AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

Level 2 Certificate in Further Mathematics
FURTHER MATHEMATICS

Level 2 Paper 2 Calculator

Friday 24 June 2016 Morning Time allowed: 2 hours

Materials

For this paper you must have:
- a calculator
- mathematical instruments.

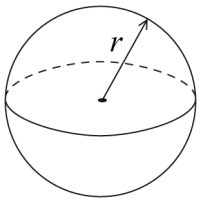
Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 105.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.
- The use of a calculator is expected but calculators with a facility for symbolic algebra must **not** be used.

Formulae Sheet

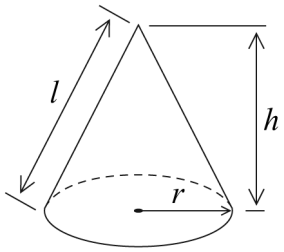
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



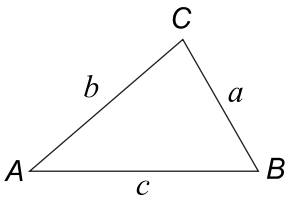
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$



In any triangle ABC

Area of triangle $= \frac{1}{2}ab\sin C$



Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

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

The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$, where $a \neq 0$, are given by

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

Trigonometric Identities

$\tan\theta \equiv \dfrac{\sin\theta}{\cos\theta}$ $\qquad \sin^2\theta + \cos^2\theta \equiv 1$

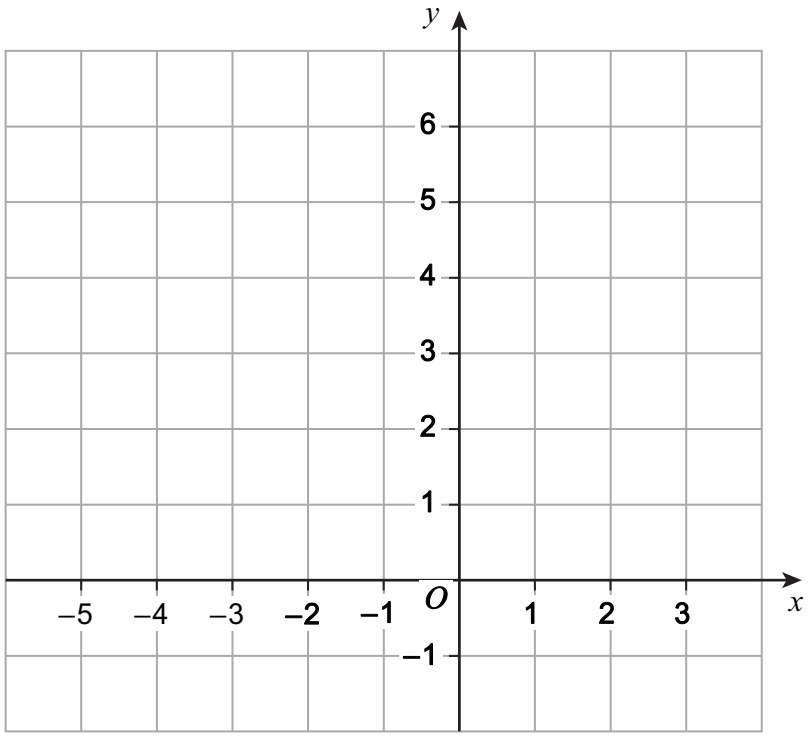
Answer **all** questions in the spaces provided.

1 A triangle has vertices

$A(2, 5)$ $B(2, 0)$ and $C(-4, 3)$

Work out the area of triangle ABC.
You may use the grid to help you.

[3 marks]

