Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number | Candidate Number

Core Mathematics C1

Advanced Subsidiary

Wednesday 18 May 2016 – Morning
Time: 1 hour 30 minutes

Paper Reference
6663/01

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

Calculators may NOT be used in this examination.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
  – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

Information

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 4 6 7 1 5 A 0 1 2 8

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1. Find

$$\int \left(2x^4 - \frac{4}{\sqrt{x}} + 3\right) \mathrm{d}x$$

giving each term in its simplest form.

(4)

$\int 2x^4 - 4x^{-\frac{1}{2}} + 3 \; dx$

$\frac{2x^5}{5} - \frac{4x^{\frac{1}{2}}}{1/2} + 3x + C$

$\frac{2}{5}x^5 - 8x^{\frac{1}{2}} + 3x + C$

Q1

(Total 4 marks)

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2. Express 9^{3x+1} in the form 3^y, giving y in the form $ax + b$, where a and b are constants.

(2)

9^{3x+1}

$3^{2(3x+1)}$

3^{6x+2}

Q2

(Total 2 marks)

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3. (a) Simplify

$$\sqrt{50} - \sqrt{18}$$

giving your answer in the form $a\sqrt{2}$, where a is an integer.

(2)

(b) Hence, or otherwise, simplify

$$\frac{12\sqrt{3}}{\sqrt{50} - \sqrt{18}}$$

giving your answer in the form $b\sqrt{c}$, where b and c are integers and $b \neq 1$

(3)

a) $\sqrt{25}\sqrt{2} - \sqrt{9}\sqrt{2}$

$5\sqrt{2} - 3\sqrt{2}$

$2\sqrt{2}$

b) $\frac{12\sqrt{3} \times \sqrt{2}}{2\sqrt{2} \times \sqrt{2}}$

$\frac{12\sqrt{6}}{4}$

$3\sqrt{6}$

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4.

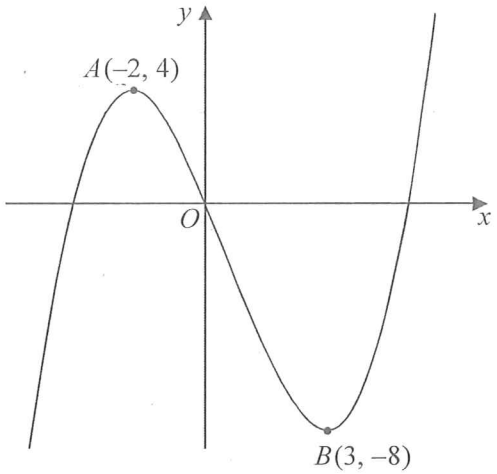


Figure 1

Figure 1 shows a sketch of part of the curve with equation $y = f(x)$. The curve has a maximum point A at $(-2, 4)$ and a minimum point B at $(3, -8)$ and passes through the origin O.

On separate diagrams, sketch the curve with equation

(a) $y = 3f(x)$,

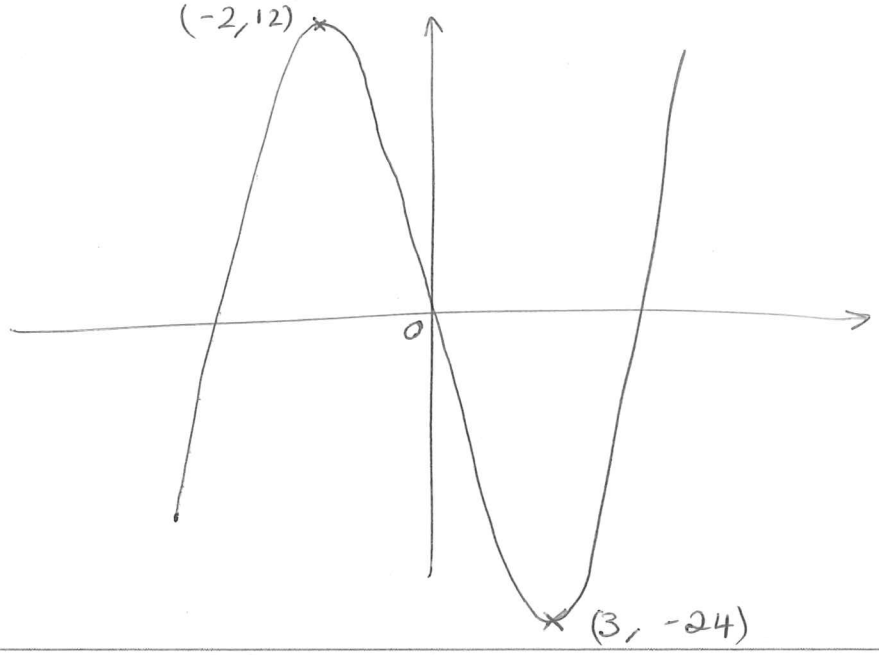
(2)

