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0606/23

May/June 2012

2 hours

Additional Materials: Electronic calculator

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

You are reminded of the need for clear presentation in your answers.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 80.

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Total	

This document consists of **16** printed pages.

Mathematical Formulae**1. ALGEBRA***Quadratic Equation*

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{r} a^{n-r} b^r + \dots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2. TRIGONOMETRY*Identities*

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for $\triangle ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} bc \sin A$$

- 1 (i) Given that $\mathbf{A} = \begin{pmatrix} 4 & -3 \\ 2 & 5 \end{pmatrix}$, find the inverse matrix $\mathbf{A}^{-1}$.

[2]

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- (ii) Use your answer to part (i) to solve the simultaneous equations

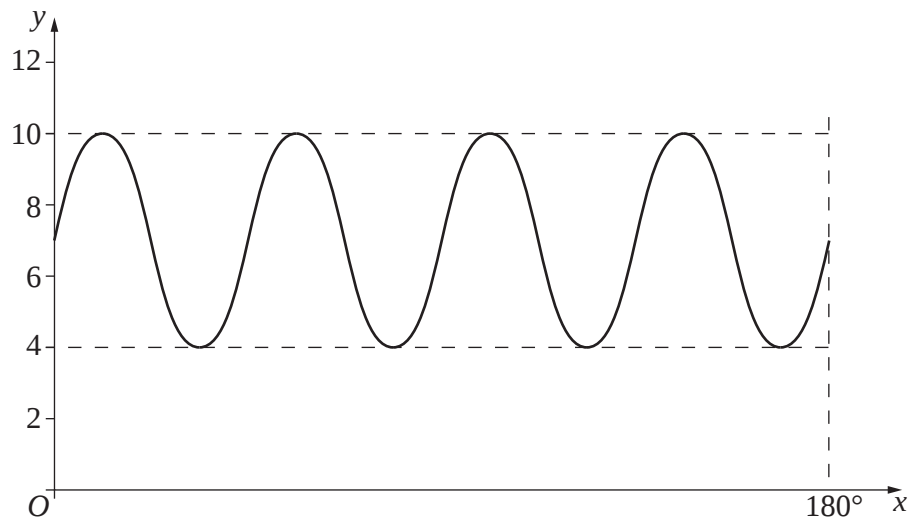
$$\begin{aligned} 4x - 3y &= -10, \\ 2x + 5y &= 21. \end{aligned}$$

[2]

- 2 A cuboid has a square base of side $(2 + \sqrt{3})$ cm and a volume of $(16 + 9\sqrt{3})$ cm³. Without using a calculator, find the height of the cuboid in the form $(a + b\sqrt{3})$ cm, where a and b are integers. [4]

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3 (a)

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The diagram shows a sketch of the curve $y = a\sin(bx) + c$ for $0^\circ \leq x \leq 180^\circ$. Find the values of a , b and c . [3]

(b) Given that $f(x) = 5\cos 3x + 1$, for all x , state

(i) the period of f , [1]

(ii) the amplitude of f . [1]

4 (i) Find $\frac{d}{dx}(x^2 \ln x)$.

[2]

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(ii) Hence, or otherwise, find $\int x \ln x \, dx$.

[3]

- 5 (a) Solve the equation $3^{2x} = 1000$, giving your answer to 2 decimal places.

[2]

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- (b) Solve the equation $\frac{36^{2y-5}}{6^{3y}} = \frac{6^{2y-1}}{216^{y+6}}$.

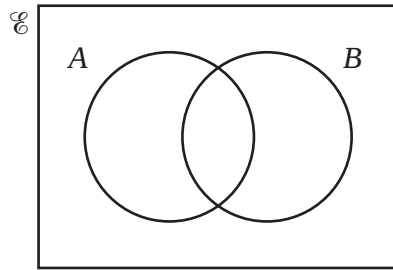
[4]

- 6 By shading the Venn diagrams below, investigate whether each of the following statements is true or false. State your conclusions clearly.

