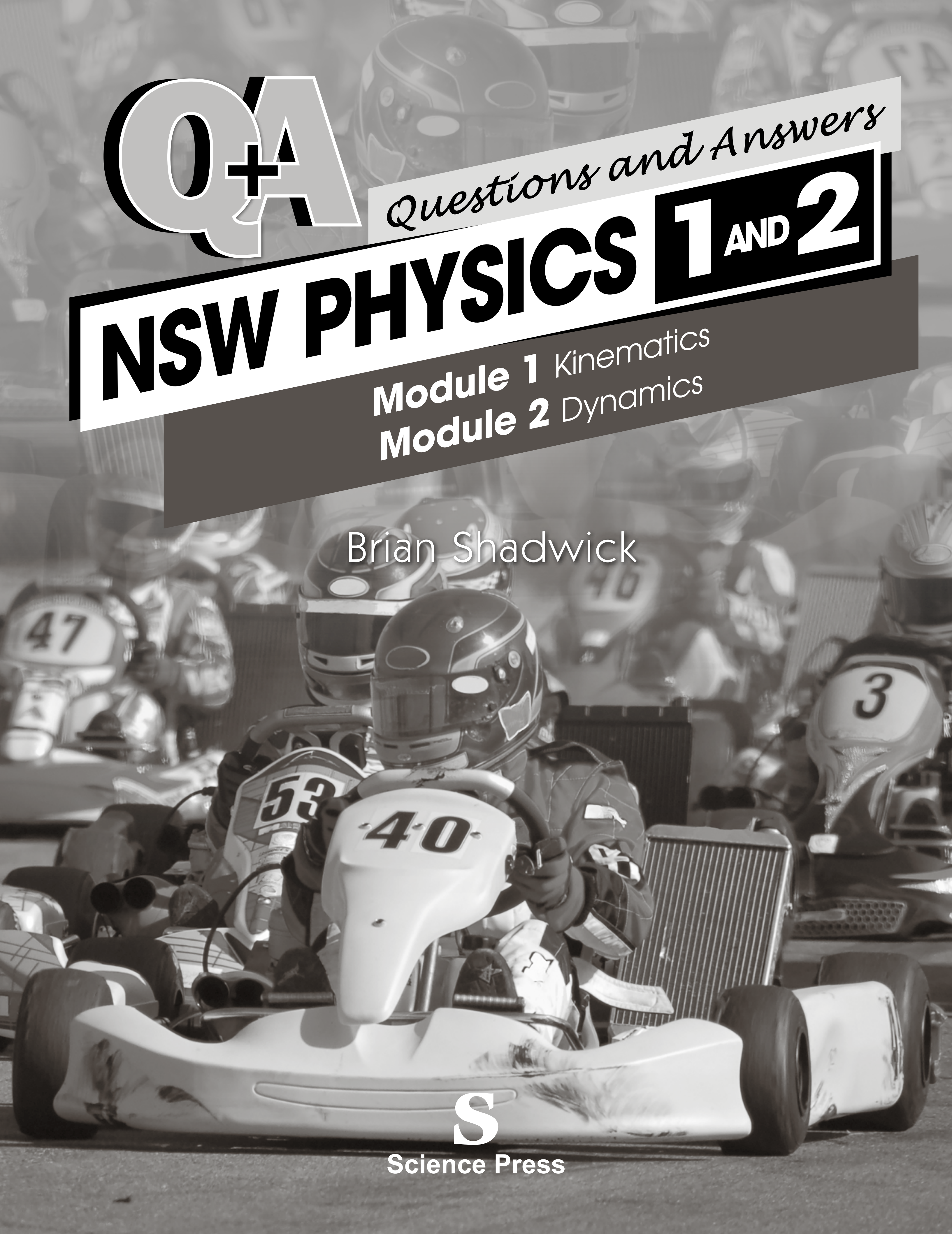

Q+A Questions and Answers

NSW PHYSICS 1 AND 2

Module 1 Kinematics

Module 2 Dynamics

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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.