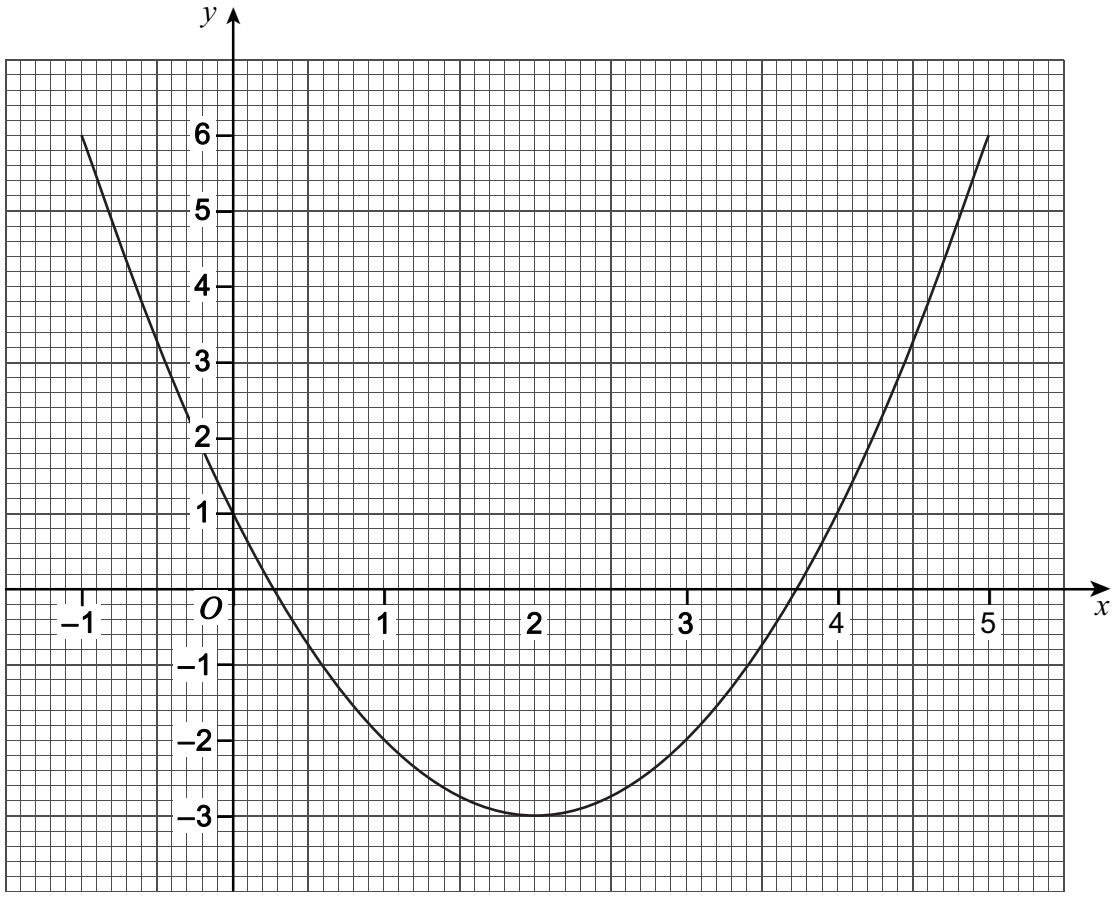


Answer _____ square units

3

2 The function $f(x) = x^2 - 4x + 1$ has domain $-1 \leqslant x \leqslant 5$

Here is the graph of $y = f(x)$



2 (a) Write down the equation of the line of symmetry of the graph.

[1 mark]

Answer _____

2 (b) Use the graph to work out the solutions of $x^2 - 4x + 1 = 5$

Give your answers to 1 decimal place.

[2 marks]

Answer _____

2 (c) Write down the range of f(x) for domain $-1 \leqslant x \leqslant 5$

[2 marks]

Answer _____

3 L is a straight line with equation $ax + by = c$
where a, b and c are non-zero integers.

3 (a) At which point does L intersect the x-axis?
Circle your answer.

[1 mark]

$\left(\frac{a}{c}, 0\right)$ $\left(\frac{c}{a}, 0\right)$ $\left(\frac{b}{c}, 0\right)$ $\left(\frac{c}{b}, 0\right)$

3 (b) What is the gradient of a line parallel to L?
Circle your answer.

[1 mark]

$-\frac{b}{a}$ $\frac{b}{a}$ $-\frac{a}{b}$ $\frac{a}{b}$

7

4 Work out the point of intersection of the lines

$2x + 3y = 11$ and $2y = 13 - 3x$

[4 marks]

Answer (_____ , _____)

5 a, b and c are numbers such that

$$a < 0$$
$$b > 1$$
$$-1 < c < 1$$

Tick the correct box for each statement.

