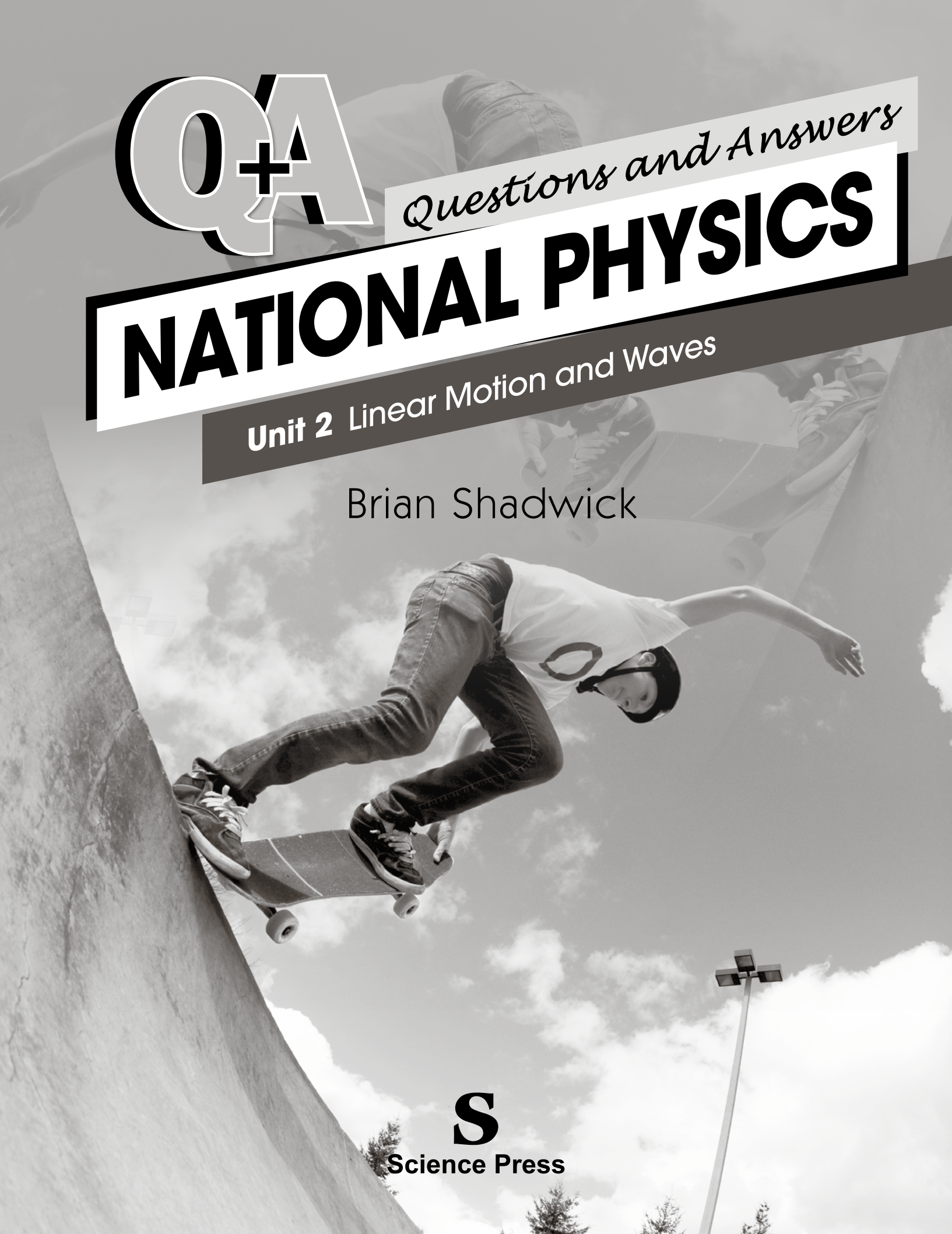
Q+A

Questions and Answers

NATIONAL PHYSICS

Unit 2 Linear Motion and Waves

Brian Shadwick



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Contents

Words to Watch

account, account for State reasons for, report on, give an account of, narrate a series of events or transactions.

analyse Interpret data to reach conclusions.

annotate Add brief notes to a diagram or graph.

apply Put to use in a particular situation.

assess Make a judgement about the value of something.

calculate Find a numerical answer.

clarify Make clear or plain.

classify Arrange into classes, groups or categories.

comment Give a judgement based on a given statement or result of a calculation.

compare Estimate, measure or note how things are similar or different.

construct Represent or develop in graphical form.

contrast Show how things are different or opposite.

create Originate or bring into existence.

deduce Reach a conclusion from given information.

define Give the precise meaning of a word, phrase or physical quantity.

demonstrate Show by example.

derive Manipulate a mathematical relationship(s) to give a new equation or relationship.

describe Give a detailed account.

design Produce a plan, simulation or model.