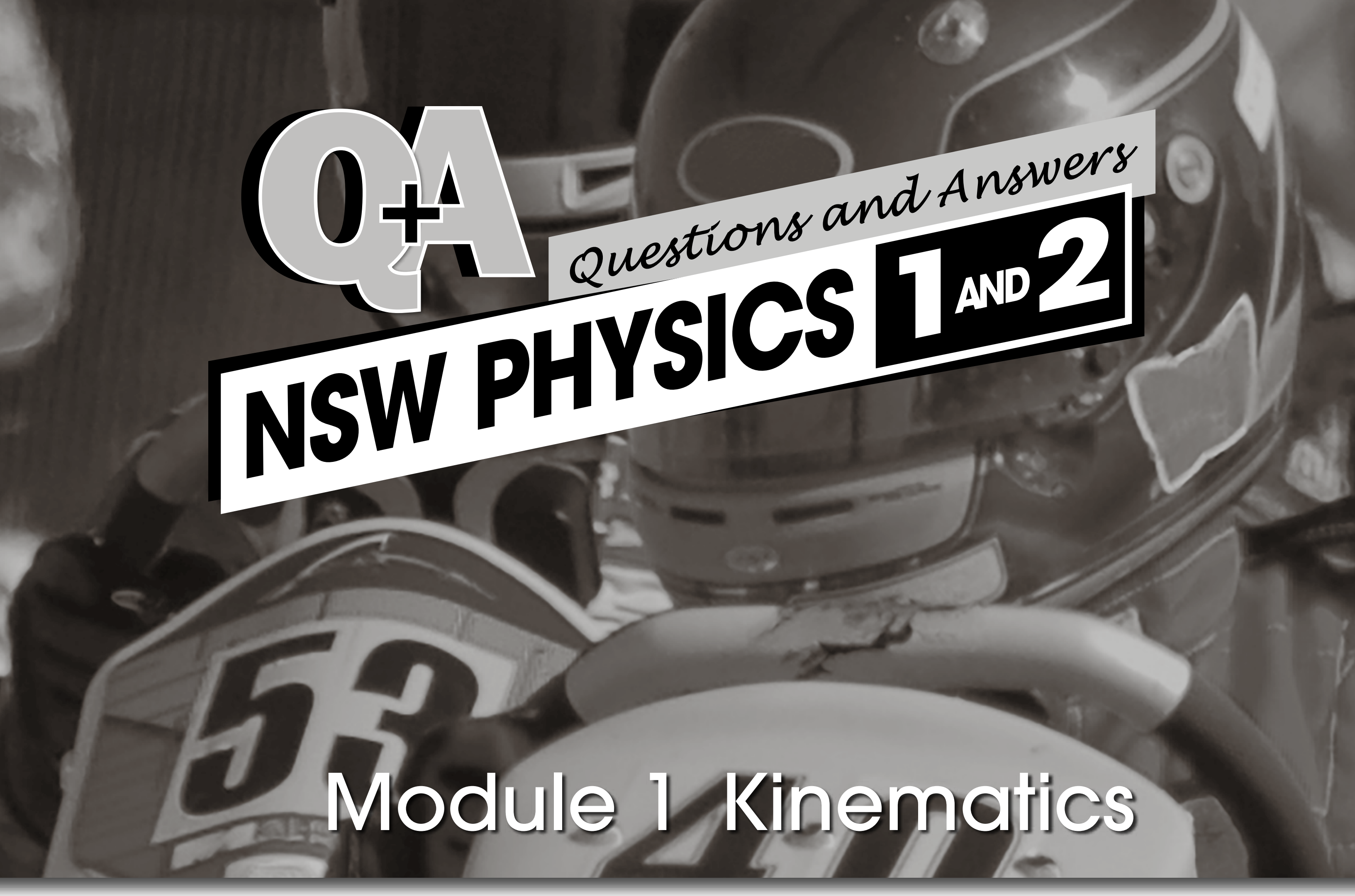
solve Work out the answer to a problem.

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 NSW PHYSICS 1 AND 2

Module 1 Kinematics

CONTENT FOCUS

In this module you will:

- Investigate aspects of kinematics by describing, measuring and analysing motion without considering the forces and the masses involved in that motion.
- Explore uniformly accelerated motion in terms of relationships between measurable scalar and vector quantities, including displacement, speed, velocity, acceleration and time.
- Describe linear motion and predicted motion both qualitatively and quantitatively using graphs and vectors, and the equations of motion.
- Understand that scientific knowledge can enable scientists to offer valid explanations and make reliable predictions, particularly in regard to the motion of an object.
- Engage with all the Working Scientifically skills for practical investigations involving the focus content to examine trends in data and to solve problems related to kinematics.

Motion In a Straight Line and On a Plane

CONTENT FOCUS

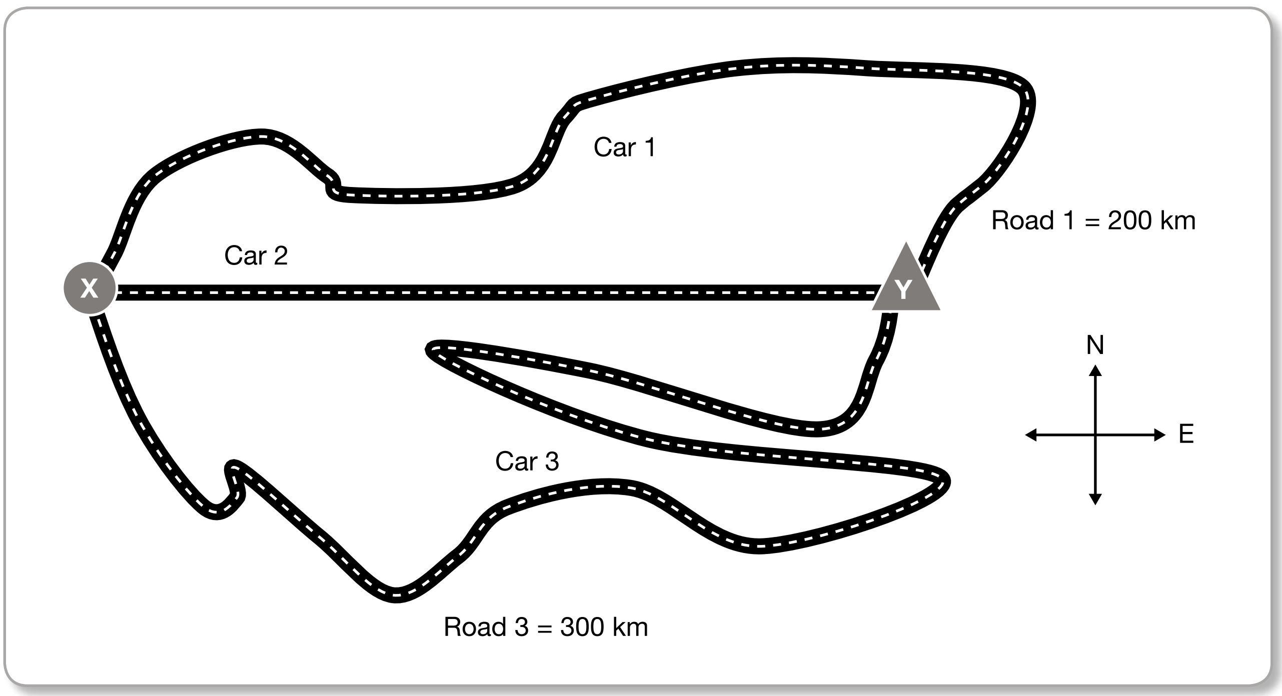
Describe uniform straight line (rectilinear) motion and uniformly accelerated motion through qualitative descriptions

