Name: _____ Class: _____ Date: _____

Exercise 2A Speed, Velocity and Acceleration

1. Complete these sentences.

(a) Displacement is the _____.

(b) Speed is the rate of change of _____. It is measured in _____.

(c) Velocity is the rate of change of _____. It is measured in _____.

(d) Speed is a _____ quantity whereas velocity is a _____ quantity.

(e) Negative values of displacement or velocity indicate motion in the _____.

(f) Acceleration is the rate of change of _____. It is measured in _____.

(g) The speedometer is used to measure the _____ speed of a car.

(h) The average speed of a moving object is given by _____ divided by total time taken.

2. Complete the following table with values for the distance, speed or time taken by a moving body. What are the speeds in m s^{-1} and km h^{-1}?

Distance/m	Time/s	Speed/m s^{-1}	Speed/km h^{-1}
20	4		
100		20	
	30		126

3. A car travels 5 km along a straight road, makes a U-turn and travels a further distance of 1 km. The time taken for him to do this is 5 min. Complete the following table to show the distance, displacement and average speed of the car for the 5 min of travelling.

Distance	Displacement	Average speed

4. Complete the following table with values for the acceleration of a moving body.

Initial velocity/m s^{-1}	Final velocity/m s^{-1}	Time taken/s	Acceleration/m s^{-2}
20	20	4	
0	20	5	
5	25	8	
30	0	10	

5. A car moving along a straight level road has an initial velocity of 3 m s^{-1}. Its acceleration is 2 m s^{-2}. What is the velocity of the car after 5 s?

6. The take-off velocity of a small jet plane on a straight runway is 55 m s^{-1}. If the average acceleration of the plane during take-off is 2.2 m s^{-2}, calculate the time the plane will take to reach its take-off velocity.

7. A car moving along a straight level road has an initial velocity of 16 m s^{-1}. Its deceleration is 2 m s^{-2}. How long does it take for the car to stop?

8. A car on a straight level road accelerates uniformly from rest. In the first 4.0 s of its motion, it travels 24 m. Calculate

(a) the average speed for this period of 4.0 s,

(b) the speed at the end of 4.0 s,

(c) the acceleration.

Name: _____ Class: _____ Date: _____

Exercise 2B Distance-time Graph and Speed-time Graph

1. Complete these sentences.

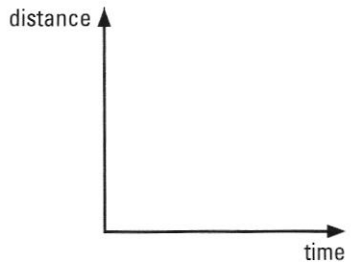
(a) The gradient of the distance-time graph gives the _____ of the moving object.

(b) The gradient of the speed-time graph gives the _____ of the moving object.

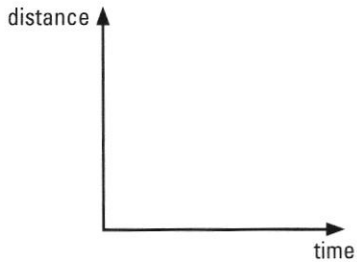
(c) The _____ under a speed-time graph gives the distance travelled.

2. Sketch the distance-time graph of an object travelling with

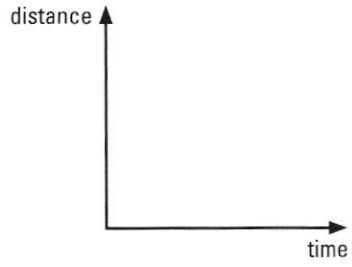
(a) constant speed,



(b) increasing speed,



(c) decreasing speed.

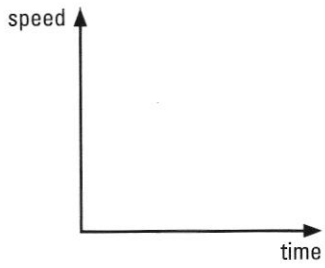


What is the quantity obtained by finding the gradient of the distance-time graph at a particular time?

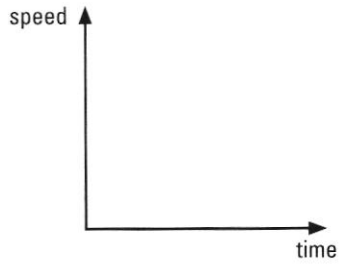
_____

3. Sketch the speed-time graph of an object travelling with

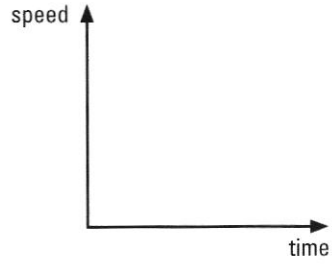
(a) constant speed (zero acceleration),



(b) constant acceleration,

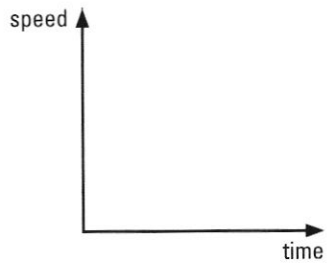


(c) constant deceleration.