	Always true	Sometimes true	Never true
$a^3 < 0$	☐	☐	☐
$b < 10a^2$	☐	☐	☐
$ab > 0$	☐	☐	☐
$b - c > 1$	☐	☐	☐

[4 marks]

Turn over for the next question

6 For the curve $y = f(x)$,

$$\frac{dy}{dx} = \frac{3}{2}x - kx^4 + k$$ where k is a constant.

When $x = -2$ the gradient of the curve is 12

Work out the value of k.

[3 marks]

Answer _____

7 Simplify fully $\left(\frac{2}{3}x^3y\right)^3$

[2 marks]

Answer _____

8 $D(-6, 4)$ and $E(-2, 9)$ are joined by a straight line.

P is a point on DE.
$DP : PE = 3 : 5$

Work out the coordinates of P.

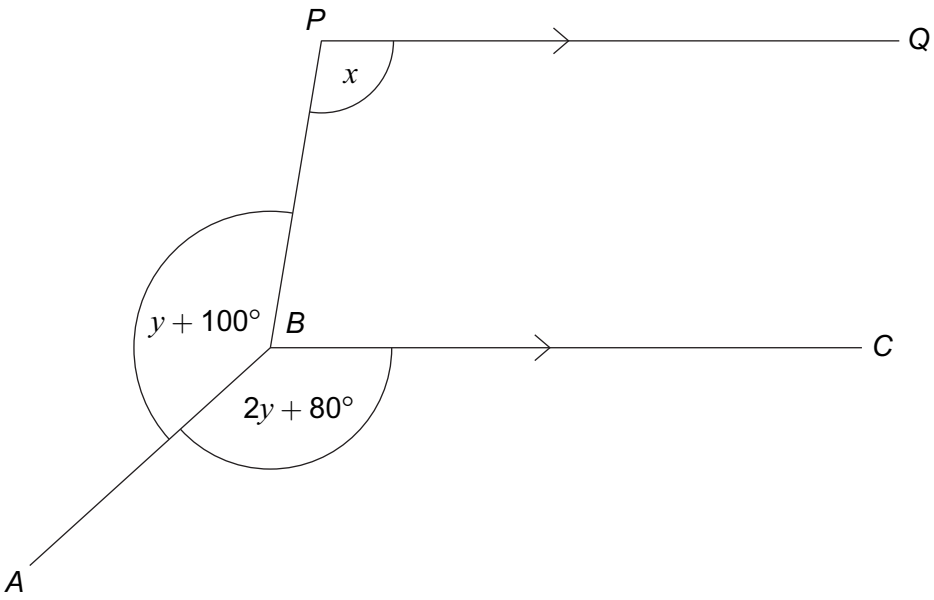
[3 marks]

Answer (_____ , _____)

8

9 *PQ* is parallel to *BC*.

Not drawn accurately



Prove that $x = 3y$

[4 marks]

10 (a) Simplify $\dfrac{x^2 - 7x + 10}{x^2 - 2x - 15}$

[2 marks]

Answer _____

10 (b) Factorise fully $w^5x^3y^2 + w^2x^6y^3$

[2 marks]

Answer _____

Turn over for the next question

8

11 The x^2 term in the expansion of $(3x + 4)(x^2 + px + 5)$ is $-23x^2$

Work out the value of p.

[3 marks]

Answer _____

12 Here are the first four terms of linear sequences *X* and *Y* and quadratic sequence *Z*.

Sequence *X*	7	9	11	13	....
Sequence *Y*	2	5	8	11	....
Sequence *Z*	14	45	88	143	....

12 (a) Work out the nth term of sequence *X*.

[2 marks]

Answer _____

12 (b) The nth term of sequence Y is $3n - 1$

Using your answer to part **(a)**, or otherwise, work out the nth term of sequence Z.
Give your answer in the form $an^2 + bn + c$ where a, b and c are integers.