determine Find the only possible answer.

discuss Talk or write about a topic, taking into account different issues or ideas.

distinguish Give differences between two or more different items.

draw Represent by means of pencil lines.

estimate Find an approximate value for an unknown quantity.

evaluate Assess the implications and limitations.

examine Inquire into.

explain Make something clear or easy to understand.

extract Choose relevant and/or appropriate details.

extrapolate Infer from what is known.

hypothesise Suggest an explanation for a group of facts or phenomena.

identify Recognise and name.

interpret Draw meaning from.

investigate Plan, inquire into and draw conclusions about.

justify Support an argument or conclusion.

label Add labels to a diagram.

list Give a sequence of names or other brief answers.

measure Find a value for a quantity.

outline Give a brief account or summary.

plan Use strategies to develop a series of steps or processes.

predict Give an expected result.

propose Put forward a plan or suggestion for consideration or action.

recall Present remembered ideas, facts or experiences.

relate Tell or report about happenings, events or circumstances.

represent Use words, images or symbols to convey meaning.

select Choose in preference to another or others.

sequence Arrange in order.

show Give the steps in a calculation or derivation.

sketch Make a quick, rough drawing of something.

solve Work out the answer to a problem.

state Give a specific name, value or other brief answer.

suggest Put forward an idea for consideration.

summarise Give a brief statement of the main points.

synthesise Combine various elements to make a whole.

Q+A

Questions and Answers

Linear Motion and Force

Science Press

SET 1 Distance and Displacement

1. Define distance travelled and give the units we use to measure it.

2. Define displacement and give the units we use to measure it.

3. An object moves from P to Q, 30 km west. At Q it turns and moves a further 40 km south until it reaches position R. It then turns and travels directly back to P.

(a) What total distance does it travel?

(b) What is its displacement at P before it starts this journey?

(c) What is its displacement at Q?

(d) What is its displacement at R?

(e) What is its displacement at P at the end of the journey?

4. A car starts at position P and moves 100 km south to position Q. It then travels to R which is 75 km east of position Q before travelling back to P.

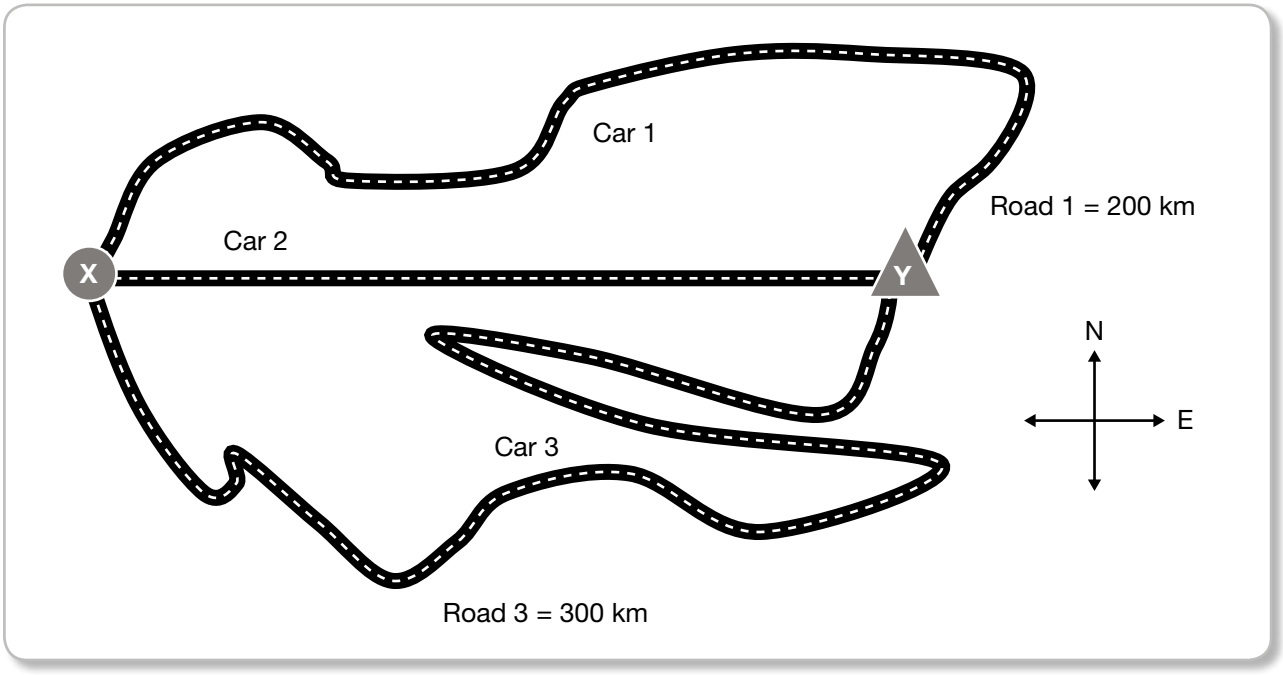
(a) What total distance does it travel?

