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# CFE National 5 Resource

Unit 1

Expressions and Formulae

Homework Exercises

❖ **Homework exercises covering all the Unit 1 topics**
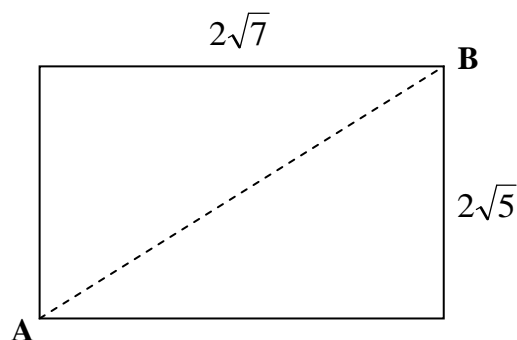
❖ **+ Answers**

❖ **+ Marking Schemes**

National 5 Homework – Expressions and Formulae

SURDS

1. Simplify   **(a)** $\sqrt{147} - 5\sqrt{3}$ **(b)** $\sqrt{2}(\sqrt{3} + \sqrt{2}) - \sqrt{6}$ **(2,2)**

2. Express $2\sqrt{5} + \sqrt{20} - \sqrt{45}$ as a surd in its simplest form.   **(2)**

3. Express with a rational denominator $\dfrac{5}{2\sqrt{3}}$ **(2)**

4. Express as a fraction with a rational denominator $\dfrac{5}{4 - \sqrt{3}}$ **(3)**

5. In the rectangle ABCD, the diagonal AC is 8cm and the height BC is 4cm.
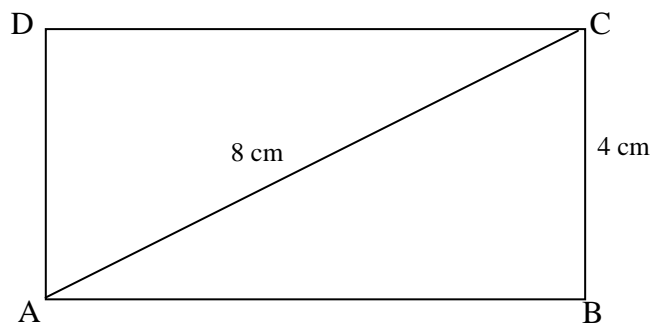
   (a) Calculate the length of the rectangle, giving your answer as a surd in its simplest form.   **(3)**
   (b) Calculate the area of triangle ABC.   **(2)**

6. Find the length of the diagonal, AB, of this rectangle leaving your answer as a surd in its simplest form.

(4)

20 marks

National 5 Homework – Expressions and Formulae

INDICES

1.   Simplify $\dfrac{m^5}{m^3}$ **(1)**

2.   Simplify the expression below, giving your answer with a positive power.

$$m^5 \times m^{-8}$$ **(2)**

3.   Express

$$p^3(p^2 - p^{-3})$$ in its simplest form.   **(2)**

4.   Simplify

$$\dfrac{3a^2 \times 2a}{a^2}$$ **(3)**

5.   Express in its simplest form

$$\dfrac{y^4 \times y}{y^{-2}}$$ **(2)**

6.   Evaluate $16^{\frac{3}{4}}$ **(2)**

7.   Simplify, expressing your answer with positive indices.

$$(x^2 y^4) \div (x^{-3} y^6)$$ **(2)**

8.   Simplify

$$k^8 \times (k^2)^{-3}$$ **(2)**

9.   Express $a^{\frac{2}{3}}(a^{\frac{2}{3}} - a^{-\frac{2}{3}})$ in its simplest form.   **(2)**

10.   Express $a^{\frac{1}{2}}(a + \dfrac{1}{a})$ in its simplest form.   **(2)**

20 marks

SCIENTIFIC NOTATION / SIGNIFICANT FIGURES

1.   Write the numbers in each of these sentences in standard form.

    (a)   The mass of the moon is about 79 250 000 000 000 000 000 000 kg   **(2)**

    (b)   The relative density of hydrogen is 0·000 089 9   **(2)**

2.   Write the numbers in each of these sentences in full.

    (a)   The number of seconds in a decade is about $3 \cdot 2 \times 10^{8}$ **(1)**

    (b)   The size of a molecule of water is roughly 1×10^{-3} **(1)**

3.   Calculate each of the following, giving your answers in standard form.

    (a) $(4 \cdot 2 \times 10^{10}) \times (3 \times 10^{-2})$ **(b)** $\dfrac{4 \cdot 2 \times 10^{5}}{8 \times 10^{-1}}$

    (c) $\dfrac{(3 \cdot 2 \times 10^{2}) \times (4 \cdot 5 \times 10^{-3})}{3 \times 10^{-6}}$ **(2, 2, 2)**

