Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

STEM | Exam Builder

Speed-time graphs

Time allowed: 1 hour

Subject code **0580**

Mathematics

Questions from Paper 2 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
You may use a calculator.

Total marks

/ 46

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 46 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

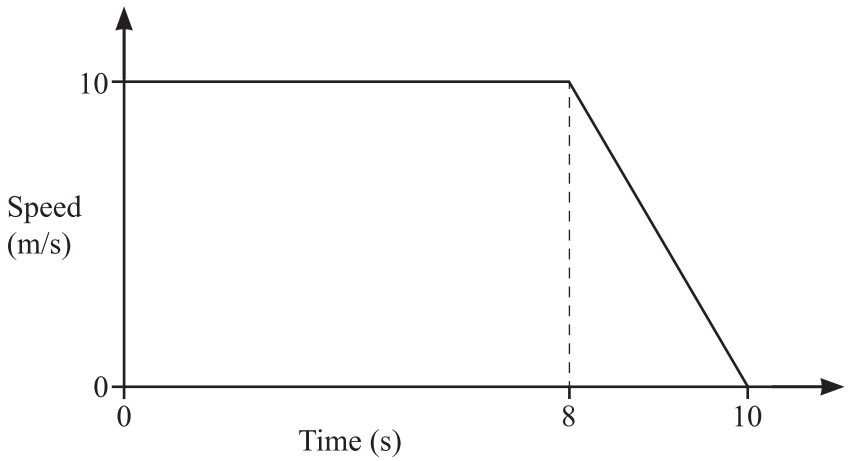
Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

STEM | Exam Builder

Print at 100% (Actual size) so diagrams keep their real measurements.

1



NOT TO SCALE

The diagram shows the speed–time graph for part of a car journey.

Calculate the total distance travelled during the 10 seconds.

..... m [2]

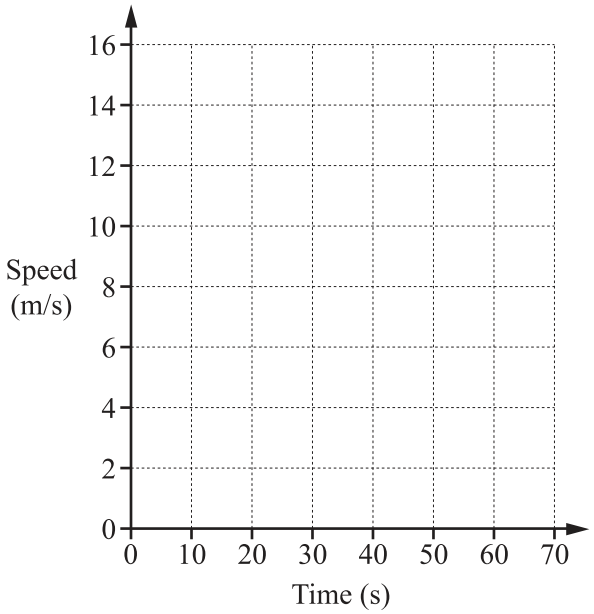
Speed-time graphs Click for more variations

1	90	**2**	**M1** for a correct area calculation e.g. 8 × 10 or 0.5 × 2 × 10 or better

STEM | Exam Builder

2 Petra begins a journey in her car.
She accelerates from rest at a constant rate of 0.4 m/s^2 for 30 seconds.
She then travels at a constant speed for 40 seconds.

On the grid, draw the speed-time graph for the first 70 seconds of Petra's journey.



[2]