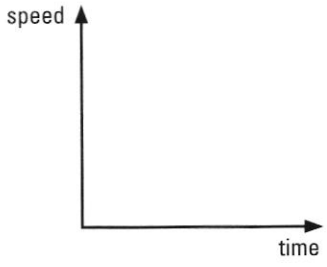


4. Sketch the speed-time graph of an object travelling with

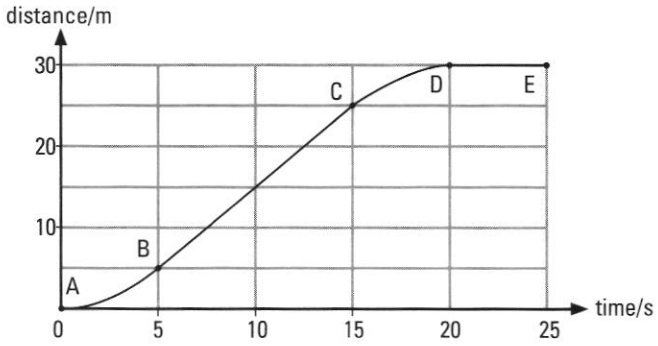
(a) increasing acceleration,



(b) decreasing acceleration.



5. The distance-time graph of an object moving along a straight line is shown below.



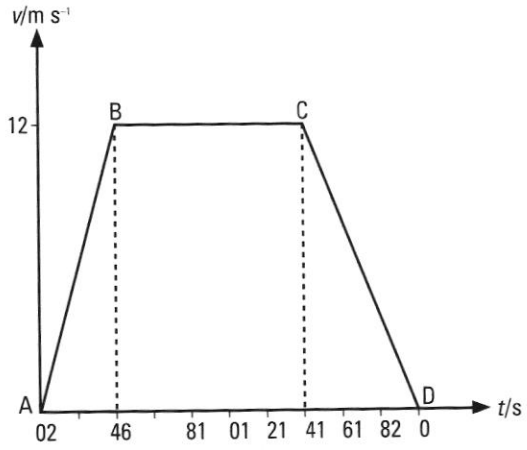
(a) Describe briefly how the speed of the object changes between sections AB, BC, CD and DE.

(b) What is the distance travelled by the object after 10 s?

(c) What is the speed of the object between B and C?

(d) Calculate the average speed of the object during the first 20 s.

6. The figure below shows the speed-time graph of a car moving along a straight road over a period of 20 s.



(a) What is the acceleration of the car between A and B?

(b) What is the acceleration of the car between B and C?

(c) What is the deceleration of the car between C and D?

(d) What is the total distance travelled by the car after 20 s?

(e) What is the average speed of the car?

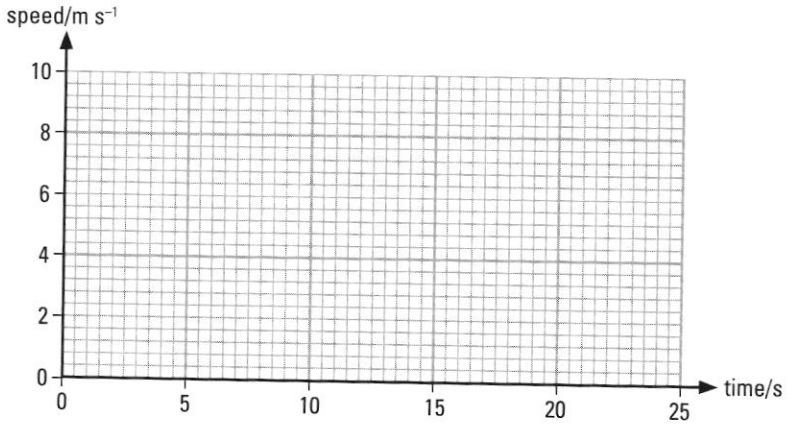
7. In an athlete's training session, a set of running exercises consists of three stages.

Stage 1: He accelerates uniformly from rest to 8.0 m s^{-1} in 4.0 s.
Stage 2: He runs at 8 m s^{-1} for a distance of 120 m.
Stage 3: He decelerates uniformly to rest.

