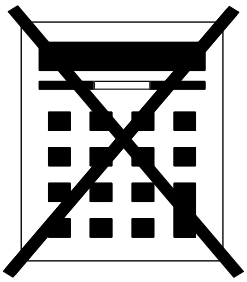
Candidate surname	Other names

BennettMaths
Engaging Learners

Practice Paper – Level 2 Certificate

FURTHER MATHEMATICS



AQA

Materials
For this paper you must have:
- mathematical instruments
- the Formulae Sheet (enclosed).

You must **not** use a calculator.

Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- 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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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 80.
- You may ask for more graph paper and tracing paper. These must be tagged securely to this answer book.

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

Do not write outside the box

1 Work out the value of $\sqrt{\frac{t}{40}}$ where $t = 3.24 \times 10^3$

[2 marks]

$\sqrt{\frac{3240}{40}} = \sqrt{81}$

$= \pm 9$

Answer _____

2 $5n^2 + 2 < 47$

Work out all the possible **integer** values of n.

$5n^2 < 45$

$n^2 < 9$

$n < \pm 3$

$-3 < n < 3$

$-2, -1, 0, 1, 2$

[2 marks]

Do not write outside the box

3 The equations of two straight lines are

$$y + 3x = 4 \quad \text{and} \quad 18y = 6x - 5$$

Show that the lines are perpendicular.

[2 marks]

$y = -3x + 4$ $\quad y = \frac{1}{3}x - \frac{5}{18}$

$-3 \times \frac{1}{3} = -1$

Do not write outside the box

4 $y = \dfrac{8x^2 - x^9}{x^5}$

Work out $\dfrac{dy}{dx}$

[3 marks]

$8x^{-3} - x^4$

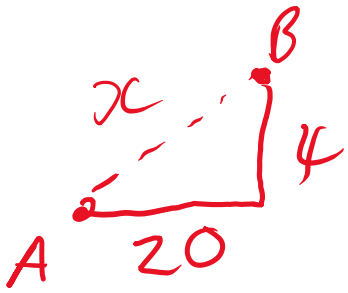
$-24x^{-4} - 4x^3$

$\dfrac{dy}{dx} =$ _____

5 Points *A* (–10, 2) and *B* (10, –2) lie on a circle.

AB is a diameter of the circle.

Work out the equation of the circle.



[3 marks]

$4^2 + 20^2 = x^2$

$16 + 400 = x^2$

$416 = x^2$

$\sqrt{416} = x$

$\sqrt{416} = 4\sqrt{26}$

$r = 2\sqrt{26}$

$r^2 = 104$

Answer $x^2 + y^2 = 104$

Do not write outside the box

6 $\begin{pmatrix} c & 1 \\ 5d & 3 \end{pmatrix}\begin{pmatrix} -2 & 0 \\ 7 & 3 \end{pmatrix} = \begin{pmatrix} -5 & 3 \\ 0 & 9 \end{pmatrix}$

Work out the values of c and d.

[3 marks]

$c \times -2 + 1 \times 7 = -5$

$-2c + 7 = -5$

$-2c = -12$

$c = 6$

$5d \times -2 + 3 \times 7 = 0$

$-10d + 21 = 0$

$-10d = -21$

$c =$ 6 $d =$ 2.1

Do not write outside the box

7 $f(x) = 2x^3 + 13x^2 + 13x - 10$

[2 marks]

$x = -2$

(a) Use factor theorem to show that $(x + 2)$ is a factor of $f(x)$

$2(-2)^3 + 13(-2)^2 + 13(-2) - 10$

$-16 + 52 - 26 - 10 = 0$

(b) Hence, or otherwise, fully factorise $2x^3 + 13x^2 + 13x - 10$ **[3 marks]**

X	$2x^2$	$9x$	-5
x	$2x^3$	$9x^2$	$-5x$
$+2$	$4x^2$	$18x$	-10

$(2x^2 + 9x - 5)(x + 2)$

$x = -10$

$+ = 9 \quad -10$

$10, -1$ $\quad 2x^2 + 10x - 1x - 5$

$2x(x + 5) - 1(x + 5)$

$(2x - 1)(x + 5)(x + 2)$

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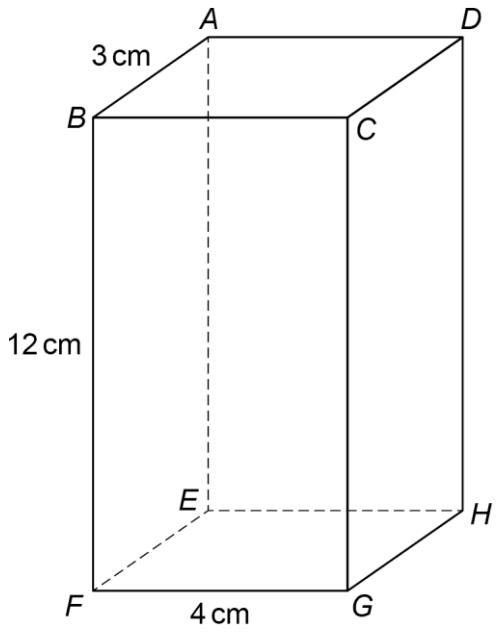
8 *ABCDEFGH* is a cuboid.