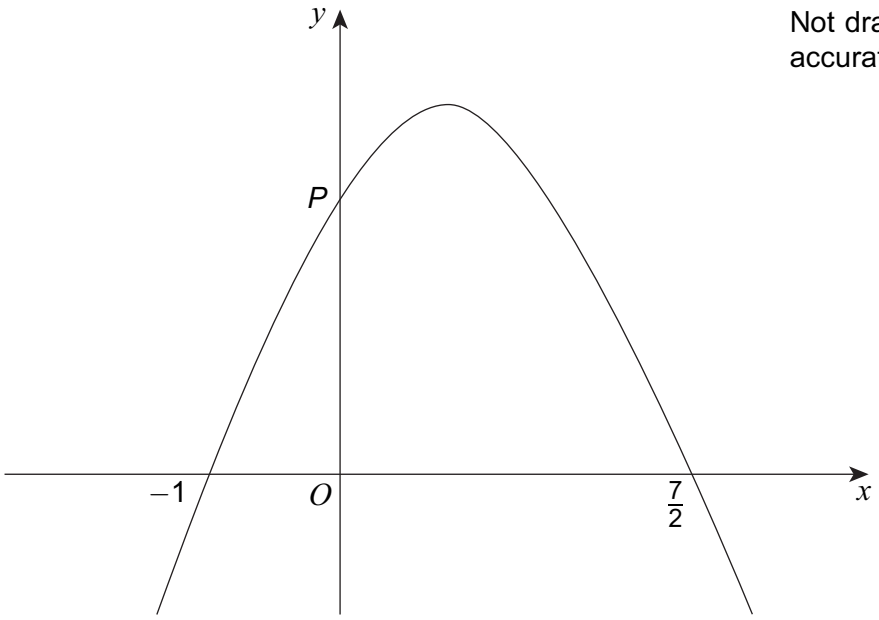
[3 marks]

Answer _____

8

13 Here is a sketch of $y = a + bx - 2x^2$ where a and b are constants.

The graph intersects the x-axis at $(-1, 0)$ and $\left(\frac{7}{2}, 0\right)$ and the y-axis at point P.



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Work out the coordinates of point P.
You **must** show your working.

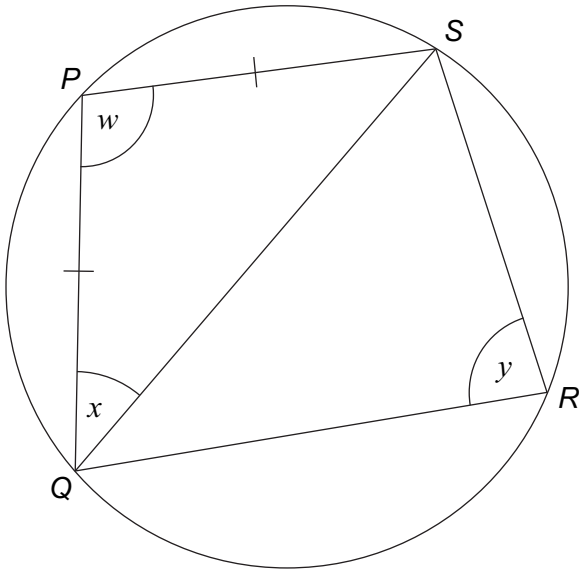
[4 marks]

Answer (_____ , _____)

14 *P*, *Q*, *R* and *S* are points on the circumference of a circle.

$w : y = 7 : 5$

$PQ = PS$



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Work out the size of angle x.

[4 marks]

Answer _____ degrees

8

15 (a) Solve $\frac{2}{5}\sqrt{x} = 1$

[2 marks]

$x =$ _____

15 (b) Solve $x^3 = 5x^2$

[2 marks]

Answer _____

16 Rearrange $y = \dfrac{8(w - x)}{x}$ to make x the subject.

[4 marks]

Answer _____

Turn over for the next question

8

17 A cylinder has base radius x cm and height y cm

A hemisphere has radius $6y$ cm

The cylinder and hemisphere have equal volumes.

Work out the value of $\frac{x}{y}$

You **must** show your working.

[3 marks]

Answer _____

18 Angle y is acute.

$$\tan y = \frac{p+1}{p-1}$$ where p is a constant greater than 1

18 (a) Which of the statements below is correct?
Circle your answer.

[1 mark]

$y = 45°$ $y < 45°$ $y > 45°$ y could be any acute angle

18 (b) Work out the expression for $\sin y$

Give your answer in the form $\frac{ap+b}{\sqrt{cp^2+d}}$ where a, b, c and d are integers.

You may use a diagram to help you.