(b) What is its displacement at P before it starts this journey?

(c) What is its displacement at Q?

(d) What is its displacement at R?

5. Three cars travel from X to Y by three different roads as shown in the diagram. Y is 140 km east of X.



(a) What is the displacement of car 1 when it is at X?

(b) What is the displacement of car 2 when it is at X?

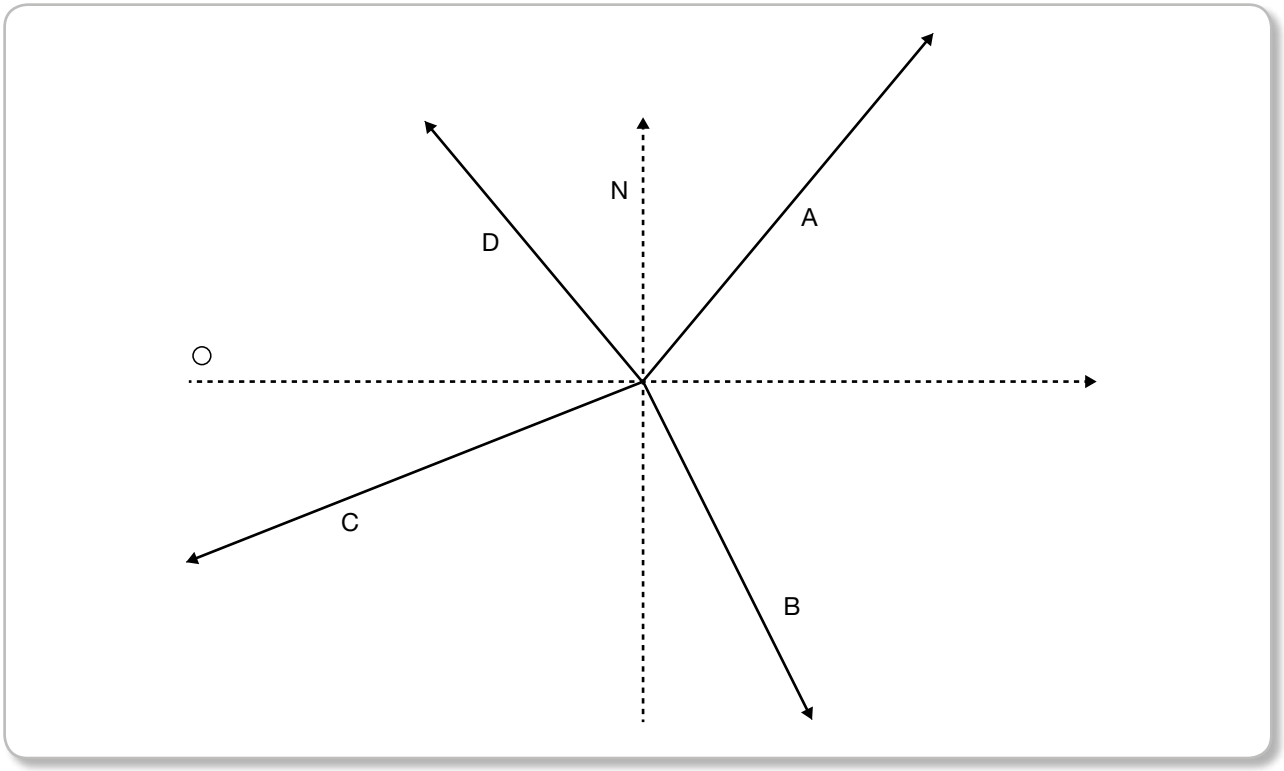
(c) What is the displacement of car 3 when it is at X?

(d) What is the displacement of car 1 when it is at Y?