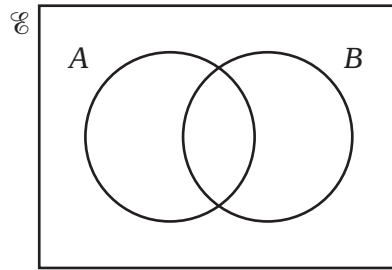
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(i) $A \cap B' = (A' \cap B)'$

[2]



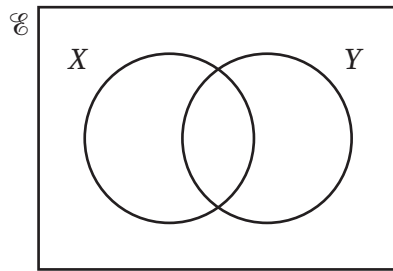
$A \cap B'$



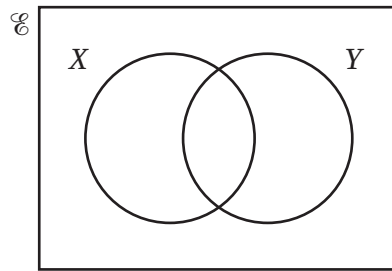
$(A' \cap B)'$

(ii) $X \cap Y = X' \cup Y'$

[2]



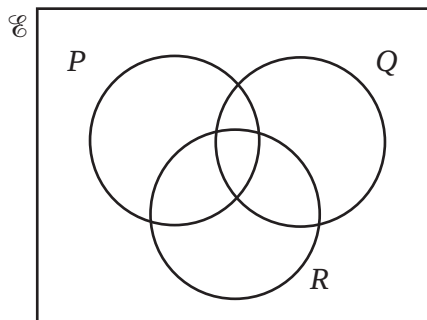
$X \cap Y$



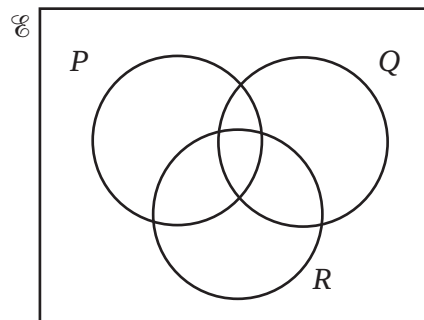
$X' \cup Y'$

(iii) $(P \cap Q) \cup (Q \cap R) = Q \cap (P \cup R)$

[2]



$(P \cap Q) \cup (Q \cap R)$



$Q \cap (P \cup R)$

7 Given that $f(x) = x^2 - \frac{648}{\sqrt{x}}$, find the value of x for which $f''(x) = 0$.

[6]

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- 8 Relative to an origin O , the position vectors of the points A and B are $2\mathbf{i} - 3\mathbf{j}$ and $11\mathbf{i} + 42\mathbf{j}$ respectively.

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- (i) Write down an expression for $\overrightarrow{AB}$. [2]

The point C lies on AB such that $\overrightarrow{AC} = \frac{1}{3}\overrightarrow{AB}$.

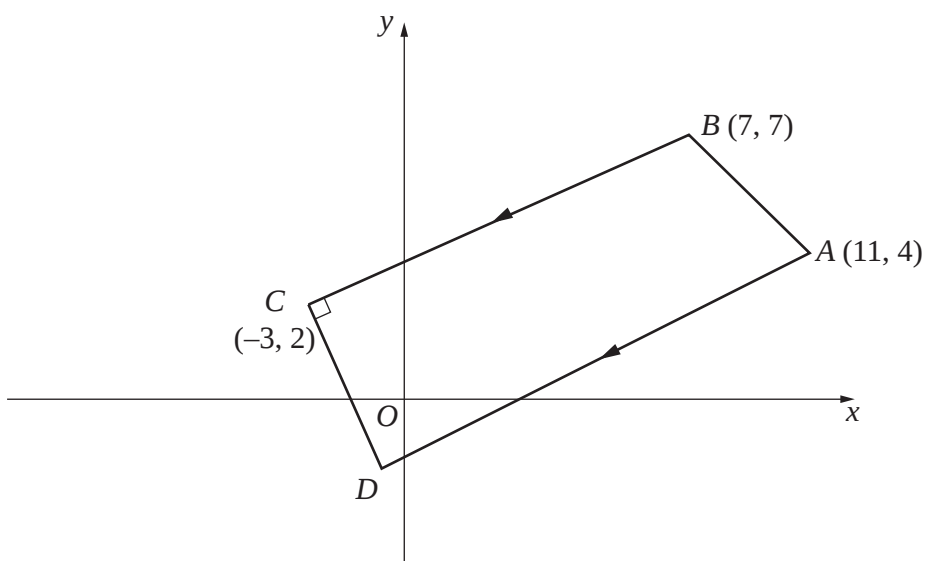
- (ii) Find the length of $\overrightarrow{OC}$. [4]

The point D lies on $\overrightarrow{OA}$ such that $\overrightarrow{DC}$ is parallel to $\overrightarrow{OB}$.