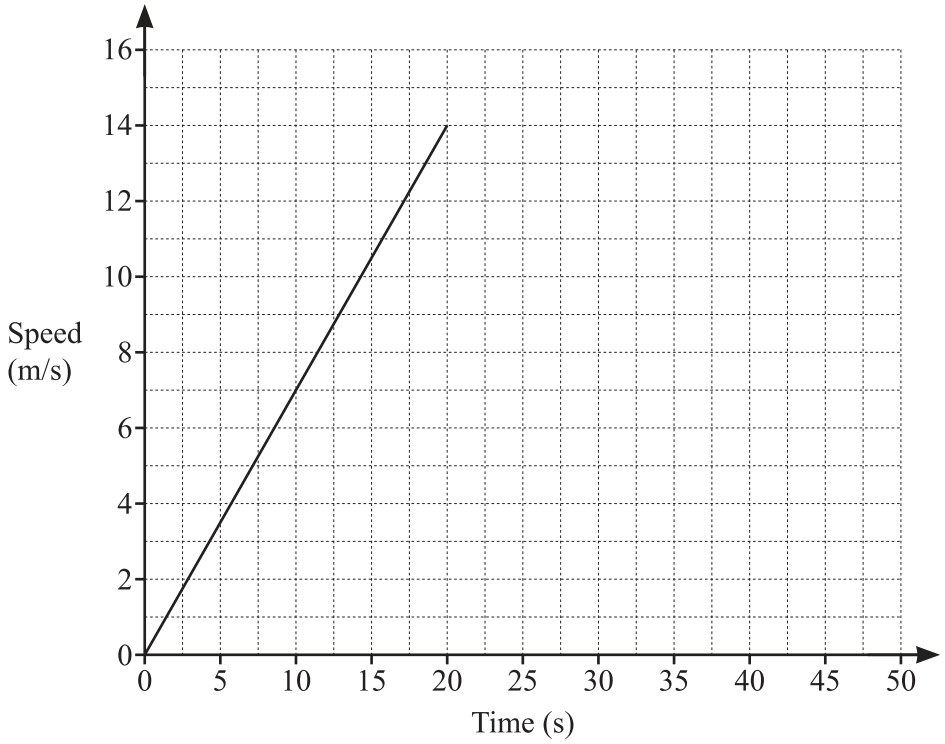
Speed-time graphs Click for more variations

2	Diagonal line from (0, 0) to (30, 12)	**1**	
	and Horizontal line from (30, 12) to (70, 12)	**1FT**	**FT** for horizontal line from (30, *k*) to (70, *k*) where *k* is *their* 12

STEM | Exam Builder

3 A car starts its journey by accelerating from rest at a constant rate of 0.7 m/s^2 for 20 seconds, before reaching a constant speed of 14 m/s.
It then travels at 14 m/s for a distance of 210 m.
The car then decelerates at a constant rate of 1.4 m/s^2, before coming to a stop.

On the grid, complete the speed–time graph for the car's journey.



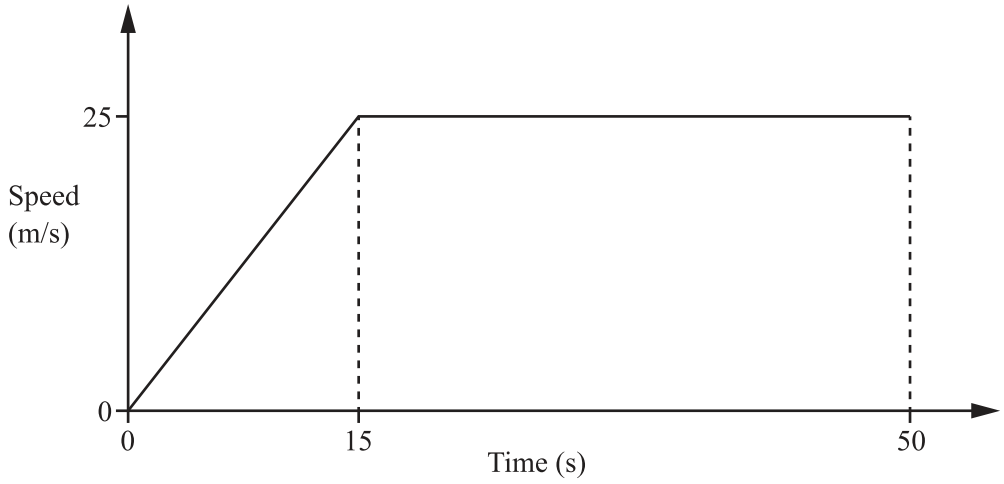
[3]

Speed-time graphs Click for more variations

3	Straight line from (20, 14) to (35, 14) and straight line from (35, 14) to (45, 0)	**3**	**M1** for 210 ÷ 14 soi **M1** for 14 ÷ 1.4 or any line with gradient –1.4 ending at *x* axis

STEM | Exam Builder

4



The speed–time graph shows the first 50 seconds of a journey.

Calculate

(a) the acceleration during the first 15 seconds,

..... m/s^2 [1]

(b) the distance travelled in the 50 seconds.

