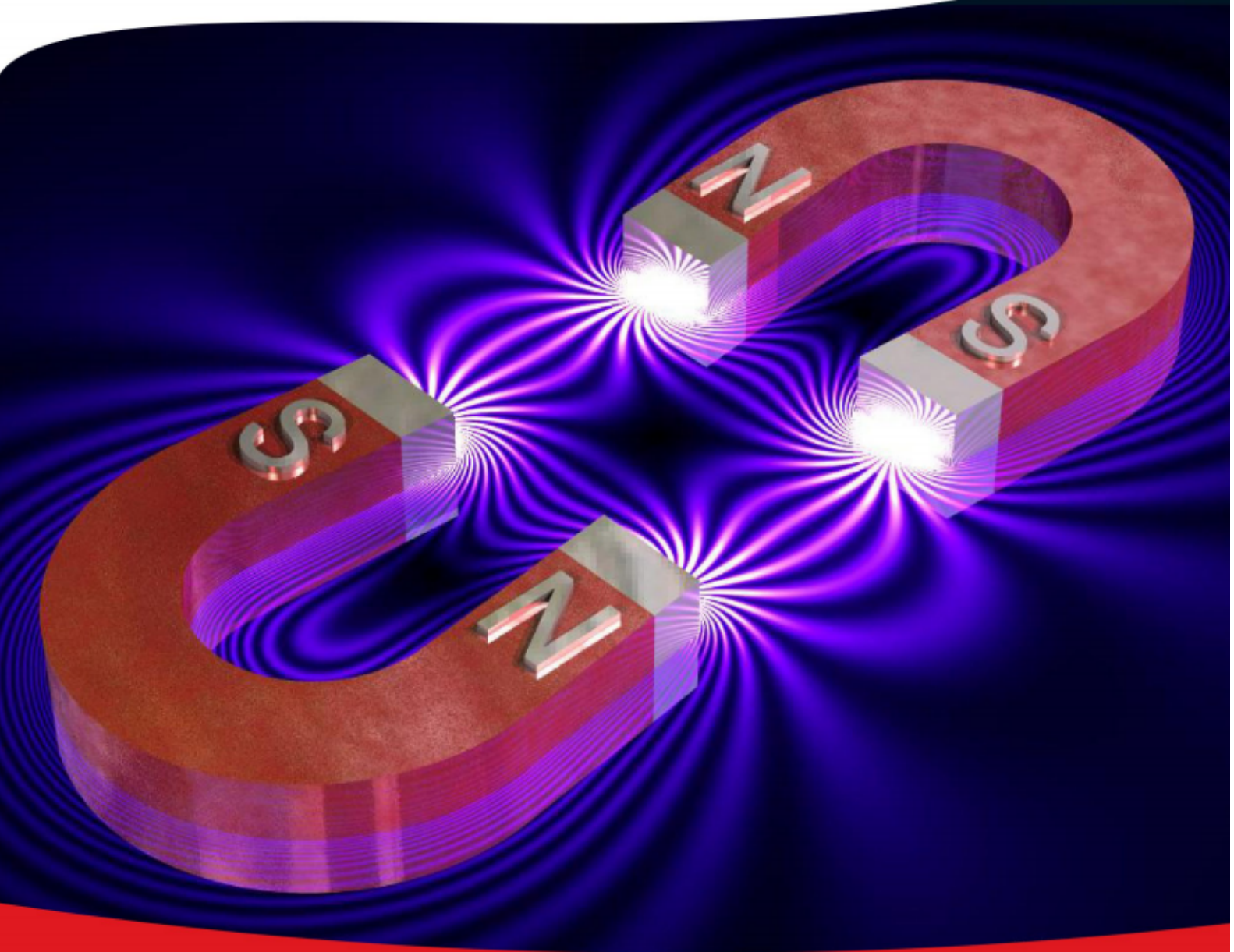
Cambridge International AS & A Level

PHYSICS (9702) P2

TOPIC WISE QUESTIONS + ANSWERS | COMPLETE SYLLABUS



PapaCambridge

Chapter 3

Kinematics

3.1 Equations of motion

24. 9702_s20_qp_23 Q: 1

(a) State **one** similarity and **one** difference between *distance* and *displacement*.

similarity: .....