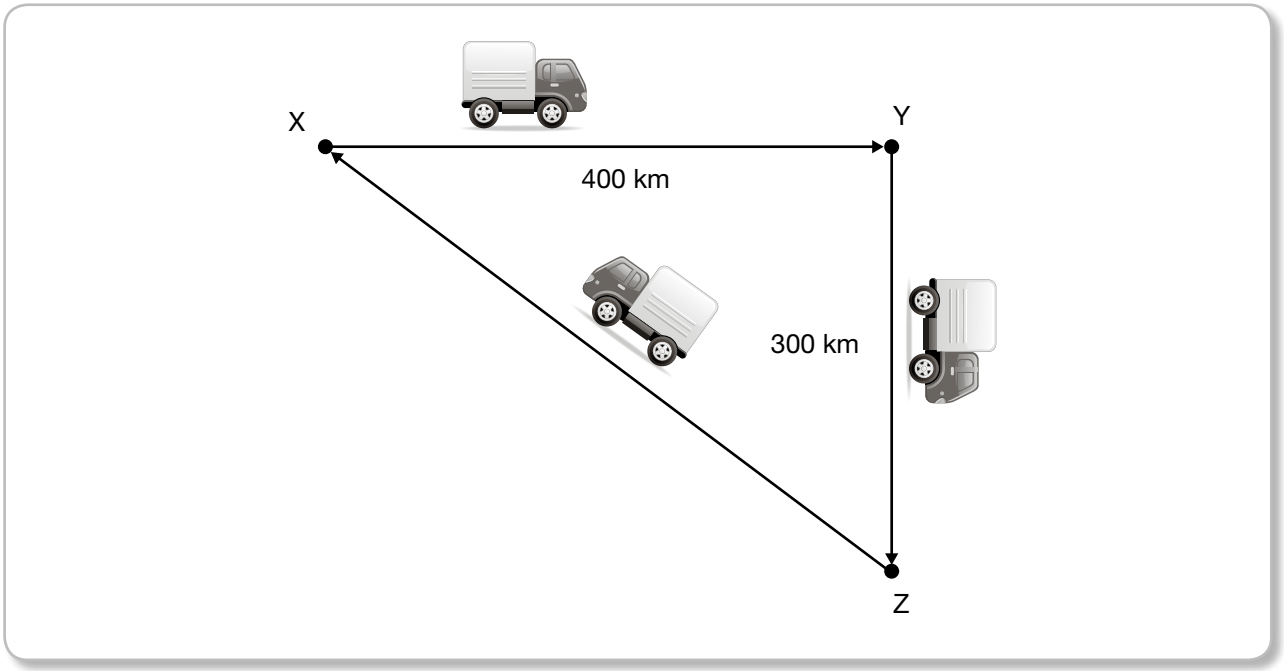
(e) What is the displacement of car 2 when it is at Y?

(f) What is the displacement of car 3 when it is at Y?

6. Determine the displacement of each car that has moved from the origin to positions A, B, C, and D. The diagram has been drawn to a scale where 1 cm = 25 km.



7. A truck drives 400 km east from X to Y then a further 300 km south to Z, then back to X as shown in the diagram.



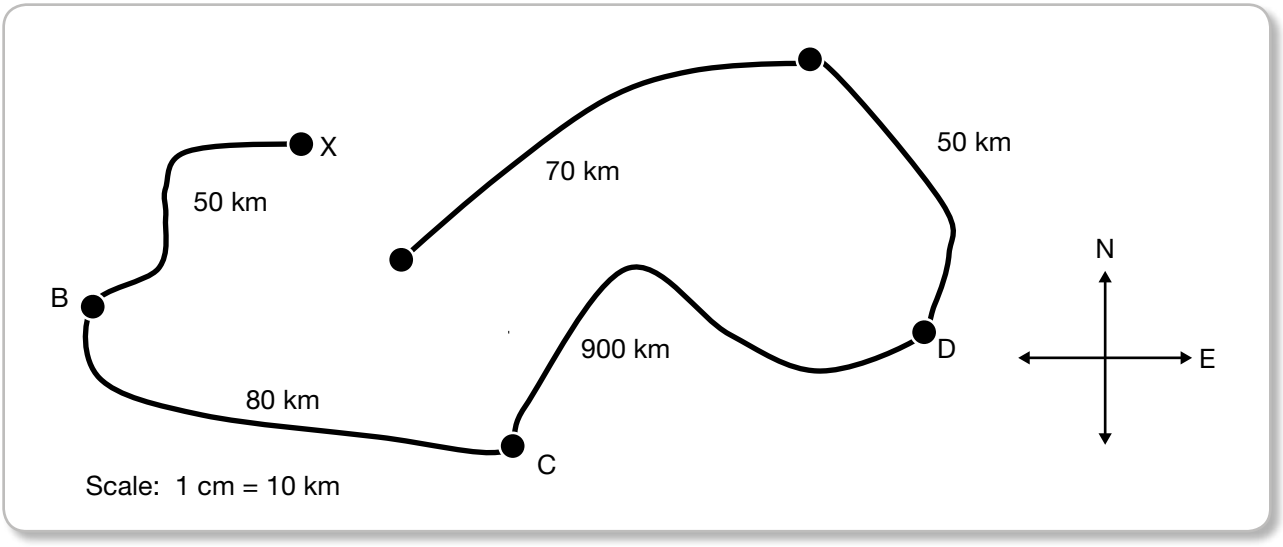
(a) Find the total distance travelled by the truck when it is:

(i) At Y. (ii) At Z. (iii) Back at X.

(b) Find the displacement of the truck when it is:

(i) At Y. (ii) At Z. (iii) Back at X.

8. The diagram shows the path taken by a car travelling from X to Y. Complete the table to show information about the journey of the car. The road distance between each point is shown.