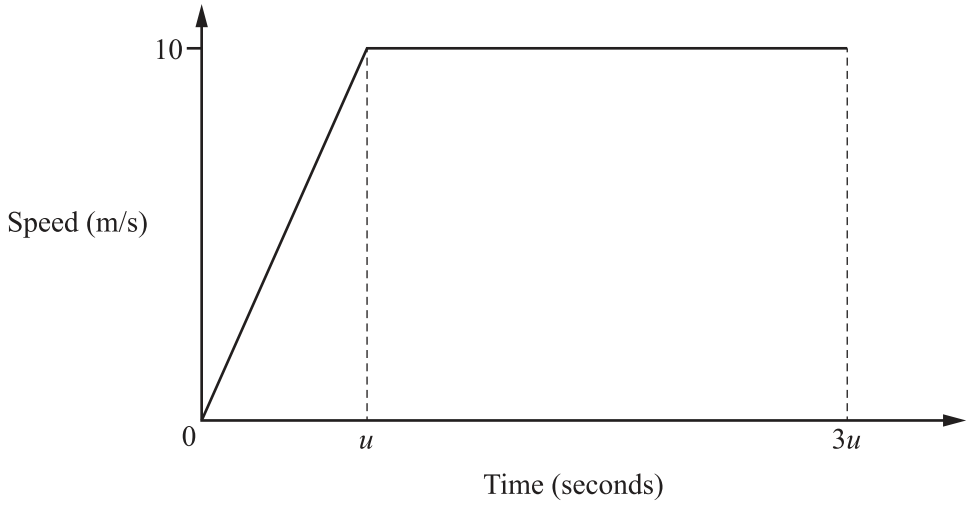
..... m [3]

(a) Speed-time graphs (b) Speed-time graphs Click for more variations

4(a)	$1\frac{2}{3}$ or 1.67 or 1.666 to 1.667	**1**	
4(b)	1062.5	**3**	**M2** for $\frac{25}{2}(50+35)$ oe or **M1** for one area

STEM | Exam Builder

5



NOT TO SCALE

A car starts from rest and accelerates for u seconds until it reaches a speed of 10 m/s.
The car then travels at 10 m/s for $2u$ seconds.
The diagram shows the speed-time graph for this journey.

The distance travelled by the car in the first $3u$ seconds is 125 m.

(a) Find the value of u.

Answer(a) $u =$ ..... [3]

(b) Find the acceleration in the first u seconds.

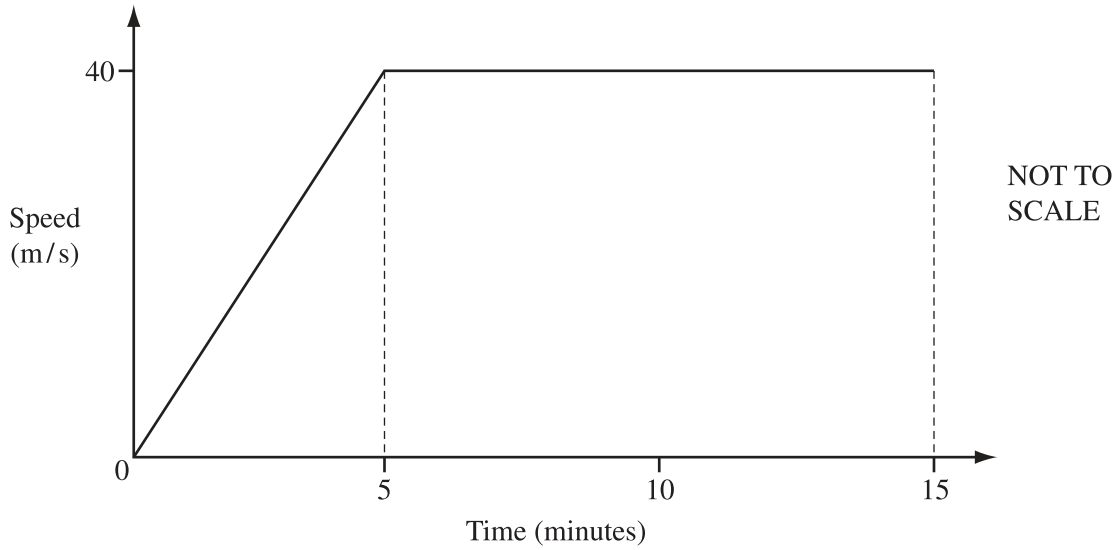
Answer(b) ..... m/s^2 [1]

(a) Speed-time graphs (b) Speed-time graphs Click for more variations

5	**(a)**	5	**3**	**M2** for $\frac{u\times10}{2}+2u\times10=125$ oe or **M1** for evidence that area represents distance e.g. $\frac{u\times10}{2}$, $2u\times10$ or $3u\times10$
	(b)	2	**1FT**	**FT** $10 \div$ *their* u correctly evaluated

STEM | Exam Builder

6



The diagram shows the speed-time graph for the first 15 **minutes** of a train journey.
The train accelerates for 5 minutes and then continues at a constant speed of 40 metres/**second**.