The athlete takes 25 s to complete one set of exercises.

(a) Calculate the time taken during stage 2.

(b) On the grid shown below, draw the speed-time graph of the athlete.



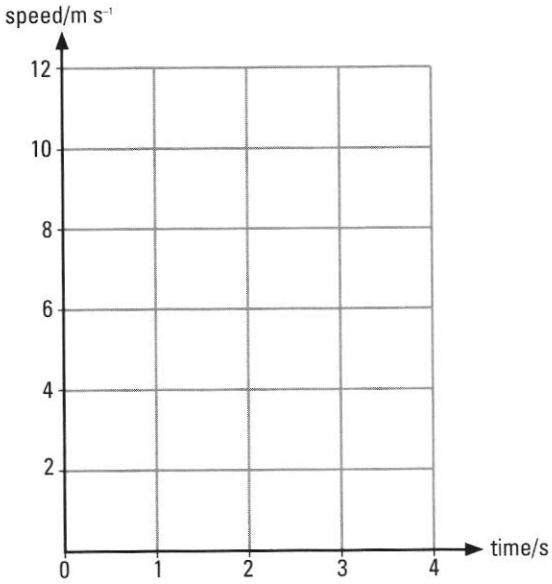
(c) Calculate the total distance travelled by the athlete after one set of exercises.

(d) Calculate the average speed of the athlete.

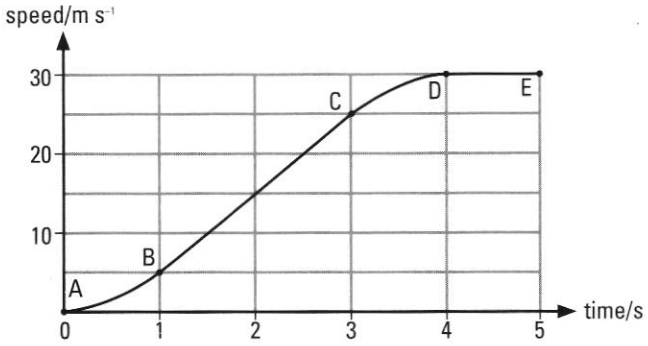
8. A car moving along a straight road at an initial speed of 2 m s^{-1} has a constant acceleration of 2 m s^{-2} for 4 s.

(a) Plot a speed-time graph for this motion on the grid provided.

(b) Calculate the distance travelled by the car in 4 s.



9. The graph shows the variation of speed with time of a motorcycle over the first 5 s of its journey on a straight road.



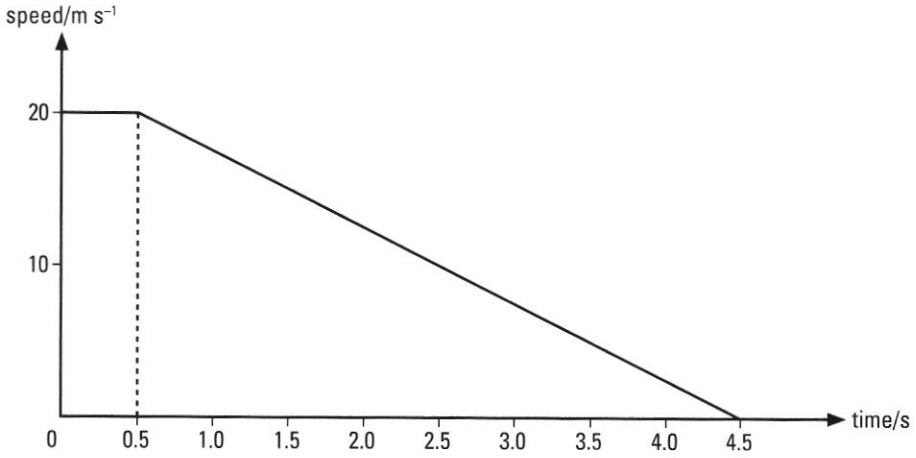
(a) Determine the maximum speed of the motorcycle.

(b) Describe briefly how the acceleration of the motorcycle varies between the various sections.

(c) Calculate the acceleration between B and C.

(d) Estimate the distance travelled by the motorcycle in the first 5 s.

10. The graph below shows how the speed of a car changed from the time the driver saw an obstacle on the straight road to the time the car stopped.



(a) How long did it take the driver to begin applying the brakes after seeing the obstacle?

(b) Calculate

(i) the distance travelled by the car before braking began,

(ii) the distance travelled by the car while the brakes were being applied,

(iii) the total distance travelled before the car stopped.