[4 marks]

Answer _____

8

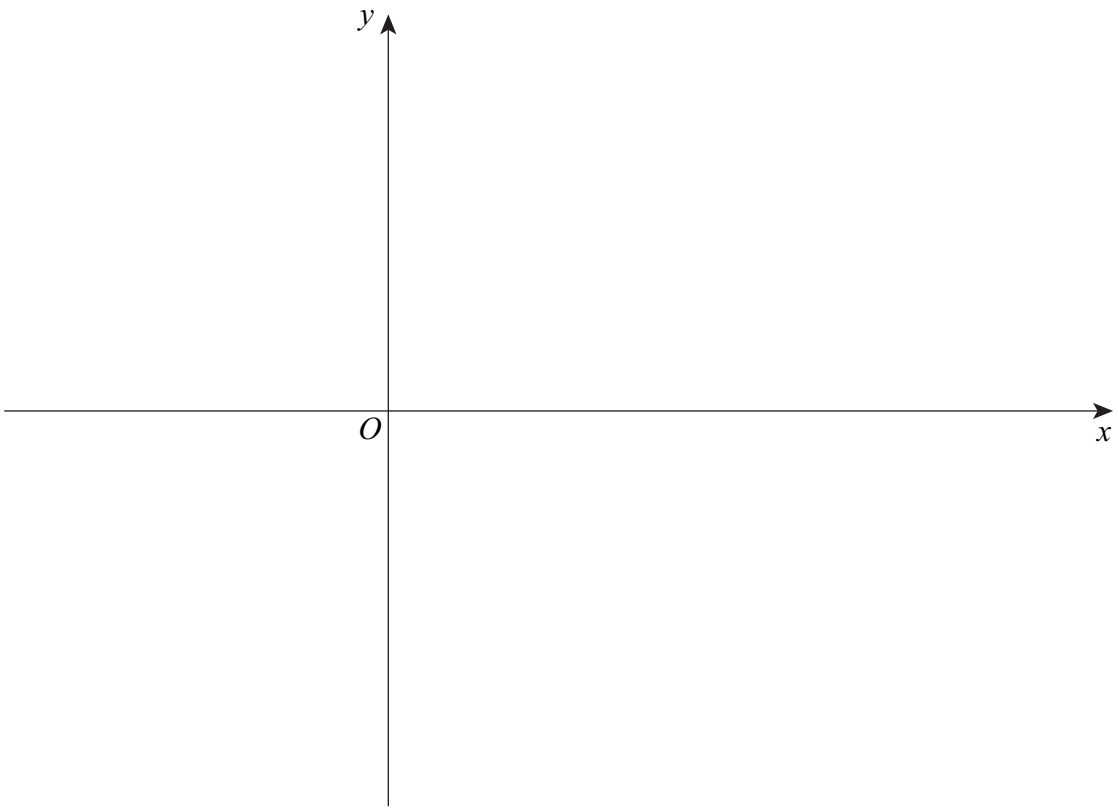
19 The continuous curve $y = g(x)$ has exactly two stationary points.

The stationary points are

- a point of inflection at $P(1, 2)$
- a minimum point at $Q(a, b)$ where $a > 1$ and $b < 0$

On the axes below, sketch the curve.
Label points P and Q on your sketch.

[3 marks]



20 Under the transformation represented by $\begin{pmatrix} -1 & -3 \\ 2 & 4 \end{pmatrix}$,

the image of point $P(a, 2)$ is point Q.

Can point Q be the same as point P?
You **must** show your working.

[4 marks]

Turn over for the next question

7

21 Solve $\dfrac{3}{x-2}+\dfrac{2}{x-1}=5$

Do **not** use trial and improvement.
Write your solutions to 3 significant figures.