Object at	Distance it has travelled from X (km)	Magnitude of displacement from X (km)	Compass direction from X	Bearing from X (degrees clockwise from north)
B				
C				
D				
E				
Y				

9. An object moves from X to Y, 80 km north. At Y it turns and moves a further 60 km east until it reaches position Z. It then turns and travels directly back to X.

(a) What total distance does it travel?

(b) What is its displacement at X before it starts this journey?

(c) What is its displacement at Y?

(d) What is its displacement at Z?

10. An object moves from X to Y, 50 km north. At Y it turns and moves a further 120 km west until it reaches position Z. It then turns and travels directly back to X.

(a) What total distance does it travel?

(b) What is its displacement at X before it starts this journey?

(c) What is its displacement at Y?

(d) What is its displacement at Z?

SET 2 Speed and Velocity

1. Define speed and give the units we use to measure it.

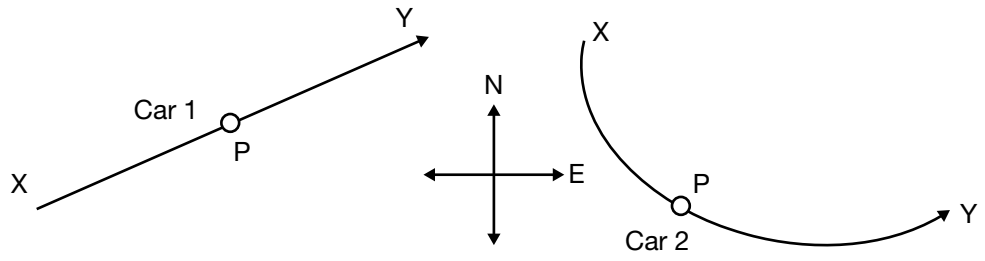
2. Define average speed, state how we calculate it, and give the units we use to measure it.

3. Define velocity and give the units we use to measure it.

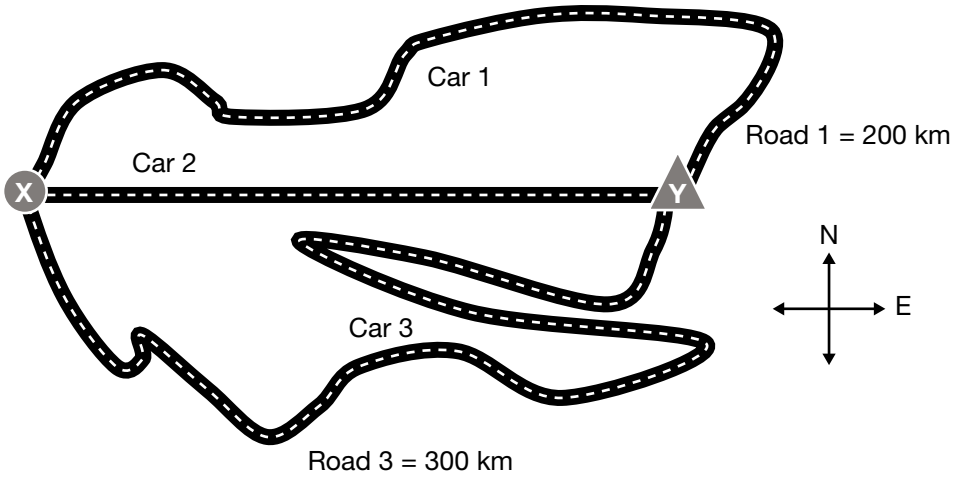
4. Define average velocity, state how we calculate it, and give the units we use to measure it.

5. (a) Clarify the idea of an instantaneous velocity and state why it is difficult to measure.

(b) Consider two cars travelling from X to Y as shown in the diagrams. Each car is travelling at a uniform speed of 20 m s^{-1}. What is the instantaneous velocity of each car at point P in each diagram?



6. Three cars travel from X to Y by three different roads as shown in the diagram. Y is 140 km east of X. Car 1 takes 4 hours to complete the journey. Car 2 takes 2 hours and car 3 takes 5 hours.



(a) What is the average speed of car 1 for the journey?

(b) What is the average speed of car 2 for the journey?

(c) What is the average speed of car 3 for the journey?

(d) What is the average velocity of car 1 for the journey?

(e) What is the average velocity of car 2 for the journey?

(f) What is the average velocity of car 3 for the journey?