SET 1 Distance and Displacement

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

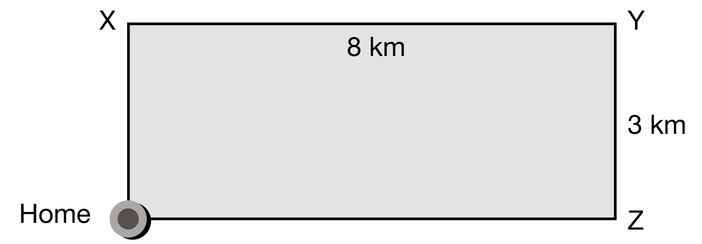
2. Define displacement and give the units we use to measure it.

3. 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?

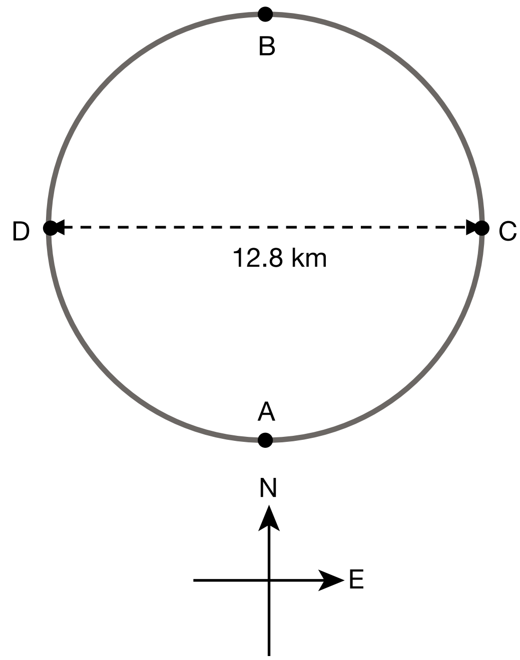
4. A farmer rides his motorbike from home clockwise around his fence line to check it for damage. The diagram (not to scale) shows the path he takes. Corner X is due north of home.



Find the total distance travelled by and the displacement of the farmer when he is

(a) At corner X. (b) At corner Y. (c) At corner Z. (d) Back home again.

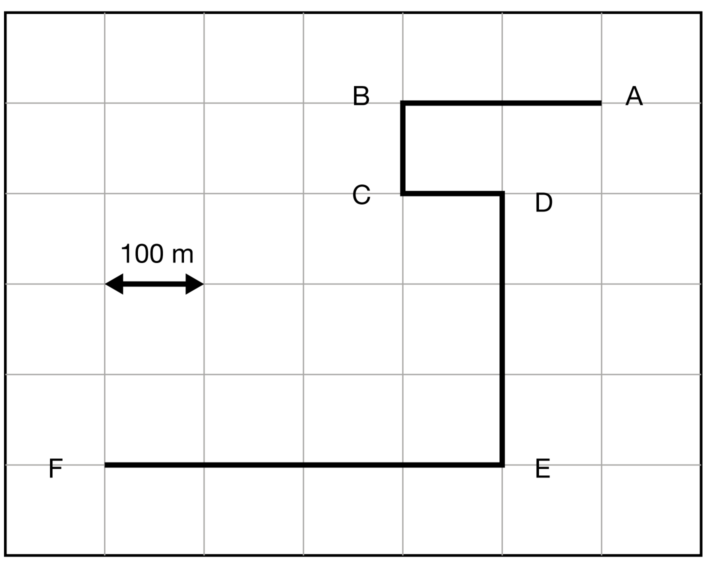
5. A plane flies in a horizontal circle of diameter 12.8 km as shown. Point B is due north of A and point C is due east of D. The plane starts from point A.



Determine the total distance travelled by and the displacement of the plane when it is:

(a) At A initially
(b) At B
(c) At C
(d) At D
(e) Back at A

6. The diagram shows the path taken by a person walking through a maze. Each grid on the diagram represents a distance of 100 m. The person started at A. Point B is due west of A.