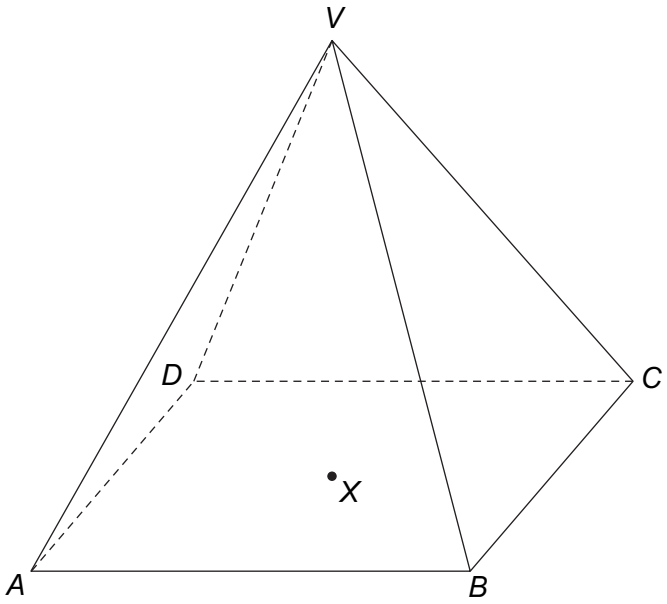
[6 marks]

Answer _____

22 Pyramid *VABCD* has a horizontal rectangular base.

X is the centre of the base.
V is vertically above *X*.

$VB = VC = 17\,\text{cm}$ $AB = 22\,\text{cm}$ $BC = 16\,\text{cm}$



Work out the angle between the planes *VBC* and *ABCD*.

[4 marks]

Answer _____ degrees

10

Turn over ▶

23 Shape *A* maps to shape *B* by an enlargement, scale factor 3, centre the origin.
Shape *B* maps to shape *C* by a rotation through 180°, centre the origin.

Shape *A* can be mapped to shape *C* by a **single** transformation.

Use matrices to show that the single transformation is an enlargement, centre the origin.
State the scale factor of the enlargement.

[5 marks]

24 $f(x) = \dfrac{x}{2x+1}$ for positive values of x.

Work out $f(x+1) - f(x)$

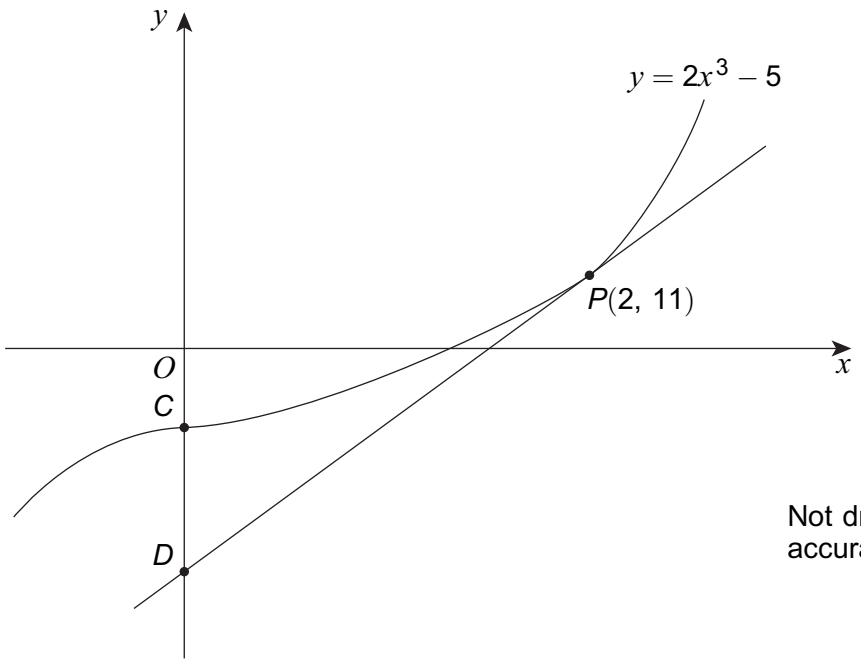
Give your answer as a fraction in its simplest form.
You **must** show your working.

[5 marks]

Turn over for the next question

25 The curve $y = 2x^3 - 5$ intersects the y-axis at C.

The tangent to the curve at $P(2, 11)$ intersects the y-axis at D.



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Work out the length CD.

[6 marks]

Answer _____ units

26 (a) Prove that $\sin^2 x - 3\cos^2 x \equiv 4\sin^2 x - 3$

[2 marks]

26 (b) Hence, or otherwise, work out the values of x between 0° and 360° for which

$$\sin^2 x - 3\cos^2 x = 0$$

[4 marks]

Answer _____

END OF QUESTIONS

12

There are no questions printed on this page

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