GRAYS TUITION CENTRE – Online Tutoring

WEEK: 16
Week Beginning: (06/07/2020)
Subject: MATHS
Year: 9

Lesson Objective:

- Continue examining graphs but focus on equations of motion and how each equation relates to one another. i.e. speed distance time or acceleration
- Introduce you to newtons laws of motion SUVAT and be able to use his equations to derive different motion equations

Class Worksheets

- Pages 206-212 GCSE Maths 4-9 Elmwood (Blue book)

Homework

- Complete remaining classwork for homework

Additional Notes

- All homework from last week will be marked at the beginning of the lesson. Make sure that you have your homework with you in the lesson and are ready to mark it
- Also prepare any questions if you struggled with the homework so I can help you.
- All lesson worksheets and homework for next week (**due Week 17**) worksheets can be found below

5. (a) Draw $y = \dfrac{5}{x}$ for x-values from 1 to 5.

   (b) Find the gradient of this curve at $(2, 2\cdot5)$.

   (c) Work out the average rate of change between $(2, 2\cdot5)$ and $(4, 1\cdot25)$.

6. A container is slowly filled with water.
   Its depth (in cm) is recorded in the table below.

| Time (mins)	0	0·5	1	1·5	2	2·5	3	3·5	4
Depth (cm)	0	3·75	7	9·75	12	13·75	15	15·75	16

   (a) Draw a graph of depth against time.

   (b) Work out the gradient when the time is 2·5 minutes.

   (c) Work out the rate of increase of the water level when the depth is 11 cm.

   (d) Find the average rate of increase of the water level between a time of 1 minute and a time of 2·5 minutes.
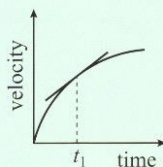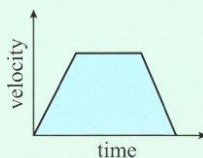
E | Distance/time, velocity/time graphs

🔑 Key Facts
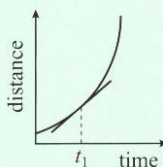
Gradient at time t_1 = gradient of tangent

$\quad = \dfrac{\text{change in distance}}{\text{change in time}}$
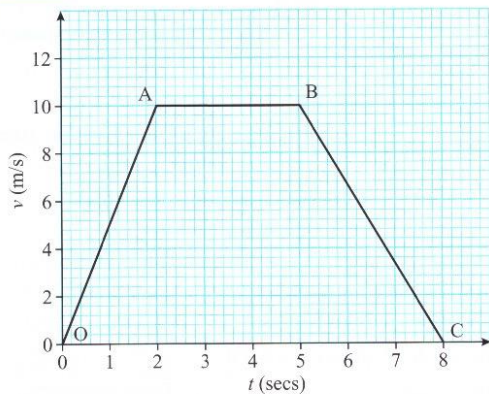
$\quad = $ velocity at time t_1

Gradient at = rate of change
time t_1 of velocity

$\quad = $ acceleration at time t_1

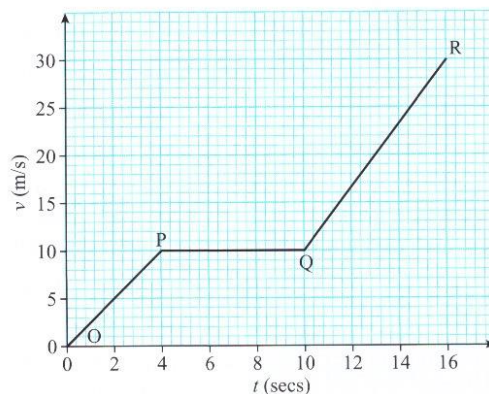area under a velocity/time graph
= distance travelled

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1

This velocity–time graph shows the motion of a particle. Find:

(a) the acceleration from O to A (in m/s^2).

(b) the acceleration from A to B (in m/s^2).

(c) the deceleration from B to C (in m/s^2).

(d) the total distance travelled from O to C.

2

This velocity–graph shows the motion of a particle. Find:

(a) the total distance travelled from O to R.

(b) the acceleration when $t = 12$ seconds.

(c) the distance travelled in the first 2 seconds.

3 A skier starts from rest and accelerates uniformly to a speed of 23 m/s in 20 seconds. He maintains this speed for 60 seconds then slows down uniformly to a stop in a further 25 seconds.

(a) Draw a velocity–time graph for the above information.

(b) Find the total distance travelled by the skier.

(c) Find the acceleration when the skier is speeding up.

(d) How long does the skier take to cover the first 690 m?