(b) $y = f(x) - 4$

(3)

On each diagram, show clearly the coordinates of the maximum and the minimum points and the coordinates of the point where the curve crosses the y-axis.

a)



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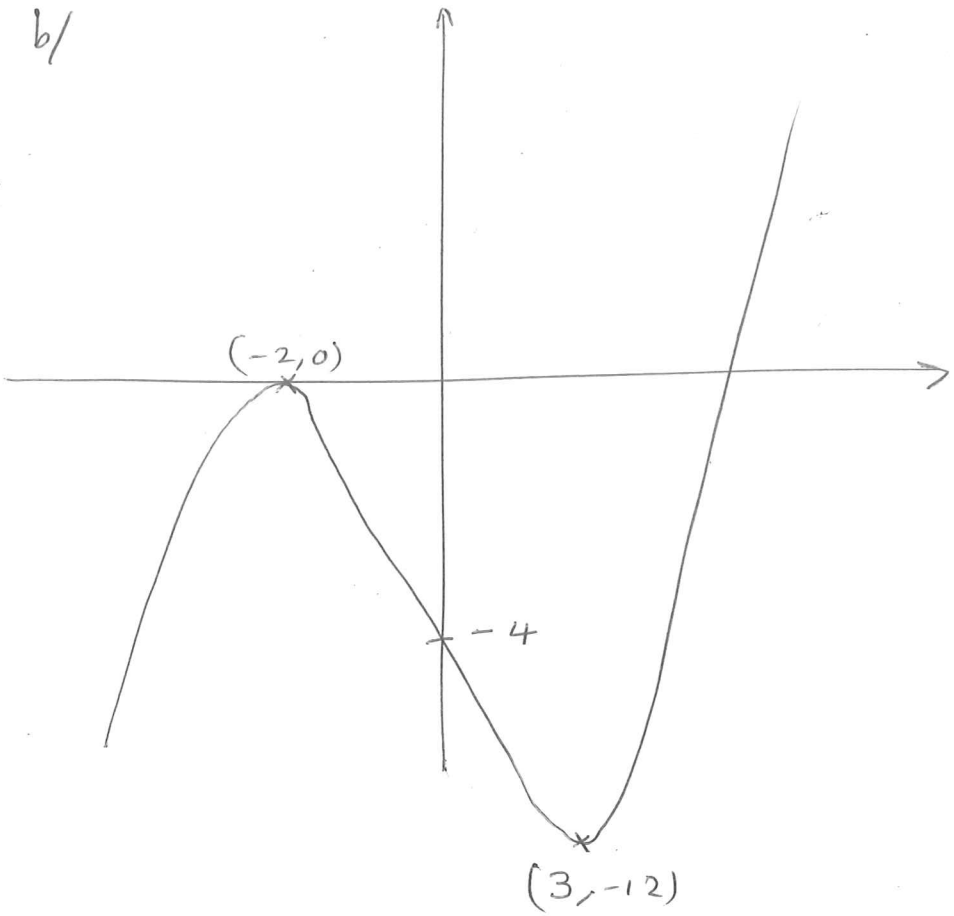
Question 4 continued

b/



Q4

(Total 5 marks)

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5. Solve the simultaneous equations

$$y + 4x + 1 = 0$$

$$y^2 + 5x^2 + 2x = 0$$

(6)

$y = -1 - 4x$

$(-1 - 4x)^2 + 5x^2 + 2x = 0$

$(-1 - 4x)(-1 - 4x) + 5x^2 + 2x = 0$

$1 + 4x + 4x + 16x^2 + 5x^2 + 2x = 0$

$21x^2 + 10x + 1 = 0$

$(3x + 1)(7x + 1) = 0$

$x = -\frac{1}{3}$ $\quad$ $x = -\frac{1}{7}$

$y = -1 - 4(-\frac{1}{3})$ $\quad$ $y = -1 - 4(-\frac{1}{7})$

$= -1 + \frac{4}{3}$ $\quad$ $= -1 + \frac{4}{7}$

$= \frac{1}{3}$ $\quad$ $= -\frac{3}{7}$

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6. A sequence $a_1, a_2, a_3, \ldots$ is defined by

$$a_1 = 4,$$

$$a_{n+1} = 5 - ka_n, \quad n \geqslant 1$$

where k is a constant.