Find the total distance travelled by and the displacement of the person when he is:

(a) At A initially
(b) At B
(c) At C
(d) At D
(e) At E
(f) At F

SET 2 Working Out Directions Another Way

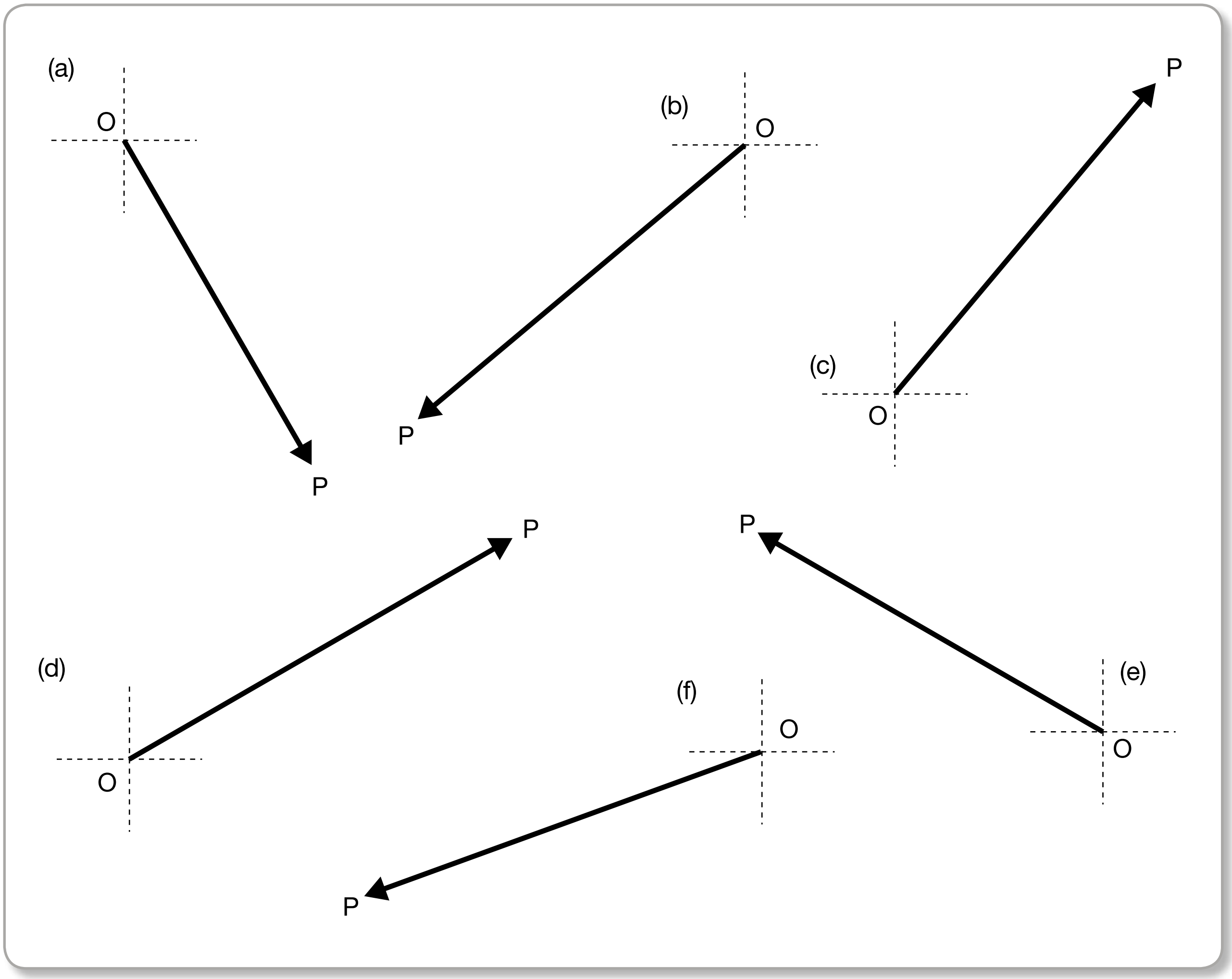
1. (a) Clarify the concept of a bearing as it is used to communicate direction.
(b) What is the main reason bearings are used?

2. Copy and complete the table by inserting the missing values. When calculating the compass directions, always put north or south first.

Compass direction	North	South	East	West	N 30° E	N 60° W	S 30° E	S 60° W	NE
Bearing									

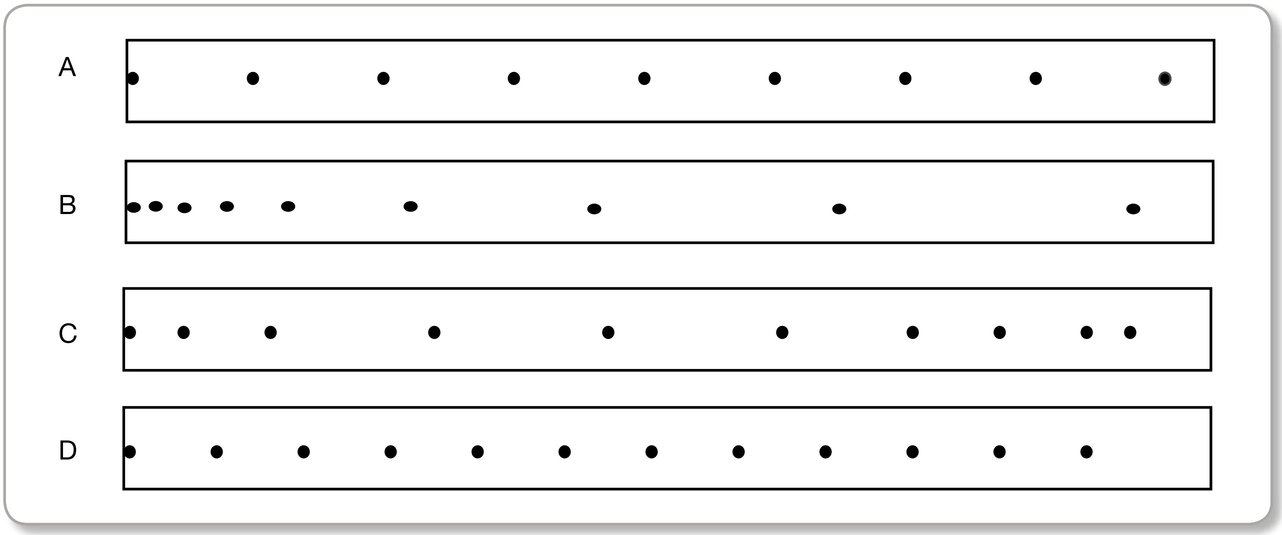
Compass direction									
Bearing	020°	280°	315°	080°	150°	230°	305°	005°	310°