.....

difference: .....

.....

[2]

(b) A student takes several measurements of the same quantity. This set of measurements has high precision, but low accuracy.

Describe what is meant by:

(i) *high precision*

.....

..... [1]

(ii) *low accuracy*.

.....

..... [1]

[Total: 4]

25. 9702_w20_qp_22 Q: 1

(a) Complete Table 1.1 by putting a tick (✓) in the appropriate column to indicate whether the listed quantities are scalars or vectors.

Table 1.1

quantity	scalar	vector
acceleration		
density		
temperature		
momentum		

[2]

(b) A toy train moves along a straight section of track. Fig. 1.1 shows the variation with time t of the distance d moved by the train.

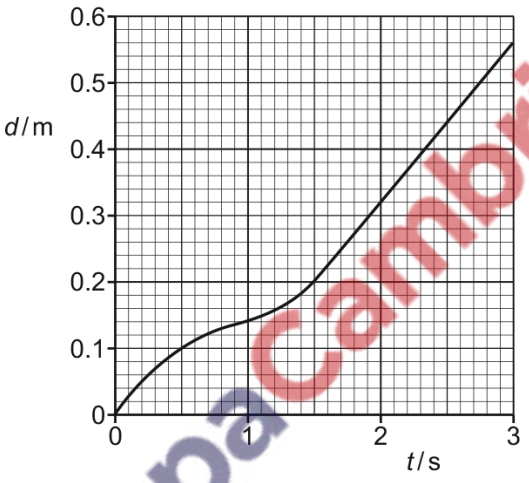


Fig. 1.1

(i) Describe qualitatively the motion of the train between time $t = 0$ and time $t = 1.0$ s.

.....

..... [1]

(ii) Determine the speed of the train at time $t = 2.0\,s$.

speed = ... $m\,s^{-1}$ [2]

(c) The straight section of track in **(b)** is part of the loop of track shown in Fig. 1.2.

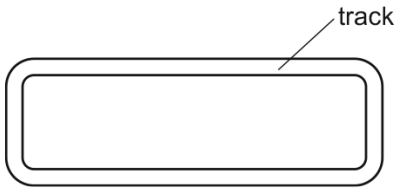


Fig. 1.2

The train completes exactly one lap of the loop.

State and explain the average velocity of the train over the one complete lap.

.....

.....

..... [1]

[Total: 6]

26. 9702_s19_qp_21 Q: 1

(a) Define *velocity*.

.....

.....[1]

(b) The speed v of a sound wave through a gas of pressure P and density ρ is given by the equation

$$v = \sqrt{\frac{kP}{\rho}}$$

where k is a constant that has no units.

An experiment is performed to determine the value of k. The data from the experiment are shown in Fig. 1.1.

quantity	value	uncertainty
v	$3.3 \times 10^2\,\text{m s}^{-1}$	± 3%
P	$9.9 \times 10^4\,\text{Pa}$	± 2%
ρ	$1.29\,\text{kg m}^{-3}$	± 4%

Fig. 1.1

(i) Use data from Fig. 1.1 to calculate k.

k = ... [2]

(ii) Use your answer in **(b)(i)** and data from Fig. 1.1 to determine the value of k, with its absolute uncertainty, to an appropriate number of significant figures.

k = ... ± ..... [3]

[Total: 6]

27. 9702_w19_qp_22 Q: 2

(a) Define *acceleration*.

..... [1]

(b) A steel ball of diameter 0.080 m is released from rest and falls vertically in air, as illustrated in Fig. 2.1.