(c) Draw on the graph, a second line to show how the speed would have changed if the initial speed had been 10 m s^{-1}. Assume the driver's reaction time and braking force are unchanged. Calculate the total distance travelled by the car in this case.

Name: _____ Class: _____ Date: _____

Exercise 2C Acceleration due to Gravity

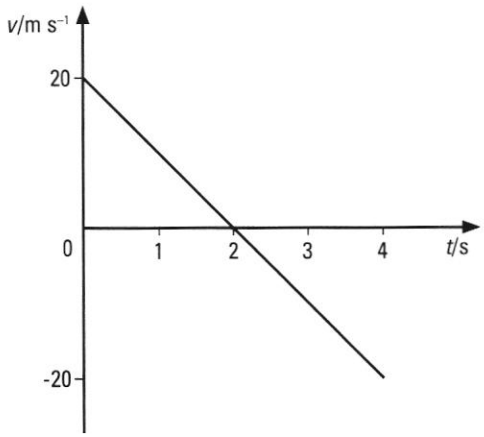
1. Complete these sentences.

(a) An object is in free fall if the only force acting on it is the _____.

(b) The acceleration due to gravity is approximately _____.

(c) Most falling objects will experience air resistance. The air resistance will increase when the _____. At the point when the air resistance equals to the weight of the object, there is no _____ and the object will fall with _____.

2. The figure below shows how the velocity of a lump of plasticine varies with time after being thrown vertically upwards into the air.



(a) How long does it take for the plasticine to reach its greatest height?

_____

(b) What is the greatest height reached by the plasticine?

(c) Calculate the acceleration.

(d) Why is the velocity negative after 2 s?

_____

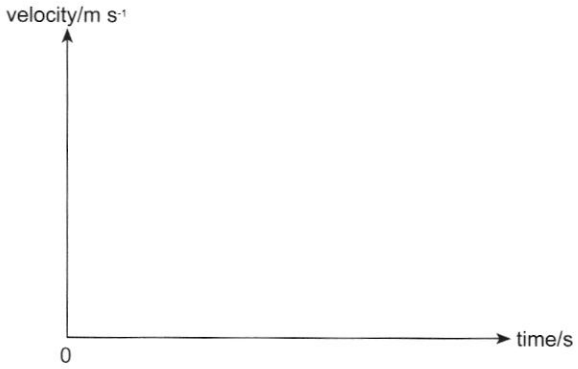
_____

3. A stone is released from rest from a tower 45 m high.

(a) Assuming that the acceleration of free fall is 10 m s^{-2},

(i) what is the velocity of the stone after t s?

(ii) sketch a graph to show how the velocity of the stone changes with time.



(b) Mark on the same graph a point corresponding to time t and the velocity at time t (in terms of t).

(c) Deduce an expression for the distance travelled during time t in terms of t.

(d) Calculate the time taken for the stone to reach the ground.

(e) Calculate the velocity of the stone on reaching the ground.

4. The acceleration due to gravity on the Moon is about $\frac{1}{6}$ that on Earth. If a stone is dropped from a certain height on the Moon,

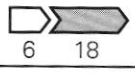
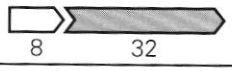
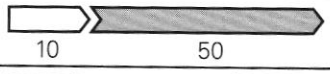
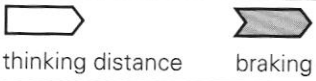
(a) will the time taken for the stone to fall to the ground be longer or shorter than the time taken for the same stone to fall from the same height on the Earth?

(b) will the velocity be higher or lower when the stone reaches the ground on the Moon (assuming there is no air resistance)?

Name: _____ Class: _____ Date: _____

Exercise 2D Analysing Data

1. The table below shows the overall stopping distances for vehicles travelling at different speeds.

Speed of vehicle/m s^{-1}	Overall stopping distance/m
5	
10	
15	
20	
25	
	

The overall stopping distance consists of:

- the thinking distance – the distance travelled while the driver prepares to brake (which depends on the driver's reaction time) and
- the braking distance – the distance travelled while braking.

(a) Use the information from the table above to calculate the reaction time.

(b) Complete the table below to show the thinking distance, the braking distance and the overall stopping distance corresponding to the various speeds of the vehicle.

Speed of vehicle/m s^{-1}	Thinking distance/m	Braking distance/m	Overall stopping distance/m
5			
10			
15			
20			
25			

(c) Compare the thinking distance when the vehicle speed is 10 m s^{-1} and when the vehicle speed is 20 m s^{-1}. What can you deduce about the thinking distance when the vehicle speed is doubled?