3. Determine the bearing of each line PO in the diagrams below.



SET 3 Speed

1. The diagrams show the pattern of oil drips left on the road as four cars travelled from left to right.



(a) Which patterns indicate the cars moving with constant speed for their entire time of travel shown? Justify your answer.

(b) In your own words, describe the motion of the objects indicated by the other patterns.

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

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

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

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

6. (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?

7. A swimmer, travelling at a steady rate, swims a 50 metre pool in 26 s. Calculate her average speed.

8. A rocket travels 15 km in 45 seconds. Calculate its average speed in m s^{-1}.

9. A car accelerates from rest and reaches a speed of 36 m s^{-1} after 9 s.

(a) What is its average speed?

(b) Estimate its instantaneous speed 4.5 s after starting to accelerate.

10. A car travels at a constant speed of 18 m s^{-1} for 45 s. How far does it travel and how long would it take to travel 16 km?

11. A plane travels at a constant air speed of 280 km h^{-1}.

(a) What is this in m s^{-1}?

(b) How long will it take to travel 1200 km?

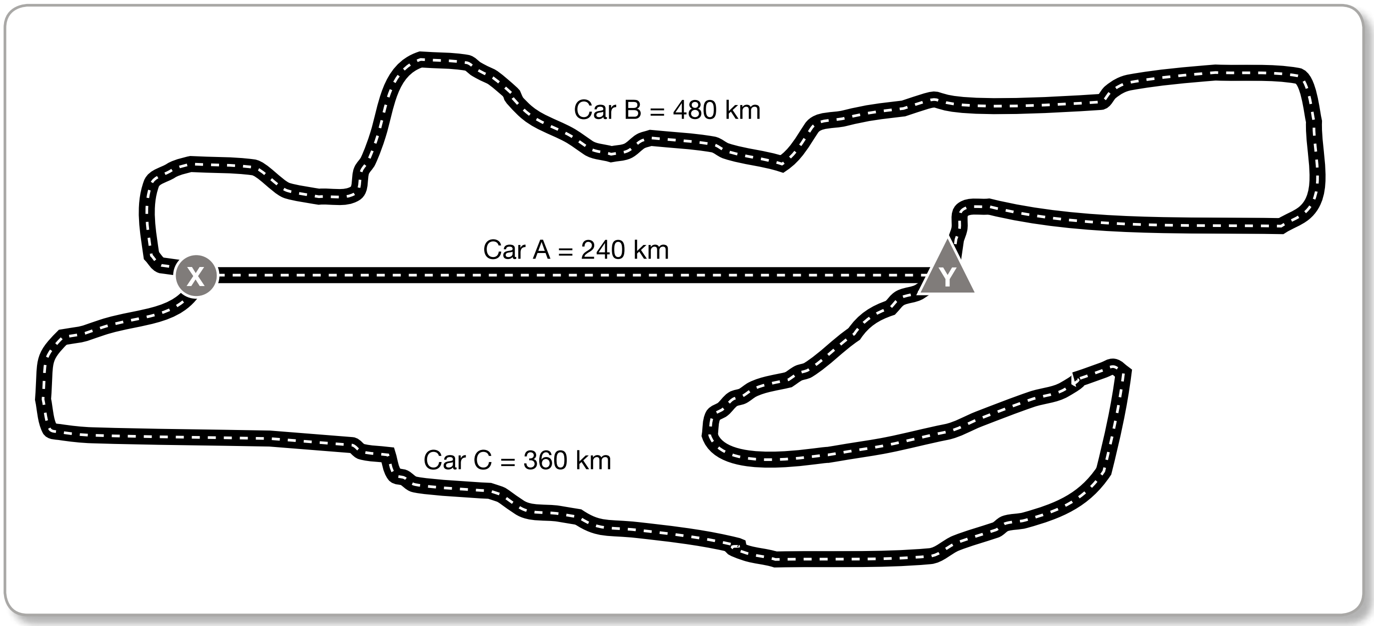
(c) How far will it travel in 2.25 hours?

12. Which car is going the fastest? Car A at 40 km h^{-1}, car B at 12 m s^{-1}or car C which covers 150 m in 15 s? Justify your answer.

13. A person walks 8 km east in 2 hours then turns around and walks 5 km back towards his starting point. This takes another 1.5 hours, What is his average speed in km h^{-1} and m s^{-1}?

14. A plane flies in a circle of radius 25 km in 2.5 hours. What is its average speed in km h^{-1} and m s^{-1}?

15. Consider three cars which started at town X and travelled to town Y by three different roads as shown in the diagram below. Car A travelled from X to Y in 4 hours. Car B made its trip in 6 hours, while car C took 9 hours to go from X to Y.



(a) How far did car A travel?

(b) How long did this take?

(c) On average, how far did car A travel each hour?

(d) Calculate the average speed of car A.

(e) Calculate the average speed of car B.

