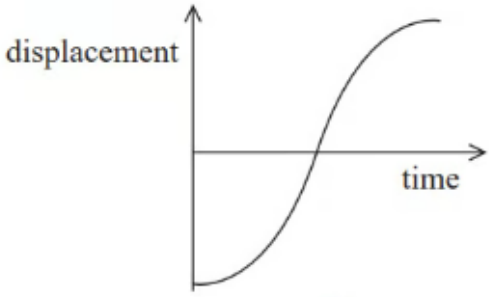
Which of the following is the displacement-time graph for this particle?



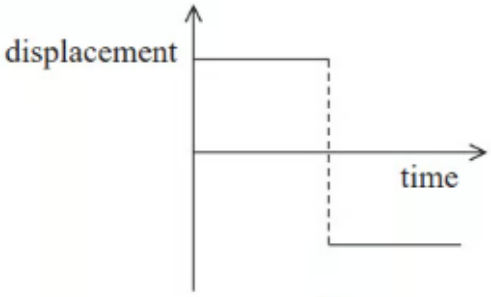
A



B



C



D

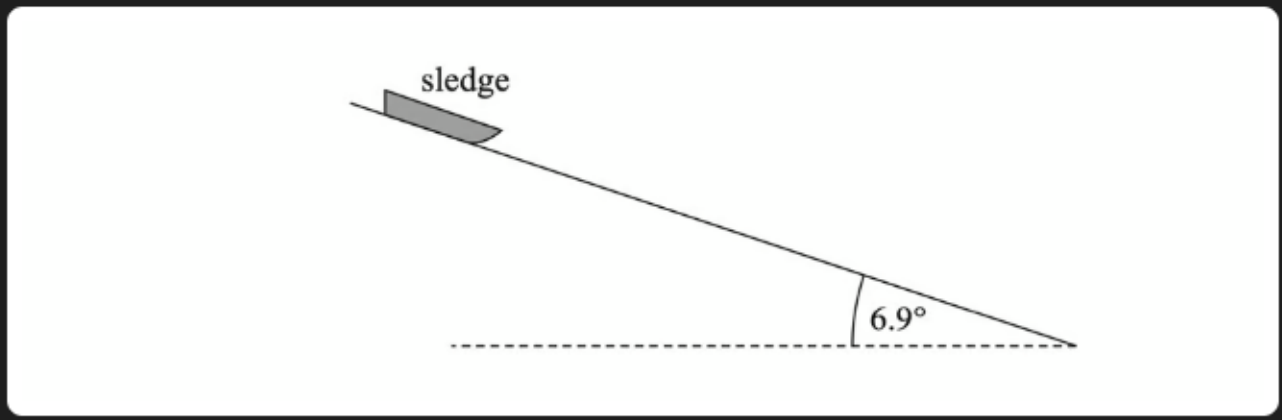
Structured Questions

Medium

1a

2 marks

A sledge accelerates, due to gravity, from rest down a frictionless slope. Air resistance can be ignored. The slope is at an angle of 6.9° to the horizontal, as shown.



Complete the free-body force diagram below for the sledge.

1b

6 marks

The slope has a total length of 60m

i) Show that the initial acceleration of the sledge along the slope is about 1 m s^{-2}

Initial acceleration = ... (2)

ii) Determine the speed of the sledge at the end of the slope.

Speed at end of slope = ... (2)

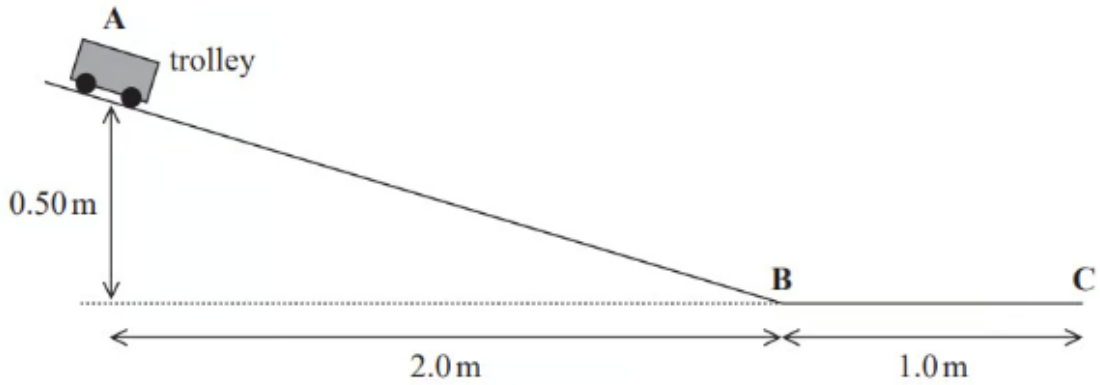
(iii) Determine the time taken for the sledge to travel to the end of the slope.