(a) Write down expressions for a_2 and a_3 in terms of k.

(2)

Find

(b) $\sum_{r=1}^{3}(1 + a_r)$ in terms of k, giving your answer in its simplest form,

(3)

(c) $\sum_{r=1}^{100}(a_{r+1} + ka_r)$

(1)

a) $a_2 = 5 - k a_1$
$= 5 - 4k$

$a_3 = 5 - k \cdot a_2$
$= 5 - k(5 - 4k)$
$= 5 - 5k + 4k^2$

b/ $1 + 4 + 1 + 5 - 4k + 1 + 5 - 5k + 4k^2$

$= 4k^2 - 9k + 17$

c/
when $r = 1$

$5 - 4k + k(4)$
$= 5$

when $r = 2$
$5 - 5k + 4k^2 + k(5 - 4k)$
$5 - 5k + 4k^2 + 5k - 4k^2$
$= 5$
$100 \times 5 = 500$

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7. Given that

$$y = 3x^2 + 6x^{\frac{1}{3}} + \frac{2x^3 - 7}{3\sqrt{x}}, \quad x > 0$$

find $\frac{dy}{dx}$. Give each term in your answer in its simplified form.

(6)

$$y = 3x^2 + 6x^{\frac{1}{3}} + \frac{2}{3}x^{\frac{5}{2}} - \frac{7}{3}x^{-\frac{1}{2}}$$

$$\frac{dy}{dx} = 6x + 2x^{-\frac{2}{3}} + \frac{10}{6}x^{\frac{3}{2}} + \frac{7}{6}x^{-3/2}$$

$$= 6x + 2x^{-2/3} + \frac{5}{3}x^{\frac{3}{2}} + \frac{7}{6}x^{-3/2}$$

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8. The straight line with equation $y = 3x - 7$ does not cross or touch the curve with equation $y = 2px^2 - 6px + 4p$, where p is a constant.

(a) Show that $4p^2 - 20p + 9 < 0$.

(4)

(b) Hence find the set of possible values of p.

(4)

$3x - 7 = 2px^2 - 6px + 4p$

$0 = 2px^2 - 6px - 3x + 4p + 7$

$0 = 2px^2 - (6p+3)x + (4p + 7)$

$a = 2p \quad b = -(6p+3) \quad c = 4p+7$

No intersection so $b^2 - 4ac < 0$

$(-6p-3)^2 - 4(2p)(4p+7) < 0$

$(6p-3)(-6p-3) - 4(2p(4p+7) < 0$

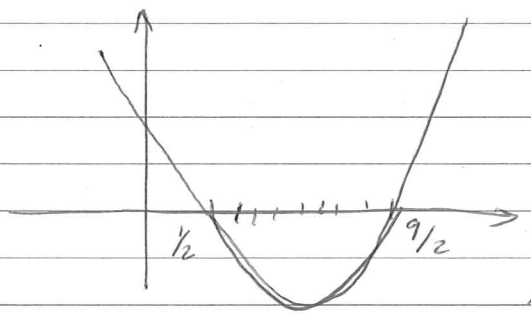
$36p^2 + 18p + 18p + 9 - 8p(4p+7) < 0$

$36p^2 + 36p + 9 - 32p^2 - 56p < 0$

$4p^2 - 20p + 9 < 0$

$(2p - 1)(2p - 9) < 0$

$p = \frac{1}{2} \qquad p = \frac{9}{2}$



$\frac{1}{2} < p < \frac{9}{2}$

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9. On John's 10th birthday he received the first of an annual birthday gift of money from his uncle. This first gift was £60 and on each subsequent birthday the gift was £15 more than the year before. The amounts of these gifts form an arithmetic sequence.

(a) Show that, immediately after his 12th birthday, the total of these gifts was £225

(1)

(b) Find the amount that John received from his uncle as a birthday gift on his 18th birthday.