(f) Calculate the average speed of car C.

(g) Explain why we are only talking about *average* speeds here.

16. A car is travelling from X to Y, at a speed of 90 km h^{-1}. It takes the driver 2 hours and 8 minutes to get to his destination. What is the distance between X and Y?

17. A plane flies from A to B at a constant speed of 800 km h^{-1}. If the distance from A to B is 3600 km, how long will it take the plane to fly that distance?

18. A space shuttle travels around the Earth at a constant speed at an altitude of about 235 km. It takes 90 minutes to complete one orbit.

(a) If the diameter of the Earth is about 12 760 km, how far does the shuttle travel in its journey around the Earth?

(b) What is its orbital speed?

19. A train travels 120 km h^{-1} for two hours. It slows down to 100 km h^{-1} for one hour.

(a) How far has the train travelled after 3 hours.

(b) What is the constant speed the train would need to travel in order to cover the same distance in the same time?

20. A snail can crawl at 0.047 km h^{-1}.

(a) What is its speed in m s^{-1}?

(b) How far can it crawl in one hour?

SET 4 Speed and Velocity

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

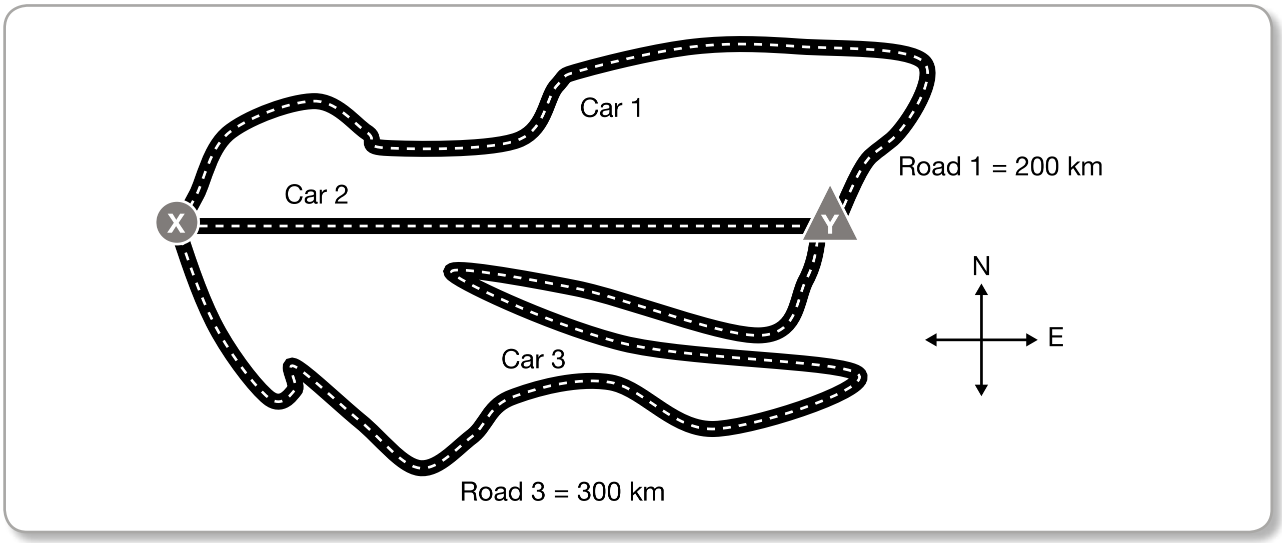
2. Define average velocity, state how we calculate it, and give the units we use to measure it.

3. Explain, giving an appropriate example, how an object can travel at constant speed and yet have a changing velocity.

4. Copy and complete the table to distinguish between the quantities in it.

	Quantity	Description/definition
(a)	Initial speed or velocity	
(b)	Final speed or velocity	
(c)	Average speed	
(d)	Average velocity	
(e)	Instantaneous speed or velocity	
(f)	Constant speed or velocity	

5. 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?

6. A car travels from point A to B in 3 hours and returns back to point A in 5 hours. Points A and B are 150 km apart along a straight highway.

(a) What is the average speed of the car?a (b) What is the average velocity of the car?

7. (a) Explain the concept of a bearing when stating the direction an object moves.

(b) If an object is moving east, what is this as a bearing?

(c) An object is moving NW. What is this direction as a bearing?

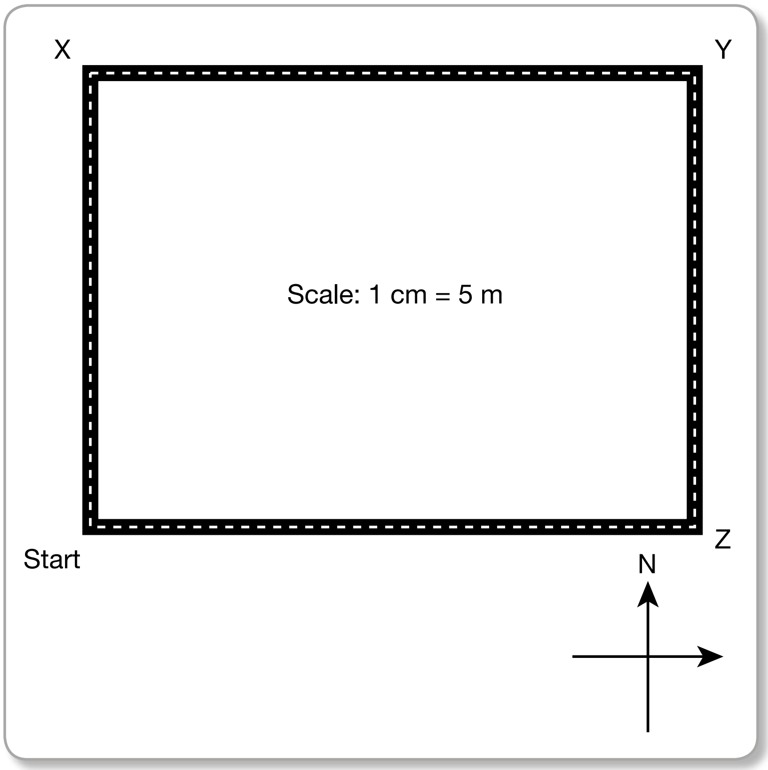
(d) What direction corresponds to a bearing of 000?