- (iii) Find the position vector of D . [2]

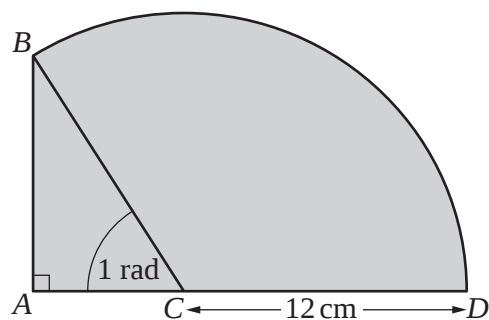
- 9 A particle moves in a straight line so that, t s after passing through a fixed point O , its velocity, $v \text{ ms}^{-1}$, is given by $v = 2t - 11 + \frac{6}{t+1}$. Find the acceleration of the particle when it is at instantaneous rest. [7]

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10 Solutions to this question by accurate drawing will not be accepted.*For
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Use*

The diagram shows a trapezium $ABCD$ with vertices $A(11, 4)$, $B(7, 7)$, $C(-3, 2)$ and D . The side AD is parallel to BC and the side CD is perpendicular to BC . Find the area of the trapezium $ABCD$. [9]

11

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The diagram shows a right-angled triangle ABC and a sector $CBDC$ of a circle with centre C and radius 12 cm. Angle $ACB = 1$ radian and ACD is a straight line.

(i) Show that the length of AB is approximately 10.1 cm. [1]

(ii) Find the perimeter of the shaded region. [5]

(iii) Find the area of the shaded region. [4]

12 Answer only **one** of the following two alternatives.

EITHER

The equation of a curve is $y = 2x^2 - 20x + 37$.

(i) Express y in the form $a(x + b)^2 + c$, where a , b and c are integers. [3]

(ii) Write down the coordinates of the stationary point on the curve. [1]

A function f is defined by $f : x \mapsto 2x^2 - 20x + 37$ for $x > k$. Given that the function $f^{-1}(x)$ exists,

(iii) write down the least possible value of k , [1]

(iv) sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$ on the axes provided, [2]

(v) obtain an expression for f^{-1} . [3]

OR

A function g is defined by $g : x \mapsto 5x^2 + px + 72$, where p is a constant. The function can also be written as $g : x \mapsto 5(x - 4)^2 + q$.

(i) Find the value of p and of q . [3]

(ii) Find the range of the function g . [1]

(iii) Sketch the graph of the function on the axes provided. [2]

(iv) Given that the function h is defined by $h : x \mapsto \ln x$, where $x > 0$, solve the equation $gh(x) = 12$. [4]

Start your answer to Question 12 here.

Indicate which question you are answering.

EITHER	
OR	

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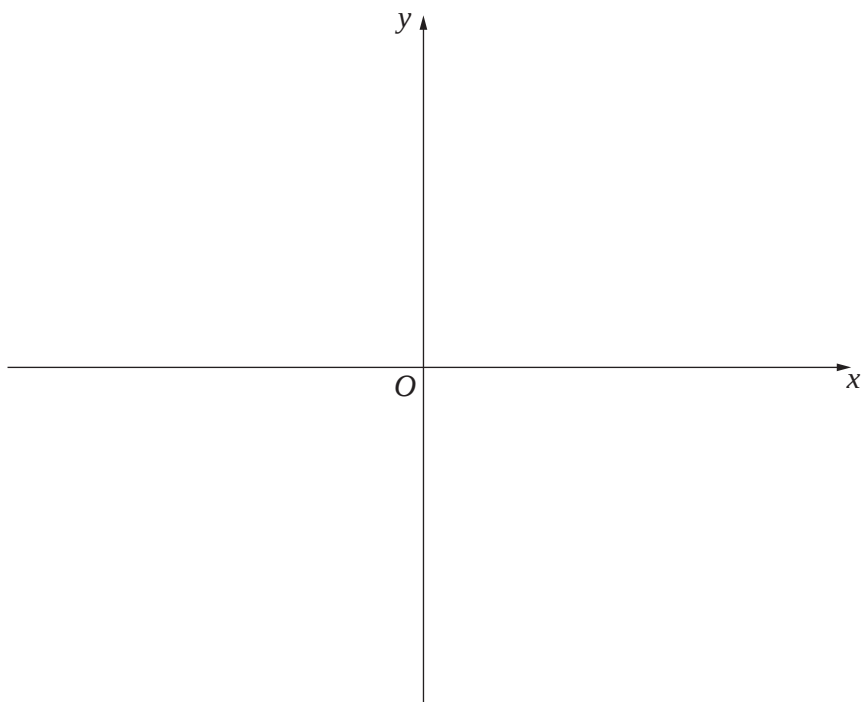
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Continue your answer here if necessary.

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