7. A swimmer, travelling at a steady rate, swims a 100 metre race in 58 seconds. Calculate her average speed.

8. A rocket travels 15 000 m in 12 seconds. Calculate its average speed.

9. A car travelled 175 km north in 3.5 hours. Calculate its average speed and velocity.

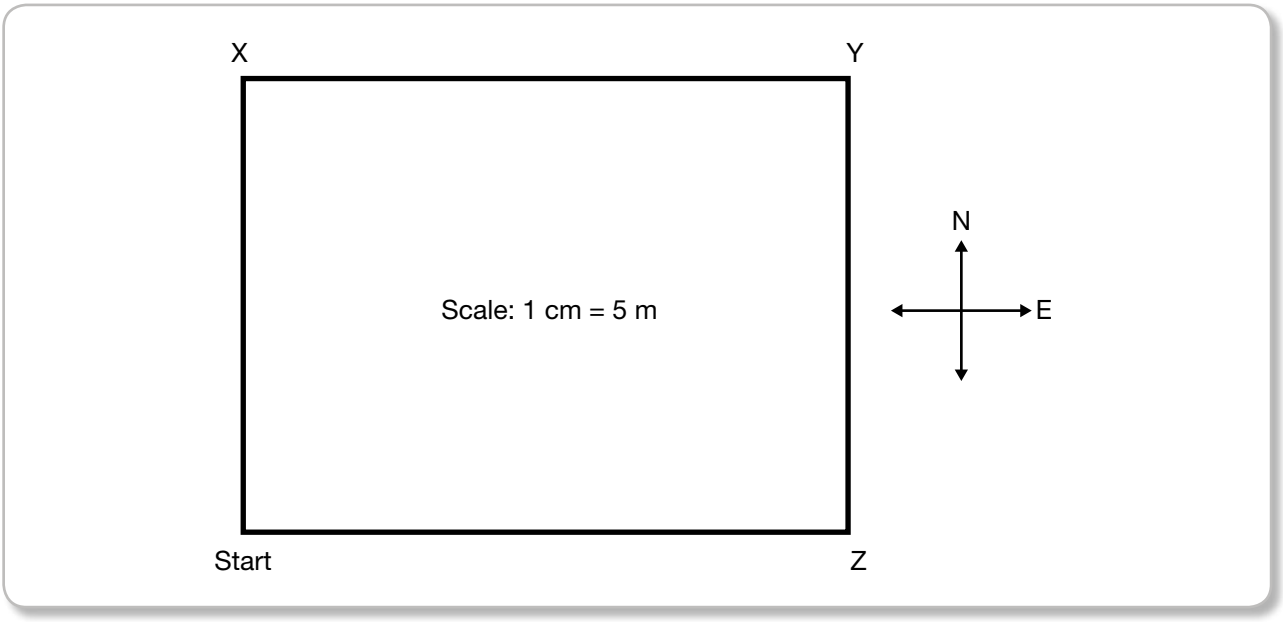
10. A ball rolled 5.0 m from X to Y. This took 4 s. Calculate its average speed and velocity.

11. (a) A car is travelling at 50 km h^{-1} towards a pedestrian crossing. How many metres does it travel each second?

(b) A child runs onto the crossing and takes 3.5 seconds to cross to half way (out of the danger zone). How far will the car travel in this time?

(c) If the car was speeding at 90 km h^{-1} and the driver did not see the child, how far from the crossing would the car have to be when the child runs onto it so that the child doesn't get hit by the car?

12. A car travels around a rectangular track as shown in the diagram below. The car takes 12 seconds to travel from the start to corner X, another 30 seconds to Y, 8 seconds more to Z and then another 20 seconds more back to the start.



Determine the following.

(a) Its average speed from start to X.
(b) Its average speed from X to Y.
(c) Its average speed from Y to Z.
(d) Its average speed from Z to start.
(e) Its average velocity from start to X.
(f) Its average velocity from X to Y.
(g) Its average velocity from Y to Z.
(h) Its average velocity from Z to start.
(i) The total distance travelled when it is at Y.
(j) The total distance travelled when it is at Z.
(k) The total distance travelled when it is back at the start.
(l) Its average speed for the journey from start to Y.
(m) Its average speed for the journey from start to Z.
(n) Its average speed for the journey from start to start.
(o) The total displacement when it is at Y.
(p) The total displacement when it is at Z.
(q) The total displacement when it is back at the start.
(r) Its average velocity for the journey from start to Y.
(s) Its average velocity for the journey from start to Z.
(t) Its average velocity for the journey from start to start (careful!).

SET 3 Acceleration

1. Define acceleration and give the units we use to measure it.

2. How can an object accelerate without changing its speed?

3. A car, at rest, accelerates at 9 m s^{-2} south for 15 s. Find its velocity after:

(a) 5 s (b) 8 s (c) 15 s

4. A rock falls from rest. Its speed when it hits the ground 4 s later is 39.2 m s^{-1}. Calculate its acceleration.

5. A car is moving at 22 m s^{-1} W. It hits a wall and stops in 0.025 s. Calculate the acceleration stopping the car.

6. After 6 s of accelerating at 1.75 m s^{-2}, a car moves at 20 m s^{-1} north. Calculate its initial velocity if the acceleration was:

(a) Positive (in direction of motion). (b) Negative (opposing motion).

