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# AS MATHEMATICS

## Paper 1

Wednesday 16 May 2018

Morning

Time allowed: 1 hour 30 minutes

### Materials

- You must have the AQA Formulae for A-level Mathematics booklet.
- You should have a graphical or scientific calculator that meets the requirements of the specification.

### Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

### Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

For Examiner's Use	
Question	Mark
1	
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<b>TOTAL</b>	



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## Section A

Answer **all** questions in the spaces provided.

1 Three of the following points lie on the same straight line.

Which point does **not** lie on this line?Tick **one** box.

[1 mark]

 $(-2, 14)$  $(-1, 8)$  $(1, -1)$  $(2, -6)$ 

2 A circle has equation  $(x - 2)^2 + (y + 3)^2 = 13$

Find the gradient of the tangent to this circle at the origin.

Circle your answer.

[1 mark]

 $-\frac{3}{2}$  $-\frac{2}{3}$  $\frac{2}{3}$  $\frac{3}{2}$ 

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State the interval for which  $\sin x$  is a decreasing function for  $0^\circ \leq x \leq 360^\circ$

[2 marks]

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**4 (a)** Find the first three terms in the expansion of  $(1 - 3x)^4$  in ascending powers of  $x$ .

**[3 marks]**

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**4 (b)** Using your expansion, approximate  $(0.994)^4$  to six decimal places.

**[2 marks]**

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5 Point C has coordinates  $(c, 2)$  and point D has coordinates  $(6, d)$ .

The line  $y + 4x = 11$  is the perpendicular bisector of CD.

Find  $c$  and  $d$ .

**[5 marks]**

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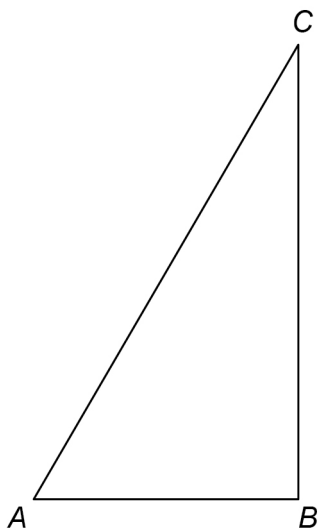
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6 *ABC* is a right-angled triangle.



*D* is the point on hypotenuse *AC* such that  $AD = AB$ .

The area of  $\triangle ABD$  is equal to half that of  $\triangle ABC$ .

6 (a) Show that  $\tan A = 2 \sin A$

**[4 marks]**

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**6 (b) (i)** Show that the equation given in part (a) has two solutions for  $0^\circ \leq A \leq 90^\circ$

**[2 marks]**

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**6 (b) (ii)** State the solution which is appropriate in this context.

**[1 mark]**

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Prove that

$n$  is a prime number greater than 5  $\Rightarrow n^4$  has final digit 1

**[5 marks]**

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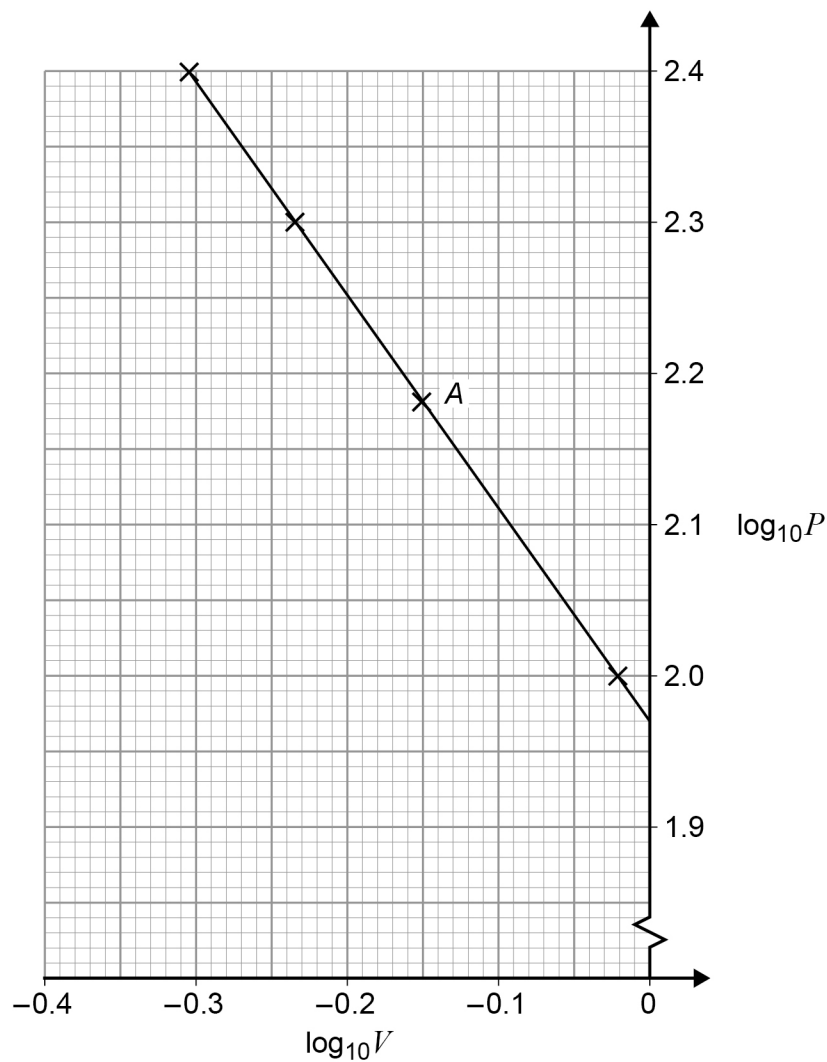
- 8** Maxine measures the pressure,  $P$  kilopascals, and the volume,  $V$  litres, in a fixed quantity of gas.