Work out the length *FD*.

[3 marks]

$\sqrt{3^2+4^2+12^2}$

$\sqrt{169} = 13$

FD = 13 cm

Do not write outside the box

9 $y = \frac{1}{2}x^2 + \frac{3}{4x^4}$

$\frac{3}{4x^4} = \frac{3}{4}x^{-4}$

Work out $\frac{d^2y}{dx^2}$

Give your answer in the form $a + bx^n$ where a, b and n are integers.

[3 marks]

$\frac{dy}{dx} = x - 3x^{-5}$

$\frac{d^2y}{dx^2} = 1 + 15x^{-6}$

Answer _____

10 A set of 4-digit integers each have

a first digit **greater than** 6 7, 8, 9

and

a second digit **less than** 5 1, 2, 3, 4, 0

What is the greatest possible number of integers in the set that are multiples of 5?

[3 marks]

$3 \times 5 \times 10 \times 2 = 300$

Answer _____

11 A function f is given by

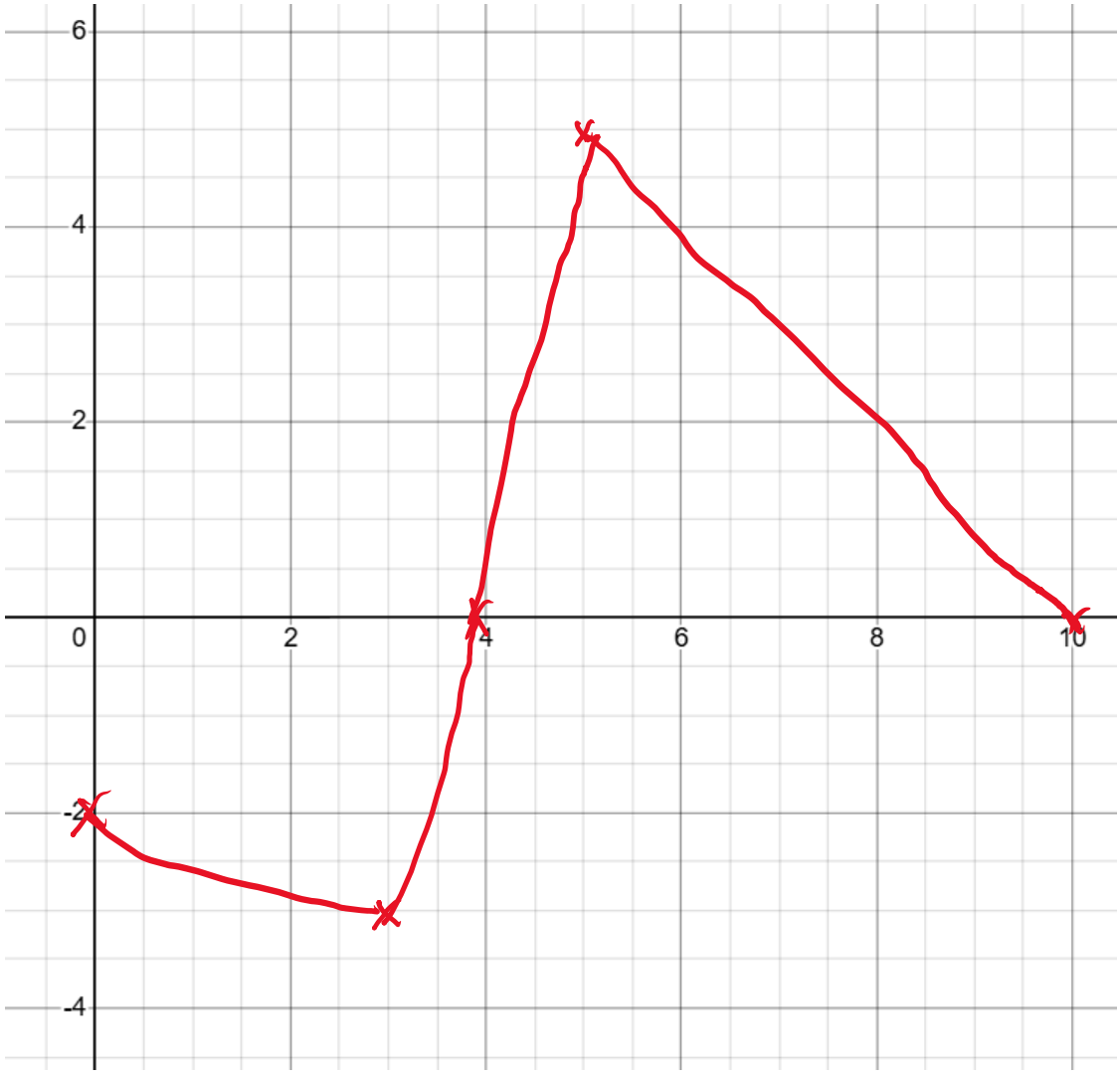
$$f(x) = -\frac{1}{3}x - 2 \qquad 0 \leqslant x \leqslant 3$$