Time taken = ...(2)

2a

3 marks

A trolley accelerates from rest at point A, down a straight track to point B. The trolley then continues along a horizontal track to point C, as shown.



The effects of air resistance and friction are negligible.

Show that the trolley reaches point B with a speed of about 3 m s^{-1}.

2b

4 marks

Determine the time taken by the object to move from point A to point C.

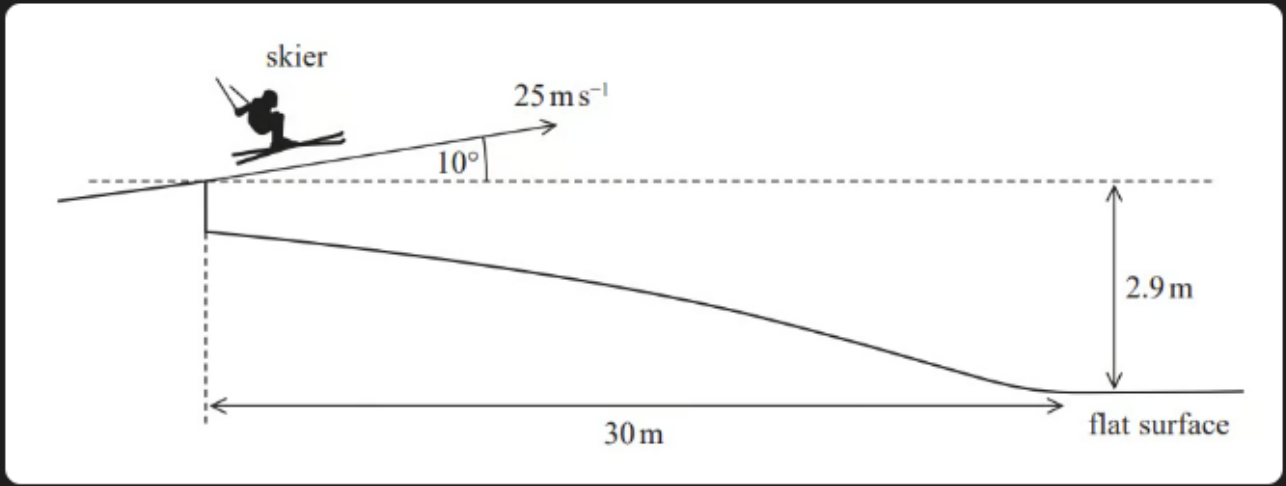
Time taken = ...

3a

5 marks

A skier moving at 25 m s^{-1} skis off a ramp. The ramp is angled upwards at 10° to the horizontal, as shown.

There is a flat surface that starts 30 m from the ramp. The flat surface is 2.9 m below the ramp.



Deduce whether the skier reaches the flat surface before landing. You may ignore any effects of air resistance.

3b

3 marks

Another skier travels along the horizontal surface with an initial speed of 23 m s–1 .

She comes to rest after travelling a distance of 43 m.

Calculate the average force required to bring the skier to rest.

mass of skier = 63 kg

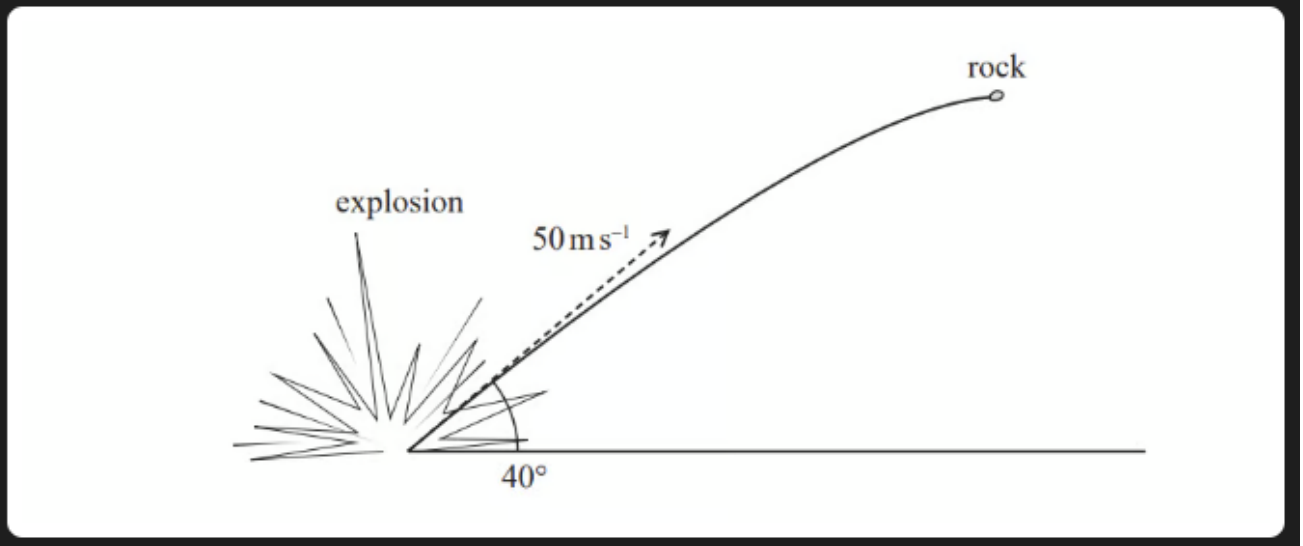
Average force = ...