Maxine believes that the pressure and volume are connected by the equation

$$P = cV^d$$

where  $c$  and  $d$  are constants.

Using four experimental results, Maxine plots  $\log_{10}P$  against  $\log_{10}V$ , as shown in the graph below.



- 8 (a)** Find the value of  $P$  and the value of  $V$  for the data point labelled  $A$  on the graph.

**[2 marks]**

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8 (b) Calculate the value of each of the constants  $c$  and  $d$ .

[4 marks]

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8 (c) Estimate the pressure of the gas when the volume is 2 litres.

[2 marks]

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**9** Craig is investigating the gradient of chords of the curve with equation  $f(x) = x - x^2$

Each chord joins the point  $(3, -6)$  to the point  $(3 + h, f(3 + h))$

The table shows some of Craig's results.

$x$	$f(x)$	$h$	$x + h$	$f(x + h)$	Gradient
3	-6	1	4	-12	-6
3	-6	0.1	3.1	-6.51	-5.1
3	-6	0.01			
3	-6	0.001			
3	-6	0.0001			

**9 (a)** Show how the value  $-5.1$  has been calculated.

**[1 mark]**

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**9 (b)** Complete the third row of the table above.

**[2 marks]**

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9 (c) State the limit suggested by Craig’s investigation for the gradient of these chords as  $h$  tends to 0

[1 mark]

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9 (d) Using differentiation from first principles, verify that your result in part (c) is correct.

[4 marks]

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**10** A curve has equation  $y = 2x^2 - 8x\sqrt{x} + 8x + 1$  for  $x \geq 0$

**10 (a)** Prove that the curve has a maximum point at  $(1, 3)$

Fully justify your answer.

**[9 marks]**

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**10 (b)**

Find the coordinates of the other stationary point of the curve and state its nature.

**[2 marks]**

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**Turn over for Section B**

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**Section B***Do not write  
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box*Answer **all** questions in the spaces provided.**11** In this question use  $g = 9.8 \text{ m s}^{-2}$ 

A ball, initially at rest, is dropped from a height of 40 m above the ground.

Calculate the speed of the ball when it reaches the ground.

Circle your answer.

**[1 mark]**

$-28 \text{ m s}^{-1}$

$28 \text{ m s}^{-1}$

$-780 \text{ m s}^{-1}$

$780 \text{ m s}^{-1}$

**12** An object of mass 5 kg is moving in a straight line.As a result of experiencing a forward force of  $F$  newtons and a resistant force of  $R$  newtons it accelerates at  $0.6 \text{ m s}^{-2}$ 

Which one of the following equations is correct?

Circle your answer.