(2)

(c) Find the total of these birthday gifts that John had received from his uncle up to and including his 21st birthday.

(3)

When John had received n of these birthday gifts, the total money that he had received from these gifts was £3375

(d) Show that $n^2 + 7n = 25 \times 18$

(3)

(e) Find the value of n, when he had received £3375 in total, and so determine John's age at this time.

(2)

a/ $a = 60 \quad d = 15$

$S_n = \frac{n}{2}(2a + (n-1)d)$

$S_3 = \frac{3}{2}(2(60) + (3-1)(15))$

$= \frac{3}{2}(120 + 30)$

$= \frac{3}{2}(150)$

$= £225$

b/ $U_n = a + (n-1)d$

$U_9 = 60 + (9-1)15$

$= 60 + 120$

$= £180$

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Question 9 continued

c/ $S_n = \frac{n}{2}(2a + (n-1)d)$

$3375 = \frac{n}{2}(2(60) + (n-1)(15))$

$6750 = n(120 + 15n - 15)$

$6750 = n(105 + 15n)$

$6750 = 105n + 15n^2$

$\frac{6750}{15} = 7n + n^2$

$450 = 7n + n^2$

$15\overline{)6750}$ $\quad 0450$

$25 \times 18 = n^2 + 7n$

d/

$n^2 + 7n - (25 \times 18) = 0$

$(n + 25)(n - 18) = 0$

$n = -25 \qquad n = 18$

$n = 18$ ∴ John was 27.

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10.

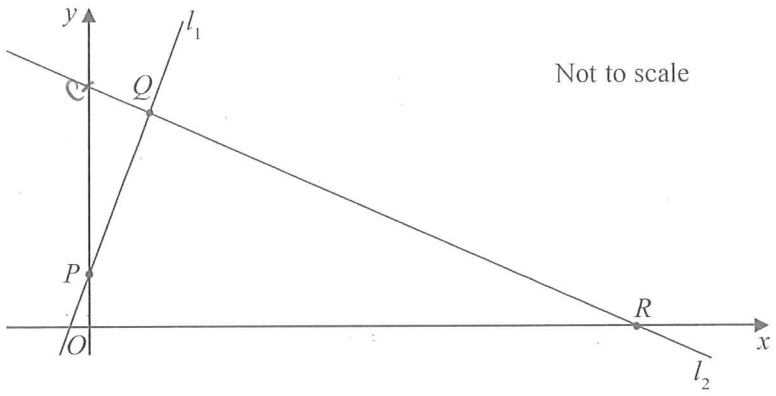

Figure 2

The points P (0, 2) and Q (3, 7) lie on the line l_1, as shown in Figure 2.

The line l_2 is perpendicular to l_1, passes through Q and crosses the x-axis at the point R, as shown in Figure 2.

Find

(a) an equation for l_2, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers,

(5)

(b) the exact coordinates of R,

(2)

(c) the exact area of the quadrilateral $ORQP$, where O is the origin.

(5)

$x_1\ y_1 \quad x_2\ y_2$

gradient of l_1 $\quad (0,2) \quad (3,7)$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{7-2}{3-0}$$