$$= x^2 - 4x \qquad 3 < x \leqslant 5$$

$$= 10 - x \qquad 5 < x \leqslant 10$$

[4 marks]

Draw a sketch of $y = f(x)$



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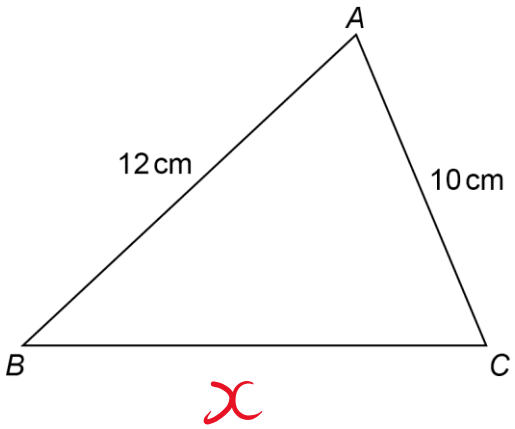
12 In triangle ABC, $\cos A = \frac{1}{2}$



Not drawn accurately

Work out the length BC. Giving your answer in the form $a\sqrt{31}$

[4 marks]

$x^2 = 12^2 + 10^2 - 2 \times 12 \times 10 \times \frac{1}{2}$

$x^2 = 144 + 100 - 120$

$x^2 = 124$

$x = \sqrt{124} = 2\sqrt{31}$

Answer _____ cm

13 Expand and simplify fully $(2x - 1)(4 - x)(3x + 5)$

[3 marks]

Do not write outside the box

$8x - 2x^2 - 4 + x$

$(-2x^2 + 9x - 4)(3x + 5)$

$-6x^3 - 10x^2 + 27x^2 + 45x$

$-12x - 20$

Answer $-6x^3 + 17x^2 + 33x - 20$

Do not write outside the box

14 (a) Write $2x^2 - 12x + 7$ in the form $k(x + m)^2 + n$ where k, m and n are integers.

[3 marks]

$2\left[x^2 - 6x + \frac{7}{2}\right]$

$2\left[(x-3)^2 + \frac{7}{2} - 9\right]$

$2\left[(x-3)^2 - 5.5\right]$

$2(x-3)^2 - 11$

Answer _____

14 (b) Solve $(x - 2)^2 - 7 = 0$

[1 mark]

$(x-2)^2 = 7$

$x - 2 = \pm\sqrt{7}$

$x = 2 \pm \sqrt{7}$

Answer _____

Do not write outside the box

15 (a) Matrix **H** represents a reflection in the line $y = -x$

Write down matrix **H**

[1 mark]

$$\mathbf{H} = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$$

15 (b) $\mathbf{G} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Describe geometrically the single transformation represented by $\mathbf{G}^2$

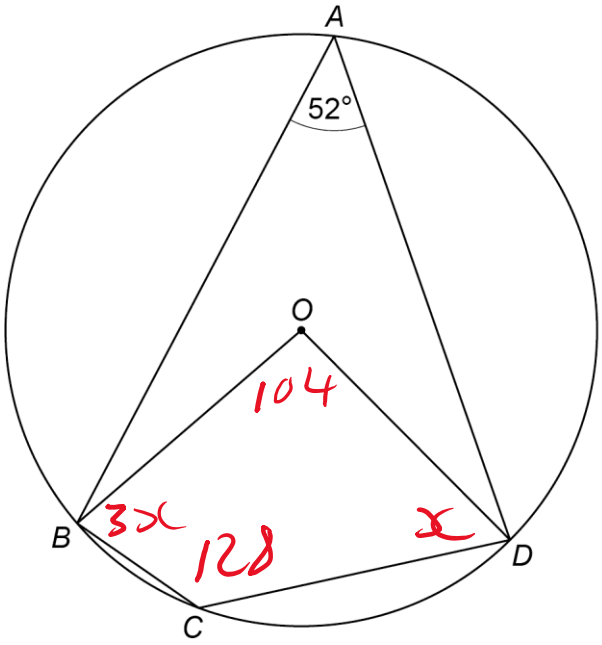
[2 marks]

Rotation 180°

Do not write outside the box

16 *A*, *B*, *C* and *D* are points on a circle, centre *O*.

angle *OBC* : angle *ODC* = 3 : 1



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Work out the size of angle *OBC*.