**[1 mark]**

$F - R = 0$

$F - R = 5$

$F - R = 3$

$F - R = 0.6$





**13** A vehicle, which begins at rest at point  $P$ , is travelling in a straight line.

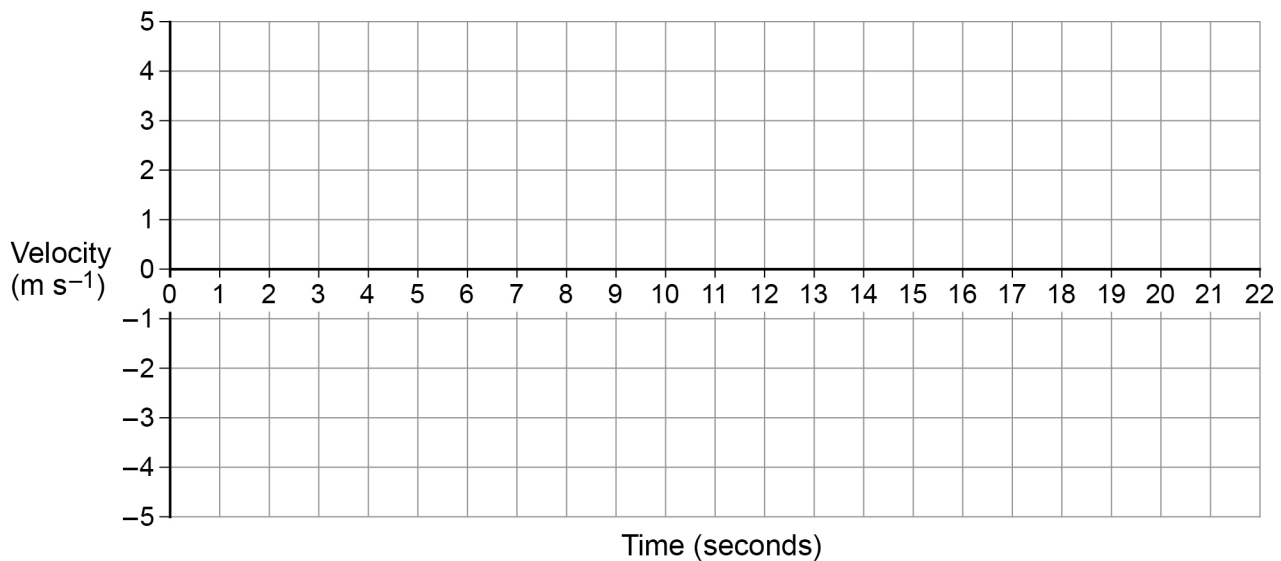
For the first 4 seconds the vehicle moves with a constant acceleration of  $0.75 \text{ m s}^{-2}$

For the next 5 seconds the vehicle moves with a constant acceleration of  $-1.2 \text{ m s}^{-2}$

The vehicle then immediately stops accelerating, and travels a further 33 m at constant speed.

**13 (a)** Draw a velocity–time graph for this journey on the grid below.

**[3 marks]**



**13 (b)** Find the distance of the car from  $P$  after 20 seconds.

**[3 marks]**

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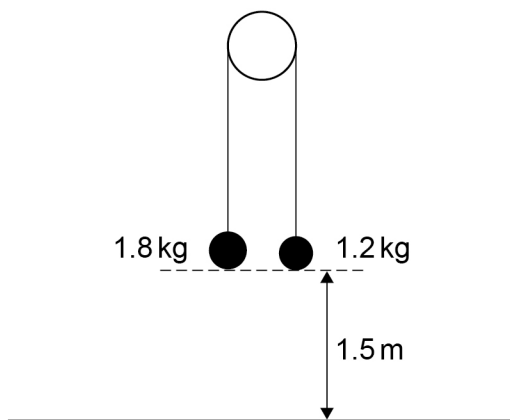
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14 In this question use  $g = 9.81 \text{ m s}^{-2}$

Two particles, of mass 1.8 kg and 1.2 kg, are connected by a light, inextensible string over a smooth peg.



14 (a) Initially the particles are held at rest 1.5 m above horizontal ground and the string between them is taut.

The particles are released from rest.

Find the time taken for the 1.8 kg particle to reach the ground.

[5 marks]

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**14 (b)** State one assumption you have made in answering part (a).

**[1 mark]**

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**Turn over for the next question**

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**15** A cyclist, Laura, is travelling in a straight line on a horizontal road at a constant speed of  $25 \text{ km h}^{-1}$

A second cyclist, Jason, is riding closely and directly behind Laura. He is also moving with a constant speed of  $25 \text{ km h}^{-1}$

**15 (a)** The driving force applied by Jason is likely to be less than the driving force applied by Laura.

Explain why.

[1 mark]

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**15 (b)** Jason has a problem and stops, but Laura continues at the same constant speed. Laura sees an accident 40 m ahead, so she stops pedalling and applies the brakes. She experiences a total resistance force of 40 N

Laura and her cycle have a combined mass of 64 kg

**15 (b) (i)** Determine whether Laura stops before reaching the accident.

Fully justify your answer.

[4 marks]

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**15 (b) (ii)** State one assumption you have made that could affect your answer to part **(b)(i)**.

**[1 mark]**

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**Turn over for the next question**

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**16** A remote-controlled toy car is moving over a horizontal surface. It moves in a straight line through a point  $A$ .

The toy is initially at the point with displacement 3 metres from  $A$ . Its velocity,  $v \text{ m s}^{-1}$ , at time  $t$  seconds is defined by

$$v = 0.06(2 + t - t^2)$$

**16 (a)** Find an expression for the displacement,  $r$  metres, of the toy from  $A$  at time  $t$  seconds.

**[4 marks]**

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**16 (b)** In this question use  $g = 9.8 \text{ m s}^{-2}$

At time  $t = 2$  seconds, the toy launches a ball which travels directly upwards with initial speed  $3.43 \text{ m s}^{-1}$

Find the time taken for the ball to reach its highest point.

**[3 marks]**

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**END OF QUESTIONS**



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