4.   The Earth is 93 million miles from the sun, which is one astronomical unit (AU).
The distance from the sun to Jupiter is 5·2 AU.
Calculate the distance in miles from the sun to Jupiter and give your answer
in standard form.   **(2)**

5.   A company's profit for the year was £$1 \cdot 2 \times 10^{8}$.
Calculate the profit made per day, giving your answer to the nearest £.   **(2)**

6.   Use your calculator to find the following. Answer correct to 3 significant figures

    (a) $8 \cdot 4 \div (9 \cdot 6 - 5 \cdot 7)$ **(b)** $20 \times (2 \cdot 1 \div 5 \cdot 9)$

    (c) $\dfrac{58}{(1 \cdot 2 \times 14)}$ **(d)** $2500 \times 1 \cdot 045^{3}$ **(1, 1, 1, 1)**

20 marks

National 5 Homework – Expressions and Formulae

ALGEBRAIC EXPRESSIONS with BRACKETS

Multiply out the brackets and simplify in each question.

1. **(a)** $3(x + 7) + 2x$ **(b)** $16y - 5(2y + 3)$ **(c)** $7(s - 2) - 13$ **(3)**

2. **(a)** $x (x^3 + 2)$ **(b)** $3m (8 - m)$ **(c)** $2y^2(w - 5y)$ **(3)**

3. **(a)** $9(a + 5) + 7(2a + 7)$ **(b)** $7(y - 8) - 5(3y - 6)$ **(1, 2)**

4. **(a)** $(x + 4)(x + 7)$ **(b)** $(y - 9)(y - 3)$

    (c) $(s + 12)(s - 2)$ **(d)** $(2a + 5)(a + 9)$

    (e) $(3w - 8)(2w + 1)$ **(f)** $(4x - 3)^2$ **(1, 1, 1, 1, 1, 1)**

5. **(a)** $(x + 1)(x^2 + 1)$ **(2)**

    (b) $(x - 2)(2x^2 - 3x - 2)$ **(3)**

20 marks

FACTORISING an ALGEBRAIC EXPRESSION

Factorise each expression in the following:

1.   **(a)** $y^2 + 5y$ **(b)** $4x^2 - 49$ **(c)** $5s^2 - 20$ **(5)**

2.   **(a)** $x^2 + 10x + 25$ **(b)** $x^2 - 10x - 24$ **(c)** $k^2 + 5k - 6$ **(6)**

3.   **(a)** $12a^2 + 7a - 12$ **(b)** $7w^2 - 2w - 9$ **(c)** $4x^2 - 11x + 6$ **(6)**

4.   **(a)** $12x^2 + 16x + 4$ **(b)** $3m^2 - 6m - 9$ **(c)** $3 - 3x - 36x^2$ **(6)**

5.   **(a)** $x^5 - 81x$ **(b)** $a^2 + 3ab + 2b^2$ **(5)**

25 marks

National 5 Homework – Expressions and Formulae

COMPLETING the SQUARE

1. Write each of the following quadratic expressions in the form $a(x+b)^2 + c$:

    (a) $x^2 + 6x - 3$ **(b)** $x^2 - 5x + 1$

    (c) $4 + 8x - x^2$ **(d)** $1 - 6x - x^2$ **(2, 2, 2, 2)**

2. Show that the function $f(x) = x^2 - 16x + 7$ can be written in the
    form $f(x) = (x + p)^2 + q$ and write down the values of p and q.

    Hence state the minimum value of the function and the corresponding value of x.   **(4)**

12 marks

National 5 Homework – Expressions and Formulae

ALGEBRAIC FRACTIONS

1. Simplify:

    (a) $\dfrac{19}{57}$
    (b) $\dfrac{w^3}{w}$
    (c) $\dfrac{5x}{10}$
    (d) $\dfrac{12x^2}{36x}$

    (4)

2. Simplify:

    (a) $\dfrac{(2x+1)}{(2x+1)(2x-1)}$
    (b) $\dfrac{x^2+5x+6}{(x+3)}$
    (c) $\dfrac{x^2-x-6}{x^2+4x+4}$ **(1, 2, 3)**

3. Simplify:

    (a) $\dfrac{m}{5}+\dfrac{m}{4}$
    (b) $\dfrac{m+4}{2}+\dfrac{m-3}{5}$
    (c) $\dfrac{4}{x}-\dfrac{1}{x+3}$
    (d) $\dfrac{x+1}{x+2}+\dfrac{x-2}{x+1}$

    (1, 2, 2, 3)