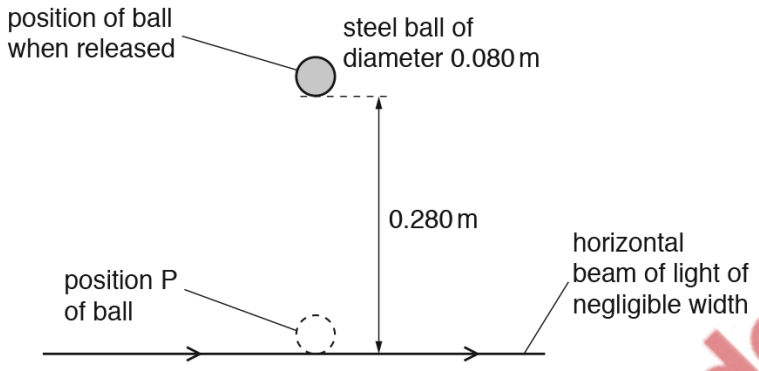


Fig. 2.1 (not to scale)

A horizontal beam of light of negligible width is a vertical distance of 0.280 m below the bottom of the ball when it is released. The ball falls through and breaks the beam of light.

(i) Explain why the force due to air resistance acting on the ball may be neglected when calculating the time taken for the ball to reach the beam of light.

.....

..... [1]

(ii) Calculate the time taken for the ball to fall from rest to position P where the bottom of the ball touches the beam of light.

time taken = ... s [2]

(iii) Determine the time interval during which the beam of light is broken by the ball.

time interval = ... s [2]

(c) A different ball is released from the same position as the steel ball in **(b)**. This ball has the same diameter but a much lower density. For this ball, the force due to air resistance cannot be neglected as the ball falls.

State and explain the change, if any, to the time interval during which the beam of light is broken by the ball.

.....

.....

.....

..... [2]

[Total: 8]

28. 9702_m18_qp_22 Q: 1

(a) Complete Fig. 1.1 to indicate whether each of the quantities is a vector or a scalar.

quantity	vector or scalar
acceleration	
speed	
power	

Fig. 1.1

[2]

(b) A ball is projected with a horizontal velocity of $1.1\,m\,s^{-1}$ from point A at the edge of a table, as shown in Fig. 1.2.

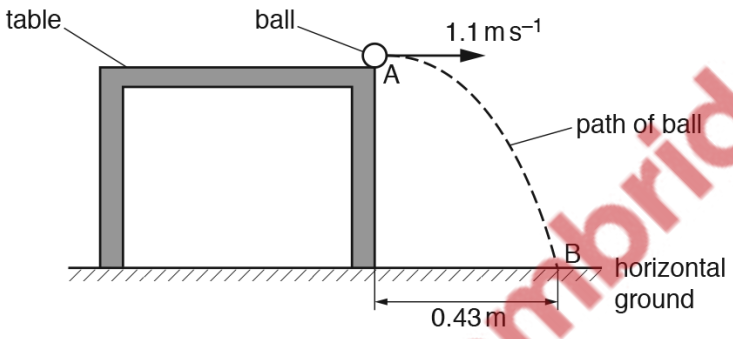


Fig. 1.2

The ball lands on horizontal ground at point B which is a distance of 0.43 m from the base of the table. Air resistance is negligible.

(i) Calculate the time taken for the ball to fall from A to B.

time = ... s [1]

(ii) Use your answer in **(b)(i)** to determine the height of the table.

height = ... m [2]

(iii) The ball leaves the table at time $t = 0$.

For the motion of the ball between A and B, sketch graphs on Fig. 1.3 to show the variation with time t of

1. the acceleration a of the ball,

2. the vertical component s_v of the displacement of the ball from A.

Numerical values are not required.