_____

(d) Compare the braking distance when the vehicle speed is 10 m s^{-1} and when the vehicle speed is 20 m s^{-1}. What can you deduce about the braking distance when the vehicle speed is doubled?

(e) Copy the values from the table in (b) for when the speed of the vehicle is 15 m s^{-1}. Then, based on your answers in (c) and (d), deduce the thinking distance, braking distance and overall stopping distance when the speed of the vehicle is 30 m s^{-1}.

Speed of vehicle/m s^{-1}	Thinking distance/m	Braking distance/m	Overall stopping distance/m
15			
30			

Name: _____ Class: _____ Date: _____

Exercise 2E Contrasting

1. Figure (a) shows a biplane flying over Singapore in the 1930s and Figure (b) shows a jet plane in the 2010s. The flights of the two aeroplanes are represented in the speed-time graph in Figure (c).

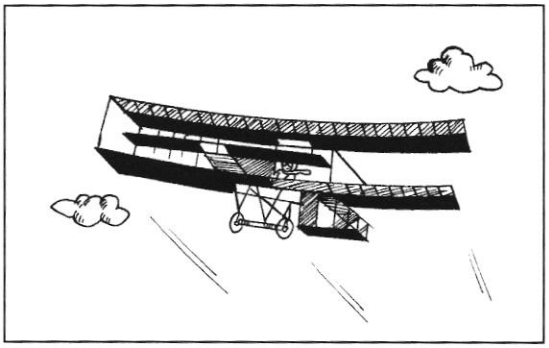


Figure (a)

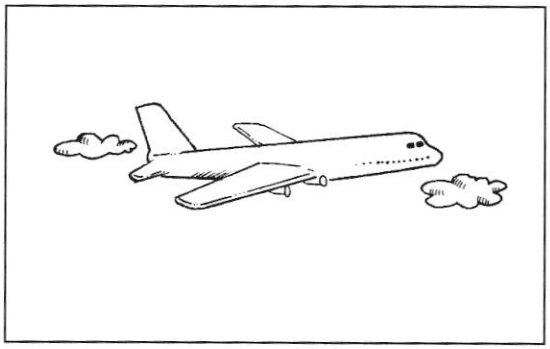


Figure (b)

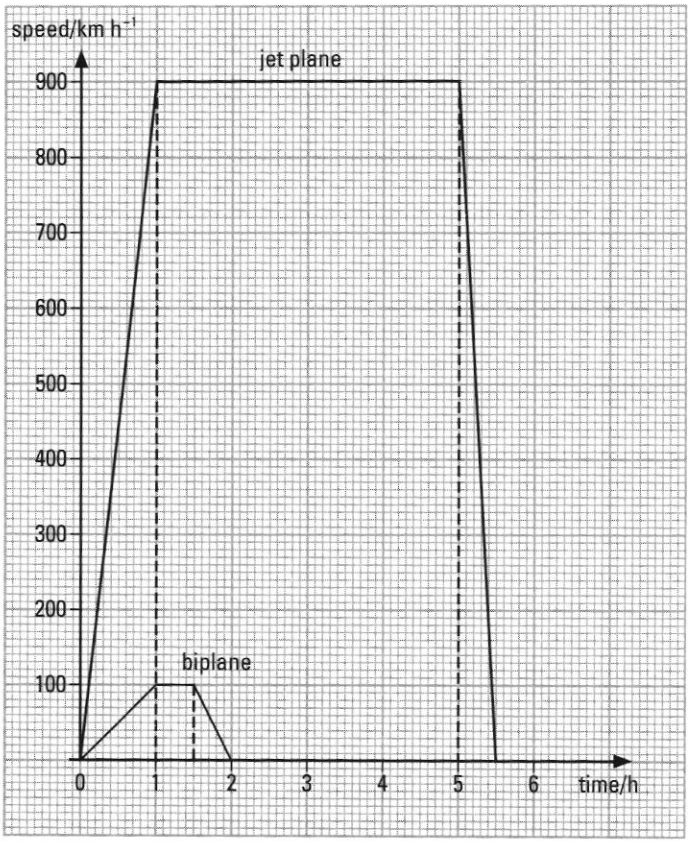


Figure (c)

(a) Using the information from the graph, determine the cruising speed (a comfortable and economical speed for a vehicle, below its maximum speed), acceleration and distance travelled for the two aeroplanes. Write your answers in the table below.

Aeroplane	Cruising speed	Acceleration	Distance travelled
Biplane			
Jet plane			

(b) List some features of the Changi International Airport that enable the Airport to handle faster and bigger aeroplanes in the new millennium. You may find the information from http://www.changiairport.com/