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4
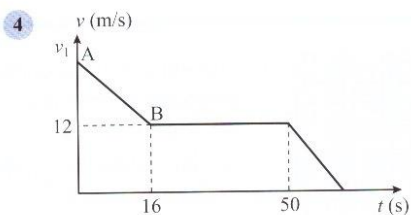
A particle travels 336 m from A to B.

Its velocity–time graph is shown opposite.

(a) Find the value of V_1.

(b) What is its deceleration after 4 seconds?

(c) How long does it take to travel 444 m?

5 s is the distance (in km) from Maria's house. Maria cycles such that $s = t^3 - t + 2$ where t is the time (in hours).

(a) Draw a graph of s against t for t-values from 0 to 3.

(b) Find Maria's speed after 2 hours.

(c) Work out Maria's average speed between 1 and 2·5 hours.

6
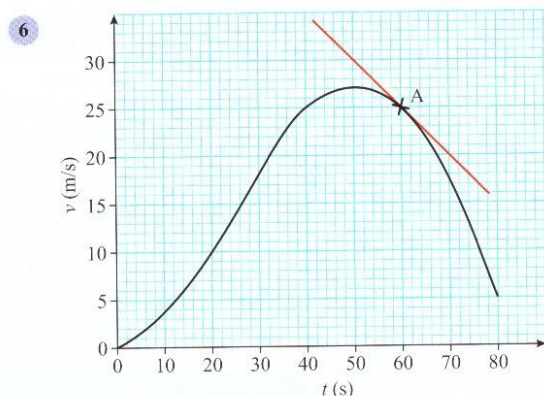
The graph above shows a car accelerating and decelerating quickly.

(a) Estimate the distance travelled in the first 80 seconds (hint: use trapezium rule with 4 strips).

(b) Work out the deceleration at the point A.

(c) Work out the average acceleration between $t = 20$ s and $t = 40$ s.

7 A cyclist slows down from 22 km/h to 8 km/h in 2 minutes at a uniform rate. Sketch a velocity–time graph and work out the distance travelled by the cyclist.

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8 The total distance travelled by a particle is 882 m. Its velocity–time graph is shown opposite.

(a) Find the maximum velocity reached.

(b) Work out the deceleration shown.

(c) How far had the particle travelled after 38 seconds?
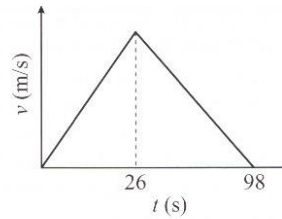
9 A couple take their dog for a long walk. If the walk time is measured from midday, the table below shows how many kilometres they have walked.

Time (hours)	1	2	3	4	5	6
Distance (km)	0	6·9	11·0	13·9	16·1	17·9
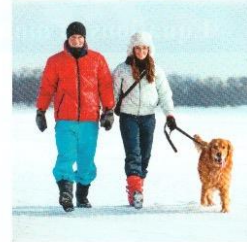
(a) Draw a graph to show the distance against time.

(b) Work out their speed after 2 hours.

(c) Work out their speed after 4 hours.

(d) Work out their average speed between 3 and 5 hours.

10 A particle moves such that its velocity v(m/s) is given by $v = 15 + 2t - t^2$ where t is the time in seconds.

(a) Draw the graph of v against t from $t = 0$ to $t = 5$.

(b) Estimate the distance travelled in the first 5 seconds.

(c) At what time is the acceleration equal to zero? Explain why you have given this answer.

(d) Find the acceleration when $t = 2$ seconds.

11
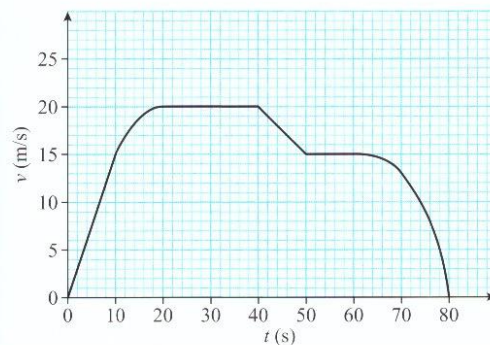
This graph shows the velocity of a motorbike.

Describe what is happening to the motorbike throughout this time period.

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12 A van is travelling at a constant speed of 27 m/s. It passes a stationary lorry which, 8 seconds later, accelerates uniformly at 3 m/s² up to a speed of 36 m/s. The lorry then travels at this speed until it catches up with the van. Find the time taken for the lorry to catch up with the van.
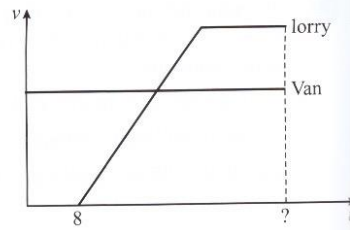
E Equations of motion

Key Facts

Equations of motion for a particle moving in a straight line with constant acceleration a.