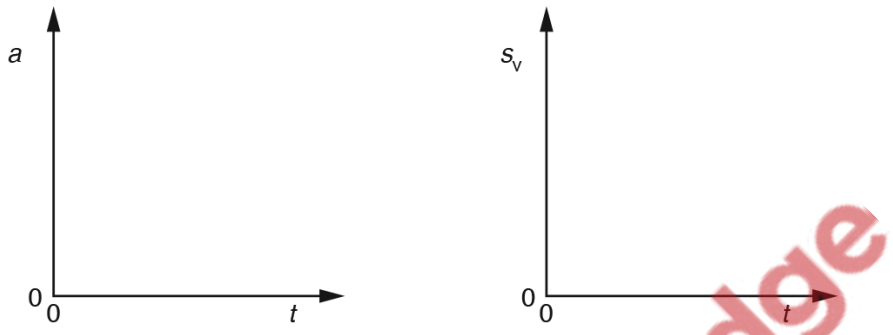


Fig. 1.3

[2]

(c) A ball of greater mass is projected from the table with the same velocity as the ball in **(b)**. Air resistance is still negligible.

State and explain the effect, if any, of the increased mass on the time taken for the ball to fall to the ground.

.....

.....[1]

[Total: 8]

29. 9702_w17_qp_21 Q: 2

The variation with time t of the velocity v of two cars P and Q is shown in Fig. 2.1.

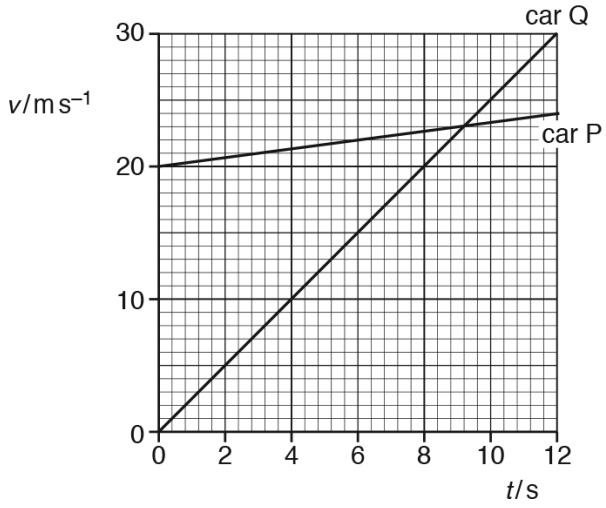


Fig. 2.1

The cars travel in the same direction along a straight road.
Car P passes car Q at time $t = 0$.

(a) The speed limit for cars on the road is 100 km h^{-1}. State and explain whether car Q exceeds the speed limit.

.....[1]

(b) Calculate the acceleration of car P.

acceleration = ... m s^{-2} [2]

(c) Determine the distance between the two cars at time $t = 12\,\text{s}$.

distance = ... m [3]

(d) From time $t = 12\,\text{s}$, the velocity of each car remains constant at its value at $t = 12\,\text{s}$.

Determine the time t at which car Q passes car P.

t = ... s [2]

[Total: 8]

30. 9702_s16_qp_21 Q: 2

A ball is thrown from a point P with an initial velocity u of $12\,m\,s^{-1}$ at 50° to the horizontal, as illustrated in Fig. 2.1.

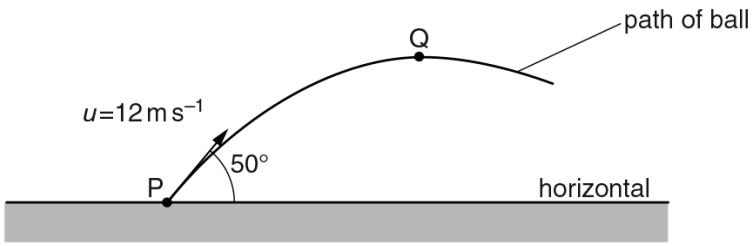


Fig. 2.1

The ball reaches maximum height at Q.

Air resistance is negligible.

(a) Calculate

(i) the horizontal component of u,

horizontal component = ... $m\,s^{-1}$ [1]

(ii) the vertical component of u.

vertical component = ... $m\,s^{-1}$ [1]

(b) Show that the maximum height reached by the ball is 4.3 m.

[2]

(c) Determine the magnitude of the displacement PQ.

displacement = ... m [4]

[Total: 8]

31. 9702_s15_qp_21 Q: 2

(a) Define *speed* and *velocity* and use these definitions to explain why one of these quantities is a scalar and the other is a vector.

speed: .....

velocity: .....