(a) Calculate the acceleration of the train during the first 5 minutes.
Give your answer in m/s^2.

Answer(a) ..... m/s^2 [2]

(b) Calculate the average speed for the first 15 minutes of the train journey.
Give your answer in m/s.

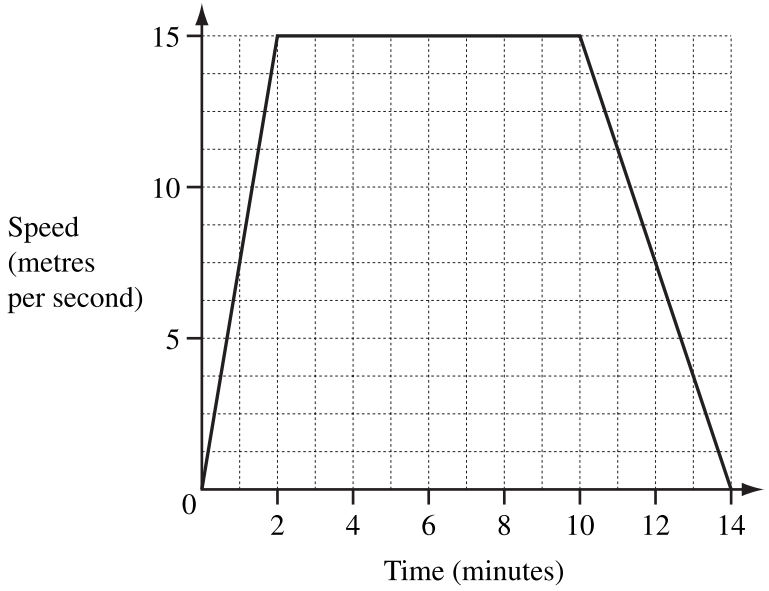
Answer(b) ..... m/s [3]

(a) Speed-time graphs (b) Speed-time graphs Click for more variations

STEM | Exam Builder

6	**(a)** 0.133 (3…) or $\frac{2}{15}$	**2**	**M1** for 40 ÷ 300 seen
	(b) $33\frac{1}{3}$ or 33.3	**3**	**M1** for area under graph attempted **M1** for correct total area statement

7



The diagram shows the speed-time graph of a train journey between two stations.
The train accelerates for two minutes, travels at a constant maximum speed, then slows to a stop.

(a) Write down the number of **seconds** that the train travels at its constant maximum speed.

Answer(a) ..... s [1]

(b) Calculate the distance between the two stations **in metres**.

Answer(b) ..... m [3]

(c) Find the acceleration of the train in the **first two minutes**.
Give your answer in m/s^2.

Answer(c) ..... m/s^2 [2]

STEM | Exam Builder

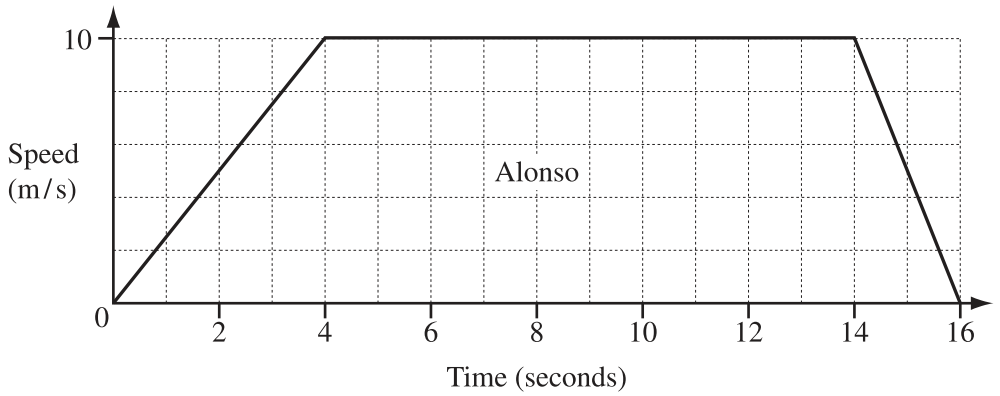
(a) Speed-time graphs (b) Speed-time graphs (c) Speed-time graphs Click for more variations