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

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

10. 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.

Find:



(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 5 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. Find 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, initially at rest, 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. What is its initial velocity?

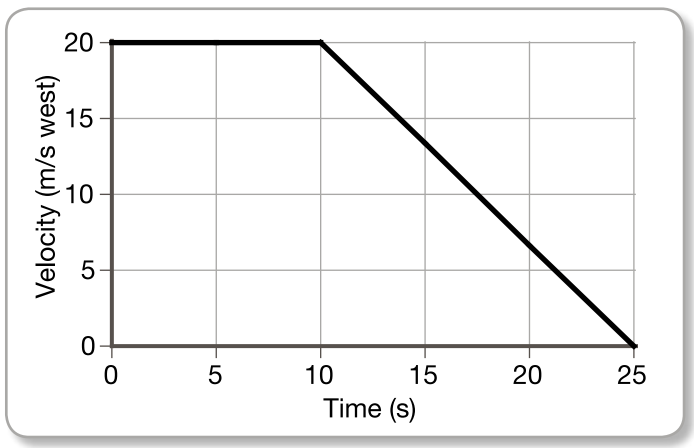
9. A car accelerates at 2.5 m s^{-2} E for 18 s. After this time the car is moving at 25 m s^{-1} W. Calculate its initial velocity.

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?

(c) Describe the motion of the car in the first 10 seconds.



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

(a) What was the acceleration of the car at time 4.0 s?

(b) How is the acceleration of the car changing over the 10 s of the journey (no calculations needed). Justify your answer.

SET 6 SI Units and Powers Of Ten

1. What are SI units and why are they used?

2. List the three acceptable ways to write the SI units for speed or velocity.

3. Units like astronomical units, or light years, or parsecs are not SI units, but we often use them in physics. Explain why.

4. Copy and complete the table below to give the SI units for the quantities listed. These are all quantities you will meet in this course. You may have to research some quantities.

Quantity	SI unit (name and symbol)	Quantity	SI unit (name and symbol)
Mass		Electric potential difference	
Length		Electrical resistance	
Time		Electric current	
Displacement		Speed	
Force		Velocity	
Energy		Acceleration	
Power		Temperature	
Momentum		Volume	

5. Copy and complete the table. One example has been done for you.

Unit prefix	Symbol	Meaning	Example
nano			nm = nanometre = 10^{-9} m
micro			
milli			
kilo			
mega			
giga			

6. Use the equation $s = v \times t$ to obtain a definition for one metre, one second and one metre per second.

7. Use the equation $F = ma$ to obtain definitions for the newton, one kilogram and one m s^{-2}.

Q+A

Questions and Answers

NSW PHYSICS 1 AND 2

Answers

Module 1 Kinematics

Set 1 Distance and Displacement

1. Distance is a measure of how far an object has travelled. Measured in various units, for example: metres (m), kilometres (km).

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

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

4. (a) At X distance travelled = 3 km, displacement = 3 km north
(b) At Y distance travelled = 11 km, displacement = 8.54 km 20.6° north of east
(c) At Z distance travelled = 14 km, displacement = 8 km east
(d) At home distance travelled = 22 km, displacement = 0

5. (a) At A initially, distance travelled = 0, displacement = 0
(b) At B distance travelled = 20.1 km, displacement = 12.8 km north
(c) At C distance travelled = 30.15 km, displacement = 9.05 km north-east
(d) At D distance travelled = 10.05 km, displacement = 9.05 km east
(e) Back at A distance travelled = 40.2 km, displacement = 0

6. (a) At A distance travelled = 0, displacement = 0
(b) At B distance travelled = 200 m, displacement = 200 m west
(c) At C distance travelled = 300 m, displacement = 223.6 m 26.6° south of west
(d) At D distance travelled = 400 m, displacement = 141 4 m 45° south of west (south-west)
(e) At E distance travelled = 700 m, displacement = 412.3 m 14° west of south
(f) At F distance travelled = 1100 m, displacement = 640.3 m 38.7° south of west

Set 2 Working Out Directions Another Way

1. (a) A bearing is direction given as a three numeral number measured clockwise from due north.
(b) Bearings are easier to calculate and communicate than compass directions.

2.

Compass direction	North	South	East	West	N 30° E	N 60° W	S 30° E	S 60° W	NE
Bearing	000	180°	090°	270°	030°	300°	150°	240°	045°

Compass direction	N 20° E	N 80° W	N 45° W	N 80° E	S 30° E	S 50° W	N 55° W	N 5° E	N 50° W
Bearing	020°	280°	315°	080°	150°	230°	305°	005°	310°

3. (a) 240° (b) 230° (c) 040°
(d) 060° (e) 300° (f) 250°

Set 3 Speed

1. (a) Cars A and D moved with constant speed – the oil drips are the same distances apart.
(b) Pattern B indicates that the car was accelerating – the drips are getting further and further apart.
Pattern C indicates an initial acceleration, then a period of constant speed then deceleration.

