AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

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
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TOTAL	

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

[2 marks]

Turn over for the next question

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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]

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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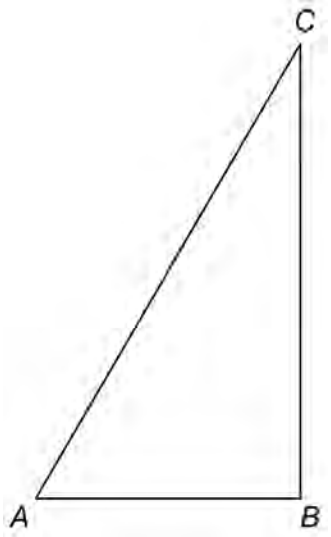
6 *ABC* is a right-angled triangle.



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

The area of ΔABD is equal to half that of ΔABC.

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 $0° \leq A \leq 90°$

[2 marks]

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

[1 mark]

Turn over for the next question

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7 Prove that

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

[5 marks]

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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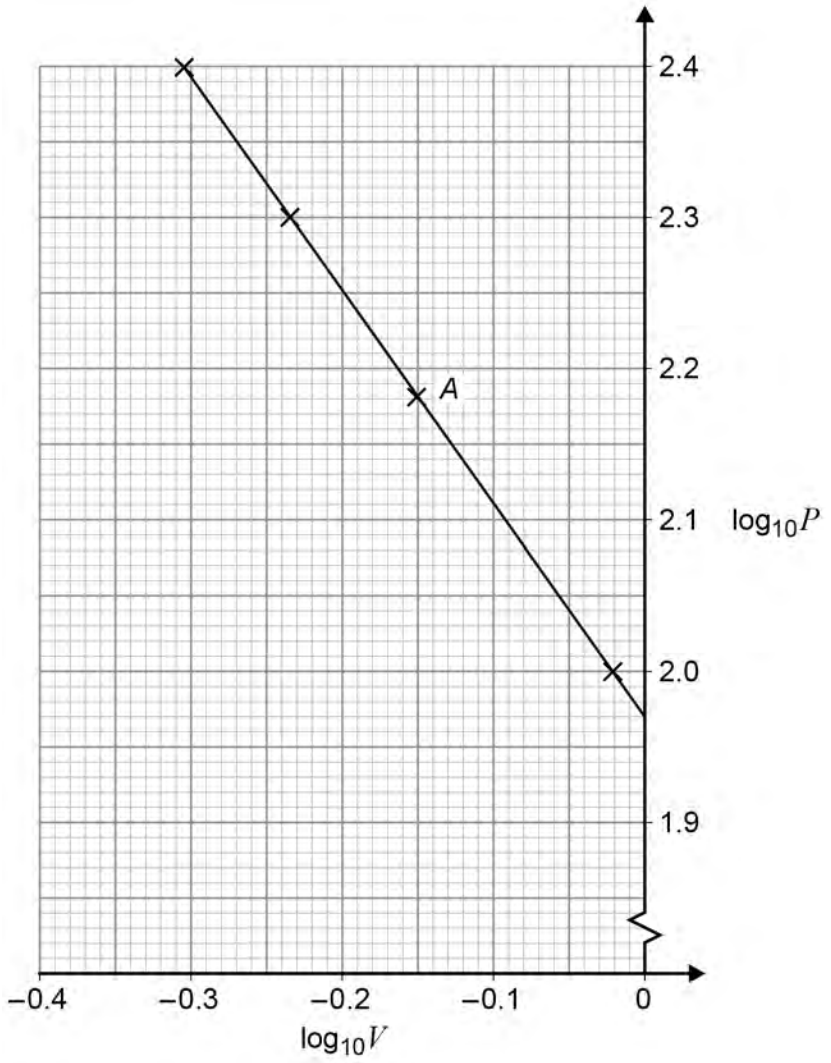
8 Maxine measures the pressure, P kilopascals, and the volume, V litres, in a fixed quantity of gas.

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]

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]

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]

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]

Turn over for Section B

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Section B

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]

$F - R = 0$ $F - R = 5$ $F - R = 3$ $F - R = 0.6$

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

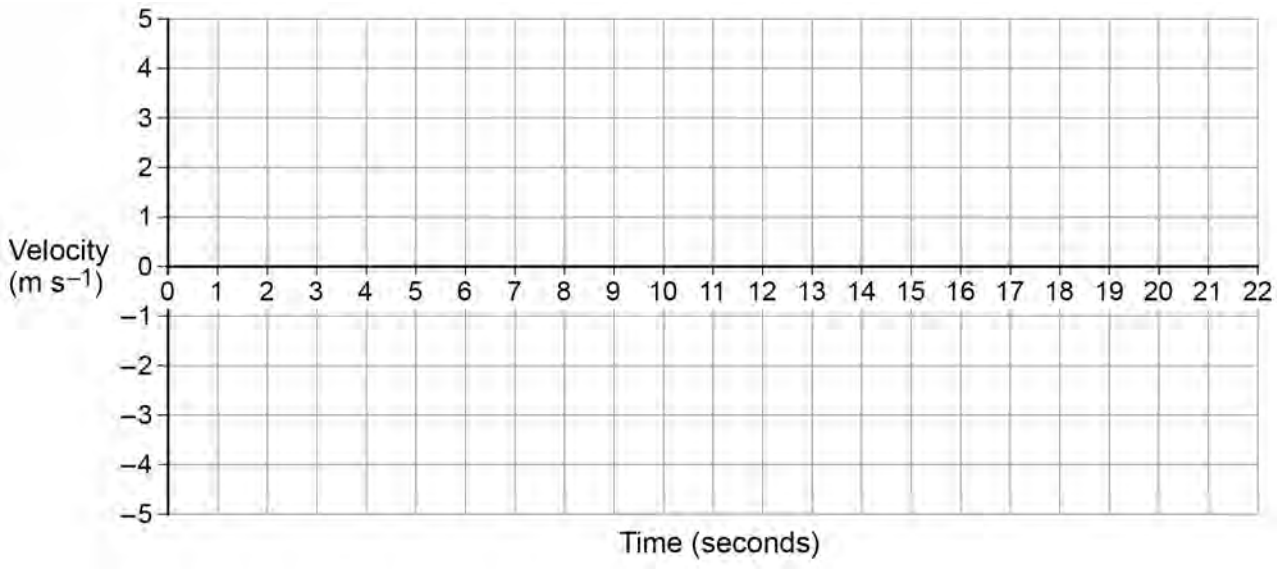
For the first 4 seconds the vehicle moves with a constant acceleration of $0.75\,m\,s^{-2}$

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

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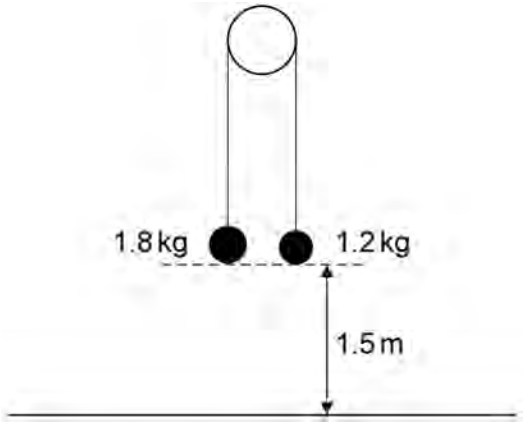
14 **In this question use $g = 9.81\,\text{m s}^{-2}$**

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]

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 km h^{-1}

A second cyclist, Jason, is riding closely and directly behind Laura. He is also moving with a constant speed of 25 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]

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 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]

END OF QUESTIONS

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