7. A rocket accelerates at 30 m s^{-2} until its speed is 1200 m s^{-1}. How long does this take?

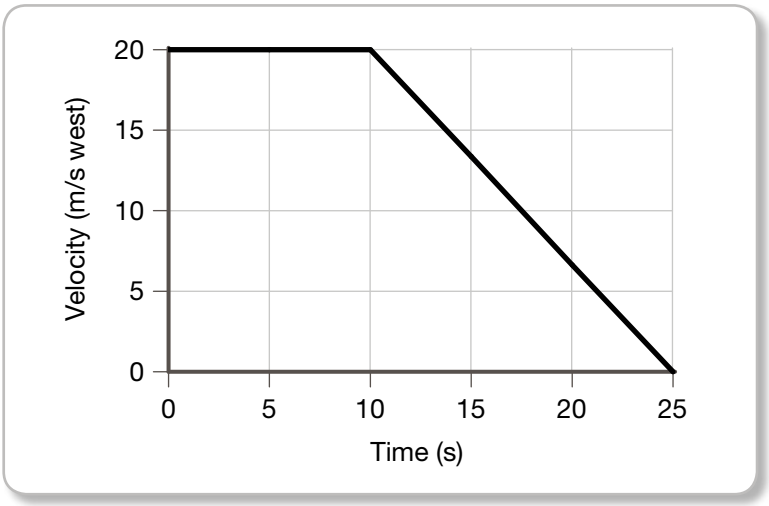
8. A car accelerates at 5.5 m s^{-2} S for 8 s. After this time it is moving at 42 m s^{-1} S. Calculate its initial velocity.

9. A car accelerates at 2.5 m s^{-2} E for 18 s. After this time the car is moving at 25 m s^{-1} W. Calculate its initial velocity.

10. The graph shows how the velocity of a car changes with time.

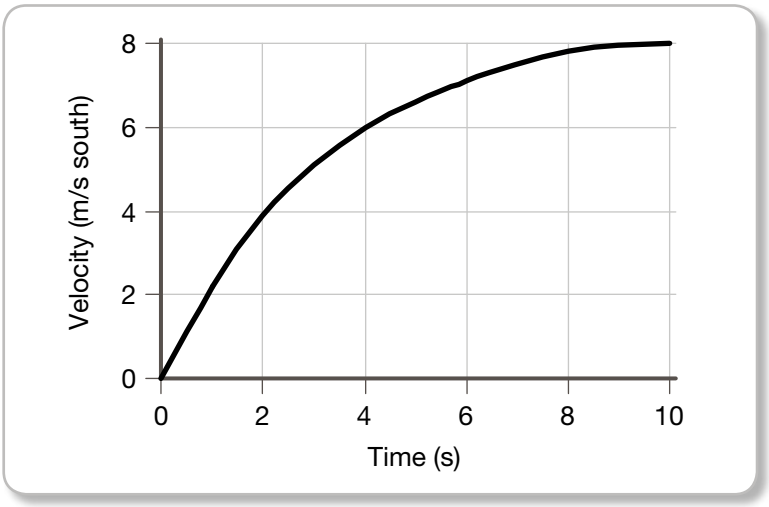
(a) What was the acceleration of the car at time 7.5 s?

(b) What was its acceleration at time 16 s?



11. The graph shows how the velocity of a car changes with time.

What was the acceleration of the car at time 4.0 s?



Q+A

Questions and Answers

ANSWERS

Set 1 Distance and Displacement

1. Distance is a measure of how far an object has travelled. Measured in metres (m) or in sensible and convenient multiples/submultiples, e.g. km, cm, mm.

2. Displacement is a measure of where an object is relative to its starting position with straight line distance and direction both indicated. Also measured in metres (m), kilometres (km).

3. (a) 120 km (b) 0 km
(c) 30 km west (d) 50 km S 37° W or bearing 217°
(e) 0 km

4. (a) 300 km (b) 0 km
(c) 100 km south (d) 125 km E 53° S to go clockwise from north as per bearings or bearing 143°

5. (a) 0 km (b) 0 km
(c) 0 km (d) 140 km east
(e) 140 km east (f) 140 km east

6. Note that answers might vary slightly due to printing or copying differences (you need to measure with your ruler and protractor).
A = 145 km bearing 050°
B = 117.5 km bearing 154°
C = 162.5 km bearing b 249°
D = 112.5 km bearing 320°

7. (a) (i) 400 km
(ii) 700 km
(iii) 1200 km
(b) (i) 400 km east
(ii) 500 km E 37° S to go clockwise from north as per bearings or bearing 127°
(iii) 0

8. Note that answers may be slightly different due to differences in diagram in printing and photocopying or instrument reading errors.