4. Express each of the following in its simplest form.

    (a) $\dfrac{7}{3k}\times\dfrac{9k}{21}$
    (b) $\dfrac{3x}{5}\times\dfrac{2}{9x^2}$
    (c) $\dfrac{1}{a^2}\div\dfrac{2}{a}$
    (d) $\dfrac{2x}{y}\div\dfrac{4x^2}{3y}$
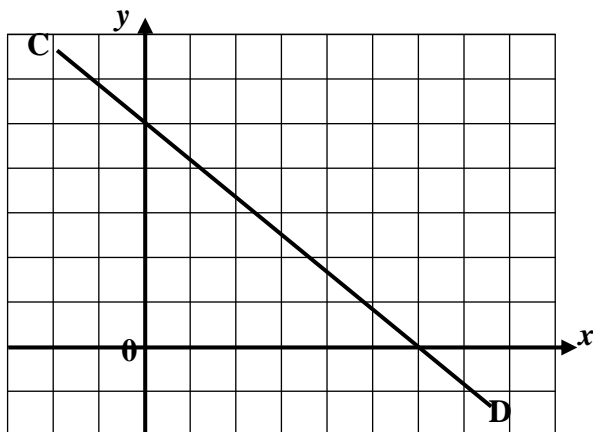
    (1, 2, 2, 2)

    25 marks

National 5 Homework – Expressions and Formulae

DETERMINING the GRADIENT of a STRAIGHT LINE given TWO POINTS

1. The line CD passes through the points (0, 5) and (6, 0)

   Calculate the gradient of CD. **(1)**

2. A line passes through the points A(−2, −4) and B(8, 1).

   Find the gradient of the line AB. **(2)**

3. Prove that the points A(0, −2), B(−4, 4) and C(6, −11) all lie on the same straight line. **(3)**

4. The points S(k, 3), T(10, 2) and U(−2, 5) are collinear. Find the value of k. **(4)**

5. Calculate the gradient of a line which is parallel to the line passing through F(3, −7) and G(−8, 2). **(2)**

6. The line which passes through (−4, 1) and (−7, −11) is parallel to the line through (2, y) and (−3, −3). Find the value of y. **(4)**

7. What is the gradient of the line perpendicular to the line with equation $y = 3x − 5$? **(1)**

8. The line which passes through (−2, 2) and (−6, −4) is perpendicular to the line through (4, b) and (−2, −2). Find the value of b. **(3)**
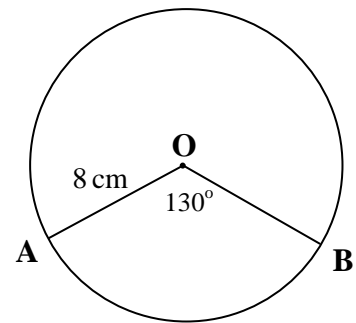
20 marks

National 5 Homework – Expressions and Formulae

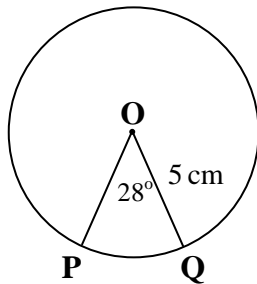## WORKING with the LENGTH of ARC and AREA of a SECTOR of a CIRCLE

Give your answers correct to 3 significant figures where necessary.

1. **(a)** Find the length of the minor arc AB in this circle. **(3)**

      (b) Calculate the area if the minor sector AOB. **(3)**
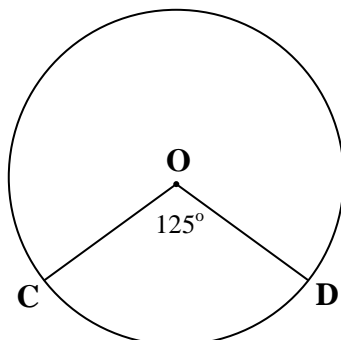
2. **(a)** Find the length of the major arc PQ in this circle. **(3)**

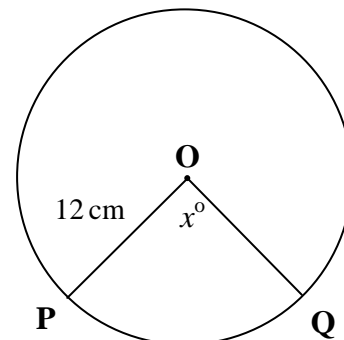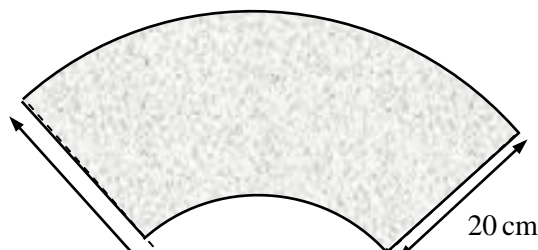   **(b)** Calculate the area of the major sector POQ. **(3)**

3. The length of arc CD is 8·8 cm. Calculate the circumference of the circle. **(2)**

4. The area of sector OPQ is 100 cm². Calculate the size of angle, x^o, to the nearest degree. **(2)**

5. Ornamental paving slabs are in the shape of part of a sector of a circle. Calculate the area of the slab shown. **(4)**
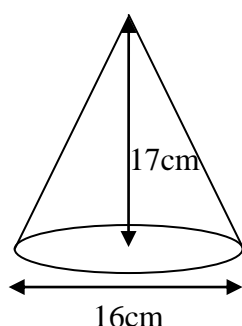
20 cm

National 5 Homework – Expressions and Formulae

WORKING with the VOLUME of a SOLID SPHERE, CONE, PYRAMID

Give your answers correct to 3 significant figures where necessary.

