

Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

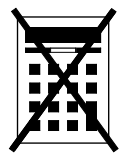
# AS MATHEMATICS

## Unit Pure Core 1

Wednesday 17 May 2017      Morning      Time allowed: 1 hour 30 minutes

### Materials

- For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.
- You must **not** use a calculator.



For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
<b>TOTAL</b>	

### 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.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- 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.
- Do not write outside the box around each page.
- 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.
- The use of calculators is **not** permitted.

### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

### Advice

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



Answer **all** questions.

Answer each question in the space provided for that question.

**1 (a)** Express  $\frac{1+4\sqrt{7}}{5+2\sqrt{7}}$  in the form  $m + n\sqrt{7}$ , where  $m$  and  $n$  are integers.

**[4 marks]**

**(b)** Solve the equation

$$x(9\sqrt{5} - 2\sqrt{45}) = \sqrt{80}$$

giving your answer in its simplest form.

**[3 marks]**

QUESTION  
PART  
REFERENCE

**Answer space for question 1**



QUESTION  
PART  
REFERENCE

**Answer space for question 1**


Turn over ►



- 2** A curve has equation  $y = 20x - x^2 - 2x^3$ . The curve has a stationary point at the point  $M$  where  $x = -2$ .
- (a) Find the  $x$ -coordinate of the other stationary point of the curve. **[4 marks]**
- (b) Find the value of  $\frac{d^2y}{dx^2}$  at the point  $M$ , and hence determine, with a reason, whether  $M$  is a minimum point or a maximum point. **[3 marks]**
- (c) Sketch the curve. **[2 marks]**

 QUESTION  
PART  
REFERENCE

**Answer space for question 2**




3 The polynomial  $p(x)$  is given by

$$p(x) = x^3 + bx^2 + cx + 24$$

where  $b$  and  $c$  are integers.

(a) Given that  $x + 2$  is a factor of  $p(x)$ , show that  $2b - c + 8 = 0$ .

[2 marks]

(b) The remainder when  $p(x)$  is divided by  $x - 3$  is  $-30$ .

Obtain a further equation in  $b$  and  $c$ .

[2 marks]

(c) Use the equations from parts (a) and (b) to find the value of  $b$  and the value of  $c$ .

[3 marks]

QUESTION  
PART  
REFERENCE

Answer space for question 3





4 The point  $A$  has coordinates  $(-2, 5)$  and the point  $B$  has coordinates  $(8, -6)$ .

(a) Find an equation for the straight line  $AB$ , giving your answer in the form  $px + qy = r$ , where  $p$ ,  $q$  and  $r$  are integers. **[4 marks]**

(b) The point  $C$  has coordinates  $(k, k + 1)$ . Given that angle  $ACB$  is a right angle, find the two possible values of  $k$ . **[5 marks]**

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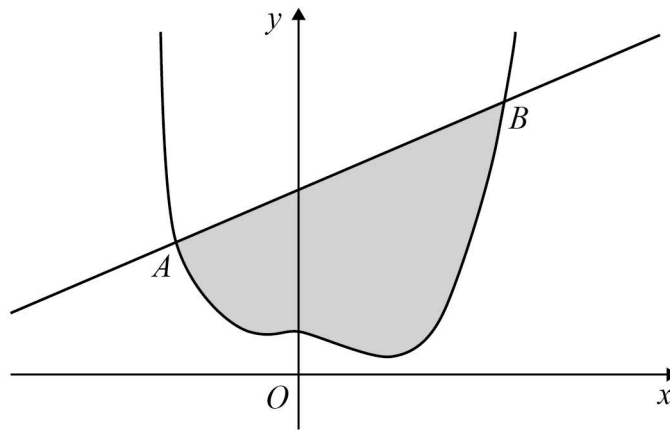
**Answer space for question 4**







- 5 A curve and the line  $AB$  are sketched below.



The curve has equation  $y = 2x^4 - 3x^3 + 4$  and the points  $A(-1, 9)$  and  $B(2, 12)$  lie on the curve.

- (a) Find the equation for the normal to the curve at the point  $A$ , giving your answer in the form  $y = mx + c$ .

[5 marks]

- (b) (i) Find  $\int_{-1}^2 (2x^4 - 3x^3 + 4) dx$ .

[5 marks]

- (ii) Hence find the area of the shaded region bounded by the curve and the line  $AB$ .

[3 marks]

QUESTION  
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REFERENCE

Answer space for question 5









**6** A circle with centre  $C$  has equation  $x^2 + y^2 + 20x - 14y + 49 = 0$ .

**(a)** Express this equation in the form

$$(x - a)^2 + (y - b)^2 = r^2$$

**[3 marks]**

**(b)** Show that the circle touches the  $y$ -axis and crosses the  $x$ -axis in two distinct points.

**[4 marks]**

**(c)** A line has equation  $y = kx + 2$ , where  $k$  is a constant.

**(i)** Show that the  $x$ -coordinates of any points of intersection of the circle and the line satisfy the equation

$$(1 + k^2)x^2 + 10(2 - k)x + 25 = 0$$

**[2 marks]**

**(ii)** Hence, find the value of  $k$  for which the line is a tangent to the circle.

**[3 marks]**

QUESTION  
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**Answer space for question 6**

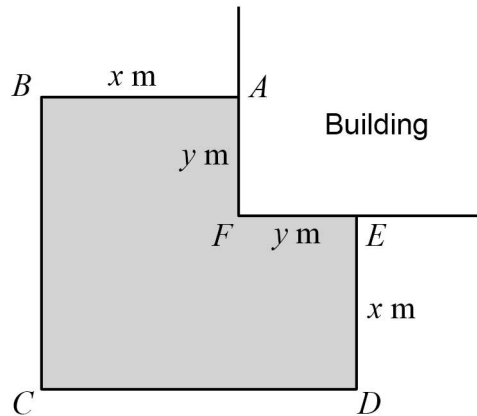


<small>QUESTION PART REFERENCE</small>	<b>Answer space for question 6</b>

Turn over ►



- 7 The diagram shows the right-angled corner  $AFE$  of a building and four sections of fencing running parallel to the walls of the building.



Each of the sections of fencing  $AB$  and  $DE$  has length  $x$  metres and each of the sections of wall  $AF$  and  $FE$  has length  $y$  metres. The total length of the four sections of fencing  $AB$ ,  $BC$ ,  $CD$  and  $DE$  is 15 metres. The shaded region bounded by the fencing and the walls of the building has area  $S$  m<sup>2</sup>.

- (a) (i) Express  $y$  in terms of  $x$ . [2 marks]
- (ii) Show that  $S = 3(5x - x^2)$ . [3 marks]
- (b) (i) Express  $5x - x^2$  in the form  $p - (x - q)^2$ , where  $p$  and  $q$  are rational numbers. [2 marks]
- (ii) Hence find the maximum value of  $S$ . [2 marks]

QUESTION  
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REFERENCE

Answer space for question 7







- 8 The water level in a reservoir rises and falls during a four-hour period of heavy rainfall. The height,  $h$  cm, of water above its normal level,  $t$  hours after it starts to rain, can be modelled by the equation

$$h = 4t^3 - \frac{59}{2}t^2 + 72t, \quad 0 \leq t \leq 4$$

- (a) Find the rate of change of the height of water, in cm per hour, 3 hours after it starts to rain. [4 marks]

- (b) Find the values of  $t$  for which the height of the water is decreasing. [5 marks]

QUESTION  
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**Answer space for question 8**





QUESTION  
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**Answer space for question 8**


**END OF QUESTIONS**

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