2. 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 ($km\ h^{-1}$).

3. 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 ($km\ h^{-1}$).

4. 1.72 $m\ s^{-1}$

5. 1250 $m\ s^{-1}$

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

7. 1.92 $m\ s^{-1}$

8. 333.3 $m\ s^{-1}$

9. (a) 18 $m\ s^{-1}$ (b) 18 $m\ s^{-1}$

10. Distance travelled = 810 m

Time to travel 16 km = 14.8 minutes (this is a more sensible answer than 888.9 s)

11. (a) 77.8 m s^{-1} (b) 4.29 hours (c) 630 km

12. Car A moves at 11.1 m s^{-1}, car B at 12 m s^{-1}, and car C at 10 m s^{-1}. Therefore car B is the fastest.

13. Average speed = $\frac{13}{3.5}$ = 3.71 km h^{-1} = 1.03 m s^{-1}

14. Average speed = 62.83 km h^{-1} = 17.45 m s^{-1}

15. (a) 240 km
(b) 4 hours
(c) 60 km
(d) 60 km h^{-1}
(e) 80 km h^{-1}
(f) 40 km h^{-1}
(g) Journeys are seldom, if ever, undertaken at a constant speed. Hills, bad roads, bends, traffic conditions, pedestrian crossings and many other factors all influence the instantaneous speed of objects. The best we can do with this data is calculate the average.

16. 192 km

17. 4.5 hours

18. (a) 41 563 km (b) 27 709 km h^{-1}

19. (a) 340 km (b) 113.3 km h^{-1}

20. (a) 0.013 m s^{-1} (b) About 47 m

Set 4 Speed and Velocity

1. 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.

2. 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.

3. If the direction of the object is changing (say, turning a corner) but its speed does not change, then this situation is an example of constant speed but changing velocity.

4.

	Quantity	Description/definition
(a)	Initial speed or velocity	The speed or velocity an object has when we first consider its motion.
(b)	Final speed or velocity	The speed or velocity an object has at the end of our consideration of its motion.
(c)	Average speed	The constant speed the object would need to travel at to cover the same distance in the same time.
(d)	Average velocity	The constant velocity the object would need to travel at to cover the same displacement in the same time.
(e)	Instantaneous speed or velocity	The speed or velocity of the object at a given instant of time.
(f)	Constant speed or velocity	The non-changing speed or velocity with which an object travels.

5. (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

6. (a) 37.5 km h^{-1}
(b) 0

7. (a) The bearing of a moving object is the direction in which it moves stated as a three numeral number measured clockwise from north.
(b) 090°
(c) Bearing 315°
(d) North

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

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

10. (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 5 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.

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. 20 m s^{-1} west

10. (a) 0

(b) 1.33 m s^{-2} east

(c) The car is moving with a constant velocity of 20 m s^{-1} west

11. (a) About 0.9 m s^{-2} south

(b) The acceleration of the car is decreasing. The gradient of the curve (= acceleration) is decreasing.

Set 6 SI Units and Powers Of Ten

1. SI units are units of measurement which form the Standard System of Units. These are units for the measurement of quantities which have been agreed on internationally and used so that communications of quantities between nations is easier. It is the modern form of the metric system.

2. (i) m/s (use a slider between the m and the s^{-1})

(ii) m.s^{-1} (a full stop between the m and the s^{-1})

(iii) m s^{-1} (a space between the m and the s^{-1})

3. For large measurements, it is more sensible to use units which better suit that measurement. For example, we would not measure the distance to the next galaxy in metres. Light years, or parsecs are much more sensible units. While they are not SI, there is international agreement on their use.

4.

Quantity	SI unit (name and symbol)	Quantity	SI unit (name and symbol)
Mass	kilogram (kg)	Electric potential difference	volt (V)
Length	metre (m)	Electrical resistance	ohm (Ω
Time	second (s)	Electric current	ampere (A)
Displacement	metre (m)	Speed	metres per second (m s^{-1})
Force	newton (N)	Velocity	metres per second (m s^{-1})
Energy	joule (J)	Acceleration	metres per second per second (m s^{-2})
Power	watt (W)	Temperature	kelvin (K)
Momentum	kilogram metre per second (kg m s^{-1} or newton second (N s)	Volume	litre (L)

5.

Unit prefix	Symbol	Meaning	Example
nano	n	10^{-9}	nm = nanometre = 10^{-9} m
micro	μ	10^{-6}	μm = micrometre = 10^{-6} m
milli	m	10^{-3}	mm = millimetre = 10^{-3} m
kilo	k	10^{3}	km = kilometre = 10^{3} m
mega	M	10^{6}	Mm = megametre = 10^{6} m
giga	G	10^{9}	Gm = gigametre = 10^{9} m

6. One metre is the distance an object which is moving at one metre per second will travel in one second.

One second is the time it will take an object moving at one metre per second to move one metre.

One metre per second is the speed of an object if it travels one metre each second.

7. One newton is the force which would give an object of mass one kg an acceleration of one m s^{-2}.

One kilogram is the mass which would be given an acceleration of one m s^{-2} when a force of one newton acted on it.

One m s^{-2} is the acceleration an object of mass one kg would gain if a force of one newton acted on it.