Hard

1a

3 marks

An explosion projects a rock into the air with a speed of 50 m s^{-1} at an angle to the horizontal of 40°.

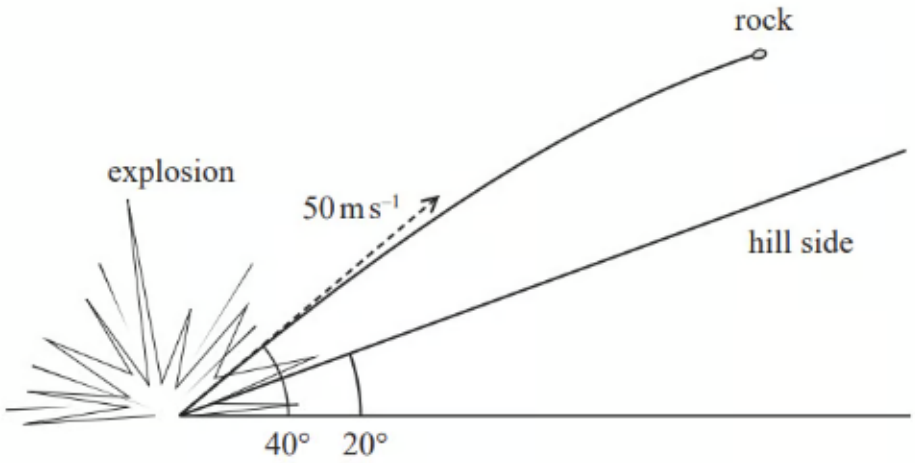


Show that the rock would reach its maximum height about 3 s after the explosion.

1b

6 marks

The rock moves in the direction of a hill. The side of the hill is at 20° to the horizontal, as shown.



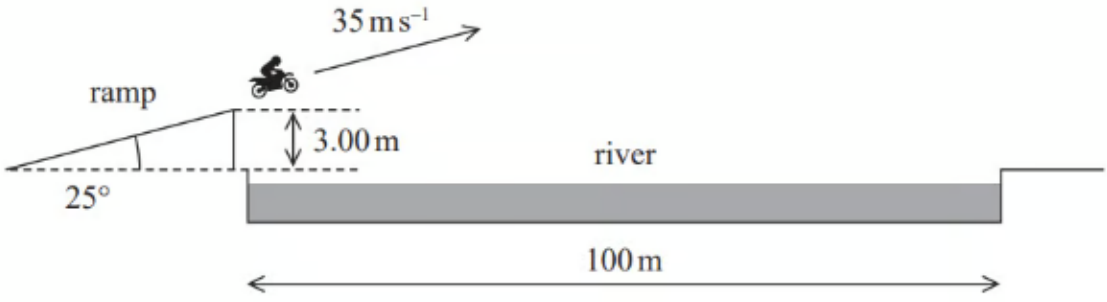
After a certain distance, the rock lands on the side of the hill.

Deduce whether the rock hits the ground before it reaches its maximum possible height.

2a

2 marks

A stunt motorcyclist wants to jump across a river to land on the other side. The diagram shows the motorcyclist driving off a ramp at the edge of a river.



The ramp is at an angle of 25° to the horizontal and the height at the end of the ramp is 3.0 m. The width of the river is 100 m. The initial velocity of the motorcyclist is 35 m s^{-1}.

Calculate the horizontal and vertical components of the motorcycle's initial velocity as it leaves the ramp.

Horizontal component = ...

Vertical component = ...

2b

4 marks

Deduce whether the rider lands on the other side of the river.
The effects of air resistance can be ignored.

2c

3 marks

Explain how air resistance would affect the jump.