.....

.....

[2]

(b) A ball is released from rest and falls vertically. The ball hits the ground and rebounds vertically, as shown in Fig. 2.1.

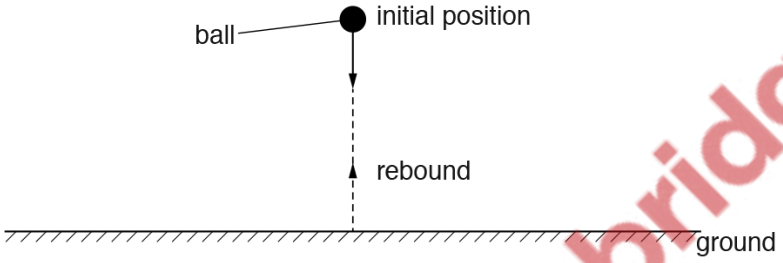


Fig. 2.1

The variation with time t of the velocity v of the ball is shown in Fig. 2.2.

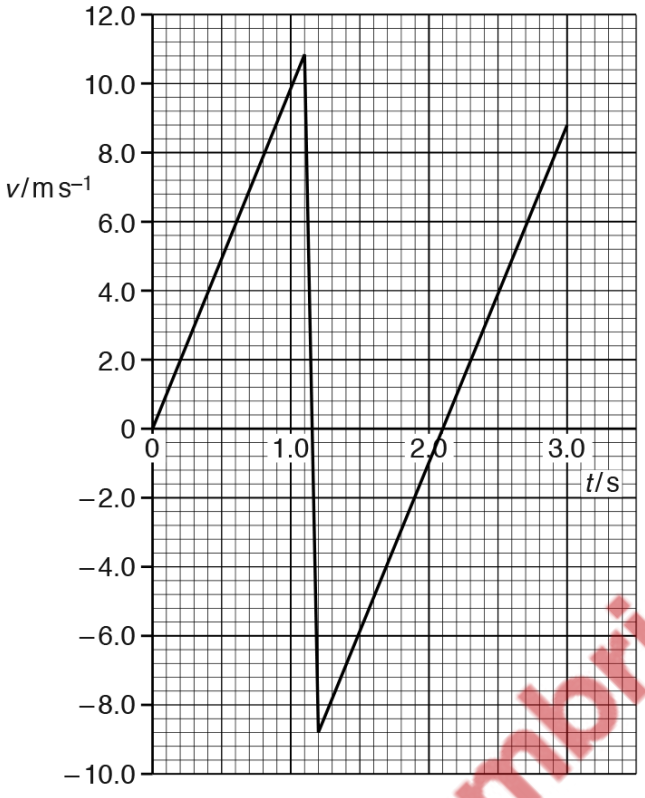


Fig. 2.2

Air resistance is negligible.

(i) Without calculation, use Fig. 2.2 to describe the variation with time t of the velocity of the ball from $t = 0$ to $t = 2.1$ s.

.....

.....

.....

.....

.....

.....[3]

(ii) Calculate the acceleration of the ball after it rebounds from the ground. Show your working.

acceleration = ... m s^{-2} [3]

(iii) Calculate, for the ball, from $t = 0$ to $t = 2.1$ s,

1. the distance moved,

distance = ... m [3]

2. the displacement from the initial position.

displacement = ... m [2]

(iv) On Fig. 2.3, sketch the variation with t of the speed of the ball.