7	**(a)** 480	**1**	
	(b) 9900	**3**	**M1** for attempt at area under graph **M1** for $0.5 \times 15 \times$ (their **(a)** $+ 14 \times 60$) oe or $0.5 \times 15 \times (8 + 14)$ oe
	(c) 0.125 or $\frac{1}{8}$	**2**	**M1** for numerical vertical/horizontal or numerical use of $v = u + at$ but $t \leq 120$ or $t \leq 2$

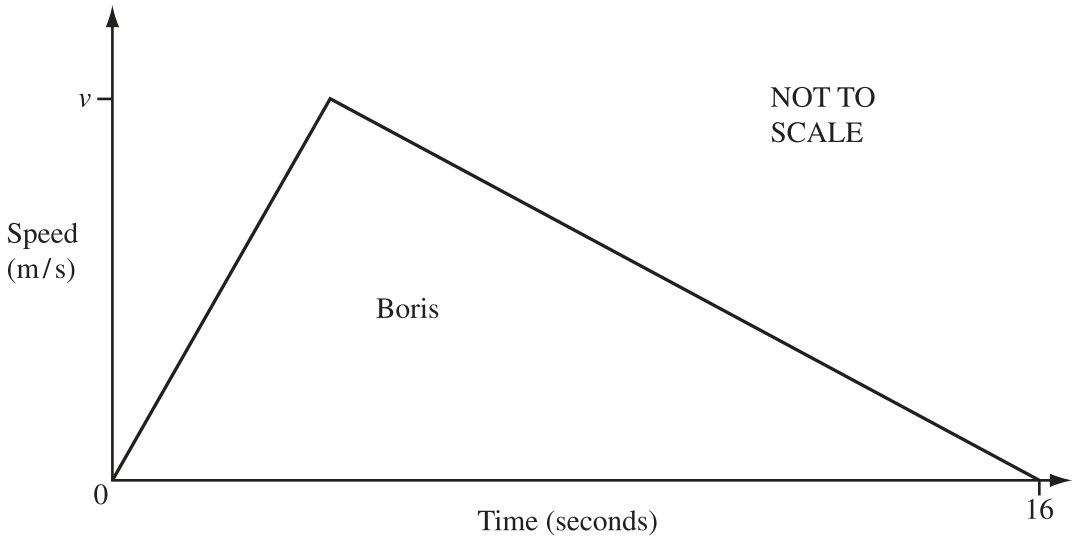
STEM | Exam Builder

8 The graphs show the speeds of two cyclists, Alonso and Boris.

Alonso accelerated to 10 m/s, travelled at a steady speed and then slowed to a stop.



Boris accelerated to his maximum speed, v m/s, and then slowed to a stop.



Both cyclists travelled the same distance in the 16 seconds.

Calculate the maximum speed for Boris.
Show all your working.

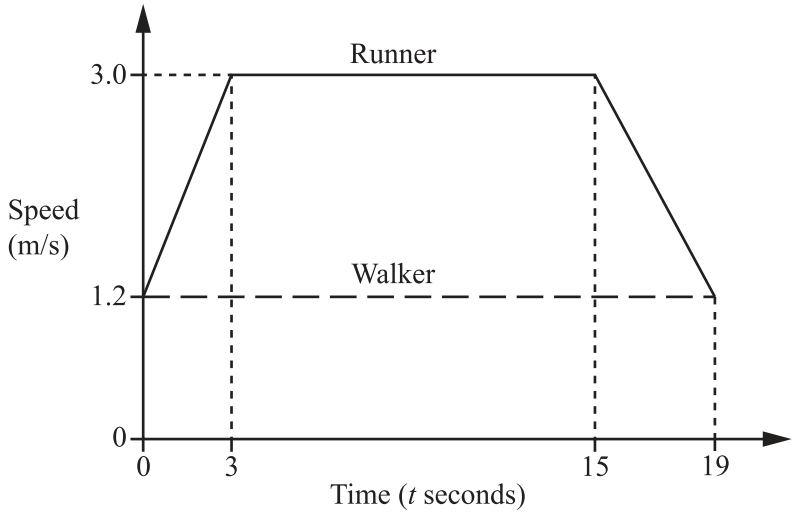
STEM | Exam Builder

Answer ..... m/s [5]

Speed-time graphs Click for more variations

8	$16\frac{1}{4}$ or 16.3	5	**M1** finding the area under graph **A1** 130 **M1** $\frac{1}{2} \times 16 \times v$ **M1** equating and solving

9 The diagram shows the speed–time graph for part of a journey for two people, a runner and a walker.



NOT TO SCALE

(a) Calculate the acceleration of the runner for the first 3 seconds.