Object at	Distance it has travelled from X (km)	Magnitude of displacement From X (km)	Compass direction from X	Bearing from X (degrees clockwise from north)
B	50	35	S 52° W	232°
C	130	48	S 35° E	145°
D	220	87	E 17° S	107°
E	270	70	E 10° N	080°
Y	340	21	S 40° E	140°

9. (a) 240 km (b) 0
(c) 80 km north (d) 100 km N 37° E or bearing 037°

10. (a) 300 km (b) 0
(c) 50 km north (d) 130 km W 22.6° N or bearing 292.6°

Set 2 Speed and Velocity

1. Speed is a measure of the rate of change in position of an object. Measured in various units, for example metres per second (m s^{-1}) or kilometres per hour (Note that the abbreviation for this is not universal. Some use km/h or kph, some use km h^{-1}. In this book km h^{-1} is used.

2. Average speed is the constant speed an object would need to travel at in order to cover the distance in the same time. It is calculated by dividing the total distance travelled by the total time taken and is measured in various units, for example metres per second (m s^{-1}) or kilometres per hour (km h^{-1}).

3. Velocity is a measure of the rate of change in displacement of an object. Measured in various units, for example: metres per second (m s^{-1}) or kilometres per hour (km h^{-1}) and a direction must be given.

4. Average velocity is the constant velocity an object would need to travel at in order to make the same displacement in the same time. It is calculated by dividing the total displacement of the object by the total time taken and is measured in various units, for example metres per second (m s^{-1}) or kilometres per hour (km h^{-1}), with direction given. Note that if acceleration is constant, then average velocity can be calculated using $V_{av} = (u + v)/2$.

5. (a) Instantaneous velocity is a measure of the velocity of an object at a stated, very small instant of time. It is difficult to measure because the distance and time values involved are so small that electronic means are required to get accurate readings.
(b) Car 1 = 20 m s^{-1} bearing 066°
Car 2 = 20 m s^{-1} bearing about 140° (measure the direction of the tangent to the curve at point P)

6. (a) 50 km h^{-1} (b) 70 km h^{-1}
(c) 60 km h^{-1} (d) 35 km h^{-1} east
(e) 70 km h^{-1} east (f) 28 km h^{-1} east

7. 1.72 m s^{-1}

8. 1250 m s^{-1}

9. Average speed is 50 km h^{-1}, average velocity is 50 km h^{-1} north

10. Average speed is 1.25 m s^{-1}, average velocity is 1.25 m s^{-1} towards Y, or from X to Y

11. (a) 13.9 m
(b) 48.6 m
(c) 87.5 m

12. (a) 2.5 m s^{-1} (b) 1.33 m s^{-1}
(c) 3.75 m s^{-1} (d) 2.0 m s^{-1}
(e) 2.5 m s^{-1} north (f) 1.33 m s^{-1} east
(g) 3.75 m s^{-1} south (h) 2.0 m s^{-1} west
(i) 70 m (j) 100 m
(k) 140 m (l) 1.67 m s^{-1}
(m) 2.0 m s^{-1} (n) 2.0 m s^{-1}
(o) 50 m N 53° E (or bearing 053°) (p) 40 m east (or bearing 090°)
(q) Zero (r) 1.2 m s^{-1} N 53° E (or bearing 053°)
(s) 0.8 m s^{-1} east (or bearing 090°) (t) 0 (displacement is zero at start)

Set 3 Acceleration

1. Acceleration is a measure of the rate at which the velocity of an object changes. We measure it in m s^{-2}.

2. By changing direction at constant speed – as in uniform circular motion.

3. (a) 45 m s^{-1} south
(b) 72 m s^{-1} south
(c) 135 m s^{-1} south

4. 9.8 m s^{-2} down

5. 880 m s^{-2} against the motion

6. (a) 9.5 m s^{-1} north
(b) 30.5 m s^{-1} north

7. 40 s

8. 2 m s^{-1} north

9. 70 m s^{-1} west

10. (a) 0
(b) 1.33 m s^{-2} east

11. About 0.75 m s^{-2} south

Set 4 Scalars and Vectors

1. Scalar quantity has magnitude but no direction.

2. Distance travelled, speed, mass, time, electric charge, energy (any form), temperature, volume, length.

3. Vector quantity has both magnitude and direction and can be represented by a scale diagram.

4. Force, velocity, acceleration, momentum, gravitational field, electric field, magnetic field.

5. (a) 40 km west (b) 200 km E 37° S or bearing 127°
(c) 495 kn E 14° S or bearing 104° (d) 495 km E 14° N or bearing 076°
(e) 360 km east (f) 80 km west W
(g) 679 km NE or bearing 045°

6. 13 km E 22.6° N or bearing 067.4°

7. (a) 74.3 km h^{-1} (b) 59.7 km h^{-1} bearing 287°

8. (a) 90 km h^{-1}
(b) 64 km h^{-1} S 37° E or bearing 143°
(c) 5 hours