You **must** show your working.

[4 marks]

$52 \times 2 = 104$

$180 - 52 = 128$

$3x + x + 128 + 104 = 360$

$4x + 232 = 360$

$4x = 128$

$x = 32$

Answer 96 °

17 Show that $\frac{21x}{3x^2-4x-4} - \frac{7}{x-2}$ simplifies to $\frac{p}{3x^2-4x-4}$ where p is an integer.

[3 marks]

$\times(3x+2)$

$\times(3x+2)$

$21x - (21x+14) = -14$

-14

$3x^2-4x-4$

Do not write outside the box

18 Rationalise the denominator and simplify fully

$$\frac{4\sqrt{6}+\sqrt{3}}{\sqrt{6}-\sqrt{3}}$$

[4 marks]

$$\times \frac{\sqrt{6}+\sqrt{3}}{\sqrt{6}+\sqrt{3}}$$

$$\frac{(4\sqrt{6}+\sqrt{3})(\sqrt{6}+\sqrt{3})}{(\sqrt{6}-\sqrt{3})(\sqrt{6}+\sqrt{3})} = \frac{24+4\sqrt{18}+\sqrt{18}+3}{6-3}$$

$$\frac{27+5\sqrt{18}}{3} = \frac{27+15\sqrt{2}}{3}$$

Answer $9+5\sqrt{2}$

Do not write outside the box

19 Rearrange $m = \dfrac{2k^3 - 7}{5m - 3k^3}$ to make k the subject.

[4 marks]

$5m^2 - 3k^3m = 2k^3 - 7$

$5m + 7 = 2k^3 + 3k^3m$

$5m + 7 = k^3(2 + 3m)$

$k^3 = \dfrac{5m + 7}{2 + 3m}$

$k = \sqrt[3]{\dfrac{5m + 7}{2 + 3m}}$

Answer _____

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20 The equation of a curve is $y = -x^3 + 12x^2 - 36x$

Work out the stationary points of the curve and determine their nature.

You **must** show your working.

[6 marks]

$\frac{dy}{dx} = -3x^2 + 24x - 36$

$-3x^2 + 24x - 36 = 0$

$x^2 - 8x + 12 = 0$

$(x-6)(x-2) = 0$

$x = 6 \quad x = 2$

$-(6)^3 + 12(6)^2 - 36(6)$

$-216 + 432 - 216 = 0$

$-(2)^3 + 12(2)^2 - 36(2)$

$-8 + 48 - 72 = -32$

Stationary point (6 , 0) Nature max

Stationary point (2 , -32) Nature min

$\frac{d^2y}{dx^2} = -6x + 24$

$-6(6) + 24 = -12$

$-6(2) + 24 = 12$

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21 $(2^{x+2})^{4x+1} = 4^{x+2}$

Work out the possible values of x.

[5 marks]

$2^{4x^2+9x+2} = (2^2)^{x+2}$

$2^{4x^2+9x+2} = 2^{2x+4}$

$4x^2+9x+2 = 2x+4$

$4x^2+7x-2 = 0$

-8

$x=-8$

$+=7$

$8,-1$

Answer _____

$4x^2+8x-1x-2$

$4x(x+2) -1(x+2)$

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

$x = \frac{1}{4}$ $x = -2$

22 Prove $sin^2x - cos^2x \equiv 1 - 2cos^2x$

[2 marks]

$\sin^2x = 1 - \cos^2x$

$1 - \cos^2x - \cos^2x = 1 - 2\cos^2x$

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23 Solve the simultaneous equations

[5 marks]

$$x - y + 3z = 5$$
$$x + y + 6z = 12$$
$$3x - 2y + 2z = 10$$

$y = -x - 6z + 12$

$2x + 9z = 17$

$5x + 14z = 34$

$10x + 45z = 85$

$-\ 10x + 28z = 68$

$17z = 17$

$z = 1$

$2x + 9 = 17$

$2x = 8$

$x = 4$

$4 + y + 6 = 12$

$y = 2$

$x =$ 4 $y =$ 2 $z =$ 1 .

END OF QUESTIONS