..... m/s^2 [1]

(b) Calculate the total distance travelled by the runner in the 19 seconds.

..... m [3]

(c) The runner and the walker are travelling in the same direction along the same path.
When $t = 0$, the runner is 10 metres behind the walker.

Find how far the runner is ahead of the walker when $t = 19$.

..... m [3]

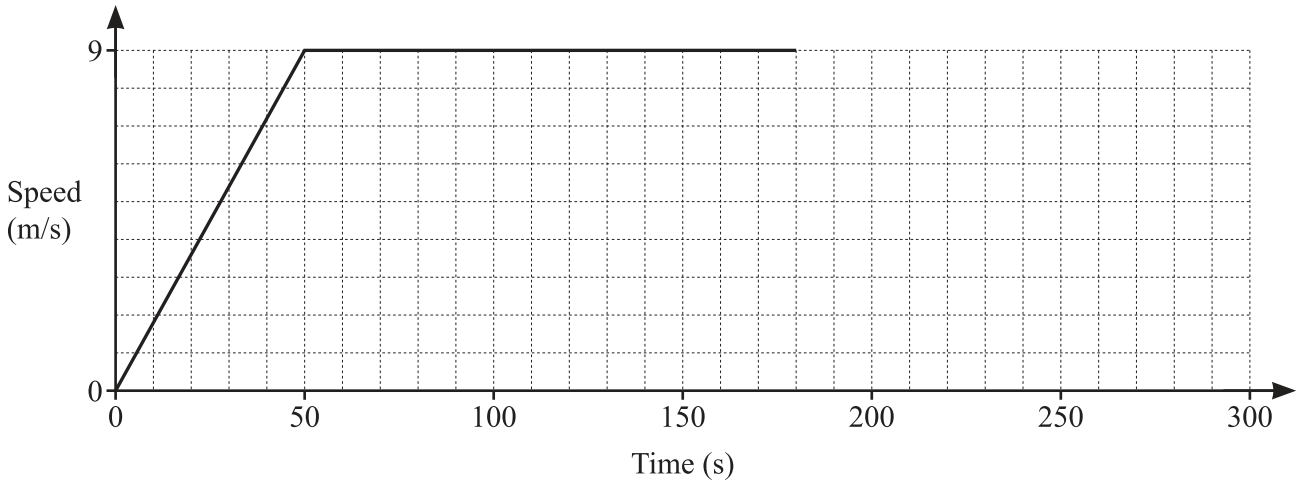
STEM | Exam Builder

(a) Speed-time graphs (b) Speed-time graphs (c) Speed-time graphs Click for more variations

9(a)	0.6	**1**	
9(b)	50.7	**3**	**M2** for $1.2 \times 19 + \frac{1}{2}(19 + 12) \times 1.8$ oe or **M1** for method for finding any relevant area
9(c)	17.9	**3**	**M2** for *their* $50.7 - 1.2 \times 19$ [– 10] oe or **M1** for 1.2×19 oe seen isw

STEM | Exam Builder

10 The diagram shows the speed–time graph for the first 180 seconds of a train journey.



(a) Find the acceleration, in m/s^2, of the train during the first 50 seconds.

..... m/s^2 [1]

(b) After 180 seconds, the train decelerates at a constant rate of 1944 $\mathbf{km/h^2}$.

Show that the train decelerates for 60 seconds until it stops.

[2]

(c) Complete the speed–time graph. [1]

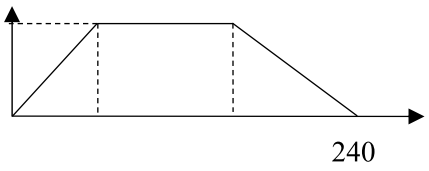
(d) Calculate the average speed of the train for the whole journey.

STEM | Exam Builder

..... m/s [4]

(a) Speed-time graphs (b) Speed-time graphs (c) Speed-time graphs (d) Speed-time graphs

Click for more variations

10(a)	0.18 or $\frac{9}{50}$	**1**	
10(b)	$1944\times\frac{1000}{3600\times3600}$	**M1**	
	$9 \div 0.15 = 60$	**M1**	
10(c)		**1**	ruled line to axis with point of contact at 240
10(d)	6.9375	**4**	**M2** for area = $\frac{1}{2}\times(130+240)\times9$ oe or **M1** for one correct partial area **M1dep** for *their* total area ÷ 240

STEM | Exam Builder