Initial velocity $= u$
Final velocity $= v$
Time taken $= t$
From graph, acceleration $a =$ gradient u

$$a = \frac{v - u}{t}$$

$$at = v - u$$

$$\boxed{v = u + at}$$

Area under graph gives displacement s

$$s = \frac{1}{2}(u + v)t \quad \text{(area of a trapezium)}$$

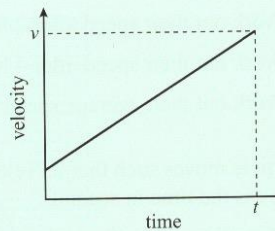Use $v = u + at$

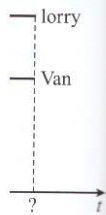$$s = \frac{1}{2}(u + u + at)t$$

$$\boxed{s = ut + \frac{1}{2}at^2}$$

Use $t = \frac{v - u}{a}$ in $s = \frac{1}{2}(u + v)t$

$$s = \frac{1}{2}(u + v)\left(\frac{v - u}{a}\right)$$

$$s = \frac{v^2 - u^2}{2a}$$

$$\boxed{v^2 = u^2 + 2as}$$

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eration a.

(a) A car decelerates uniformly at 3 m/s² from a speed of 22 m/s until it is at rest.
Find the distance travelled.

$u = 22$ $v = 0$ (at rest) $a = -3$ (deceleration)

$v^2 = u^2 + 2as$

$0 = 22^2 - 6s \Rightarrow 6s = 484 \Rightarrow s = 80\frac{2}{3}$

Car travels $80\frac{2}{3}$ m.

(b) A train has a constant acceleration of 6 m/s².
How long will it take to cover 252 m if it starts at a speed of 15 m/s?

$u = 15$ $a = 6$ $s = 252$

$s = ut + \frac{1}{2}at^2$

$252 = 15t + 3t^2 \Rightarrow 3t^2 + 15t - 252 = 0$

$t^2 + 5t - 84 = 0$

$(t + 12)(t - 7) = 0$

$t = -12$ or 7

Time taken = 7 seconds (time is positive value only).

E6.12

Assume constant acceleration for all questions in this Exercise.

1

s	u	v	a	t
	5		8	3
		58	6	7
	3	7	5	

Use the equations of motion to find the missing values in the table opposite.

2 A horse accelerates at a constant rate from 4 m/s to 10 m/s in 8 seconds.
Find:

(a) the acceleration of the horse.

(b) how far the horse runs.

3 A car accelerates uniformly at a rate of 2 m/s² from a starting speed of 18 m/s. How far does the car travel during the first 3 seconds?

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4   A dog is running at 8 m/s with a constant acceleration of 0·4 m/s^2. How long will it take the dog to run a further 100 m?

5   A particle has an initial velocity of 10 m/s. It decelerates at a constant rate of 9 m/s^2 until it reaches a velocity of 8 m/s. Find the displacement of the particle.

6   A cyclist travels for 5 seconds with constant acceleration 1·5 m/s^2. The cyclist then travels for 8 seconds with constant deceleration of 1·2 m/s^2. Find the cyclist's initial velocity if the final velocity is 3·9 m/s.

7   A ball is thrown vertically upwards with initial velocity 7 m/s. If the constant acceleration is −9·8 m/s^2, how high does the ball travel?

8   A water skier accelerates from 3 m/s to 8 m/s in 6 seconds then travels at a constant speed for another 20 seconds. How far does the water skier travel in total?

9   A mad person is travelling at 2 m/s before vertically diving for 25 m. Find the time taken to reach the bottom and the speed at that instant ($a = 9·8$ m/s^2).

10 A particle has a constant acceleration of 4 m/s^2. How long will it take to cover 70 m if it starts at a speed of 4 m/s?

Can you still?

Mixed

1   Bailey invests £2500 at 4% per annum compound interest. After how many years will Bailey have £3163·30 in her account?

2   $n = 1·67$ when truncated to 2 decimal places. Write down an inequality to show the possible values of n.

3   Factorise $9x^2 - 4$

4   Make x the subject of the formula $px - q = ax + b$
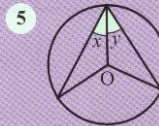
5   Prove that the angle at the centre of a circle is twice the angle at the circumference.