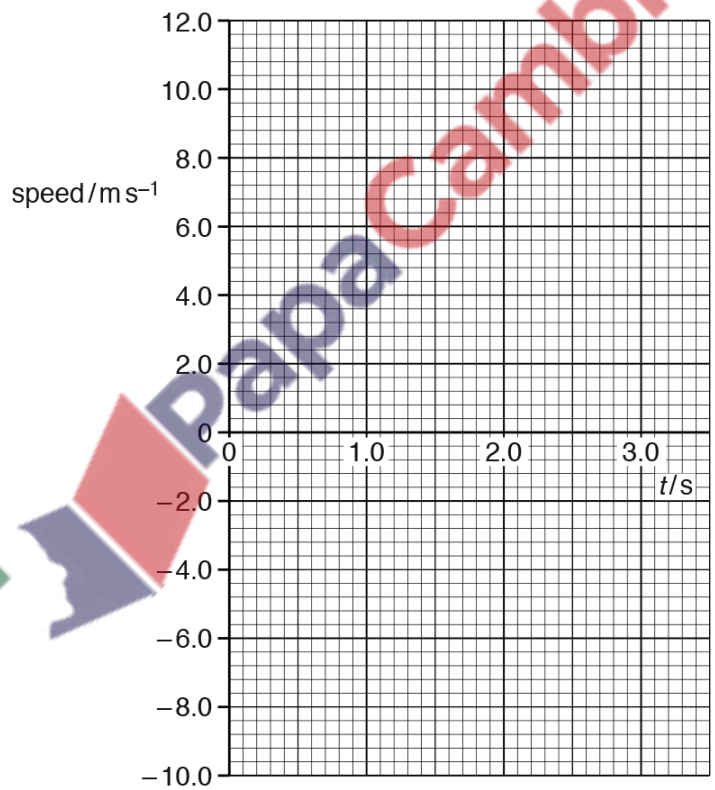


Fig. 2.3

[2]

32. 9702_s15_qp_23 Q: 1

(a) The distance between the Sun and the Earth is 1.5×10^{11} m. State this distance in Gm.

distance = ... Gm [1]

(b) The distance from the centre of the Earth to a satellite above the equator is 42.3 Mm. The radius of the Earth is 6380 km.
A microwave signal is sent from a point on the Earth directly below the satellite.

Calculate the time taken for the microwave signal to travel to the satellite and back.

time = ... s [2]

(c) The speed v of a sound wave through a gas of density ρ and pressure P is given by

$$v = \sqrt{\frac{CP}{\rho}}$$

where C is a constant.

Show that C has no unit.

[3]

(d) Underline all the scalar quantities in the list below.

acceleration energy momentum power weight [1]

(e) A boat travels across a river in which the water is moving at a speed of $1.8\,m\,s^{-1}$. The velocity vectors for the boat and the river water are shown to scale in Fig. 1.1.

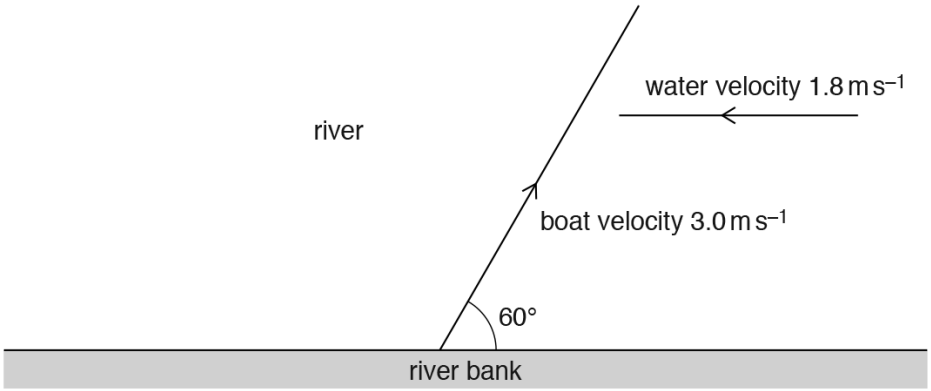


Fig. 1.1 (shown to scale)

In still water the speed of the boat is $3.0\,m\,s^{-1}$. The boat is directed at an angle of 60° to the river bank.

(i) On Fig. 1.1, draw a vector triangle or a scale diagram to show the resultant velocity of the boat. [2]

(ii) Determine the magnitude of the resultant velocity of the boat.

resultant velocity = ... $m\,s^{-1}$ [2]