$$= \frac{5}{3}$$

perpendicular $m = -\frac{3}{5}$

$y = -\frac{3}{5}x + c \qquad (3,7)$

$7 = -\frac{3}{5}(3) + c$

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Question 10 continued

$7 = -\frac{3}{5}(3) + c$

$7 = -\frac{9}{5} + c$

$\frac{35}{5} = -\frac{9}{5} + c$

$\frac{44}{5} = c$

$y = -\frac{3}{5}x + \frac{44}{5}$

$5y = -3x + 44$

$3x + 5y - 44 = 0$

b/ crosses x when $y = 0$

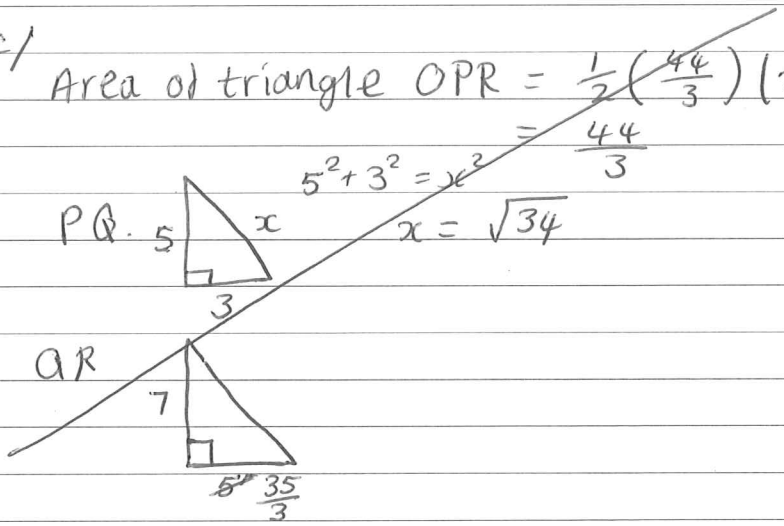
$3x + 5(0) - 44 = 0$

$3x - 44 = 0$

$x = \frac{44}{3}$ $\left(\frac{44}{3}, 0\right)$

c/ Area of triangle OPR $= \frac{1}{2}\left(\frac{44}{3}\right)(2)$

$= \frac{44}{3}$



$5^2 + 3^2 = x^2$

$x = \sqrt{34}$

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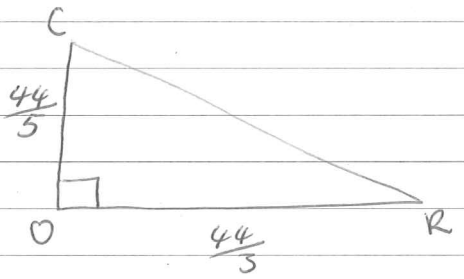
Question 10 continued

c/



(OCR)

Area of big triangle $= \frac{1}{2}\left(\frac{44}{3}\right)\left(\frac{44}{5}\right)$

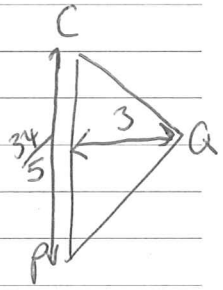
$= \frac{22}{3} \cdot \frac{44}{5}$

$= \frac{968}{15}$

×	20	2
40	800	80
4	80	8

(CQP)

Area of small triangle $= \frac{1}{2} \cdot \frac{34}{5} \cdot 3$



$= \frac{102}{10}$

$= \frac{51}{5}$

$\frac{968}{15} - \frac{153}{15} = \frac{815}{15}$

$= \frac{163}{3}$ units^2

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11. The curve C has equation $y = 2x^3 + kx^2 + 5x + 6$, where k is a constant.

(a) Find $\frac{dy}{dx}$

(2)

The point P, where $x = -2$, lies on C.

The tangent to C at the point P is parallel to the line with equation $2y - 17x - 1 = 0$

Find

(b) the value of k,

(4)

(c) the value of the y coordinate of P,

(2)

(d) the equation of the tangent to C at P, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(2)

a/ $\frac{dy}{dx} = 6x^2 + 2kx + 5$

b/ when $x = -2$

$\frac{dy}{dx} = 6(-2)^2 + 2k(-2) + 5$

$= 24 - 4k + 5$

$= 29 - 4k$

$2y - 17x - 1 = 0$

$2y = 17x + 1$

$y = \frac{17}{2}x + \frac{1}{2}$

$m = \frac{17}{2}$

$\frac{17}{2} = 29 - 4k$

$4k = 29 - \frac{17}{2}$

$4k = \frac{41}{2}$

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Question 11 continued

$k = \frac{41}{8}$

c/ $y = 2x^3 + \frac{41}{8}x^2 + 5x + 6$

$= 2(-2)^3 + \frac{41}{8}(-2)^2 + 5(-2) + 6$

$= -16 + \frac{41}{2} - 10 + 6$

$= -20 + \frac{41}{2}$

$= \frac{1}{2}$

d/ $y = mx + c$

$m = \frac{17}{2}$ $\left(-2, \frac{1}{2}\right)$

$\frac{1}{2} = \frac{17}{2}(-2) + c$

$\frac{1}{2} = -17 + c$

$1 = -34 + 2c$

$35 = 2c$

$c = \frac{35}{2}$

$y = \frac{17}{2}x + \frac{35}{2}$

$2y = 17x + 35$

$17x - 2y + 35 = 0$

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