1.   A cone has a base diameter of 16cm and a height of 17cm.

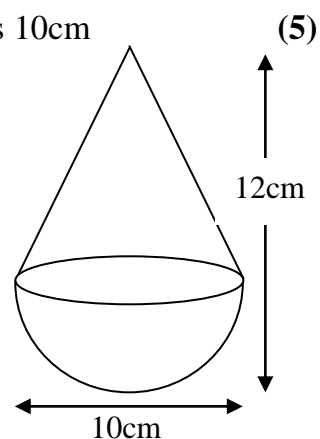Calculate the volume of the cone, giving your answer correct to 3 sig figs.

17cm

16cm

$$[\text{Volume of cone} = \frac{1}{3}\pi r^2 h]$$ **(3)**

2.   A lead sinker is in the shape of a cone with a hemispherical base.

The total height of the sinker is 12cm and the diameter of the base is 10cm   **(5)**

Calculate the volume of lead required to make the sinker.

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

12cm

10cm

3.   **(a)**   Calculate the volume of the largest sphere which will fit inside a cube of side 15cm.

        (b)   Calculate the volume of wasted space between the two. [Answer to nearest cm^3]

                                                            (2, 3)

4.   A pyramid has a square base of side 6cm and a vertical height of 9cm.

Calculate the volume of the pyramid correct to 2 significant figures. **(4)**

16 marks

ANSWERS

National 5 Homework – Expressions and Formulae

SURDS

1.   **(a)** $2\sqrt{3}$ **(b)** 2

2. $\sqrt{5}$ **3.** $\dfrac{5\sqrt{3}}{6}$

4. $\dfrac{5(4+\sqrt{3})}{13}$ **5.**   **(a)** $4\sqrt{3}$ **(b)** $8\sqrt{3}$

6. $4\sqrt{3}$

National 5 Homework – Expressions and Formulae

INDICES

1. m^2 **2.** $\dfrac{1}{m^3}$ **3.** $p^5 - 1$

4. $6a$ **5.** y^7 **6.** 8

7. $\dfrac{x^5}{y^2}$ **8.** k^2 **9.** $a^{\frac{4}{3}} - 1$ **10.** $a^{\frac{3}{2}} + a^{-\frac{1}{2}}$

National 5 Homework – Expressions and Formulae

SCIENTIFIC NOTATION / SIGNIFICANT FIGURES

1.   **(a)** $7 \cdot 925 \times 10^{22}$ **(b)** $8 \cdot 99 \times 10^{-5}$

2.   **(a)**   320 000 000   **(b)** $0 \cdot 001$

3.   **(a)** $1 \cdot 26 \times 10^9$ **(b)** $5 \cdot 25 \times 10^5$ **(c)** $4 \cdot 8 \times 10^5$

4. $4 \cdot 836 \times 10^8$ **5.**   £328 767

6.   **(a)** $2 \cdot 15$ **(b)** $7 \cdot 12$ **(c)** $3 \cdot 45$ **(d)**   2 850

National 5 Homework – Expressions and Formulae

ALGEBRAIC EXPRESSIONS with BRACKETS

1. (a) $5x + 21$ (b) $6y - 15$ (c) $7s - 27$

2. (a) $x^4 + 2x$ (b) $24m - 3m^2$ (c) $2y^2w - 10y^3$

3. (a) $23a + 94$ (b) $-8y - 26$

4. (a) $x^2 + 11x + 28$ (b) $y^2 - 12y + 27$ (c) $s^2 + 10s - 24$

   (d) $2a^2 + 23a + 45$ (e) $6w^2 - 13w - 8$ (f) $16x^2 - 24x + 9$

5. (a) $x^3 + x^2 + x + 1$ (b) $2x^3 - 7x^2 + 4x + 4$

National 5 Homework – Expressions and Formulae

FACTORISING an ALGEBRAIC EXPRESSION

1. (a) $y(y + 5)$ (b) $(2x - 7)(2x + 7)$ (c) $5(s - 2)(s + 2)$

2 (a) $(x + 5)(x + 5)$ (b) $(x - 12)(x + 2)$ (c) $(k + 6)(k - 1)$

3. (a) $(4a - 3)(3a + 4)$ (b) $(7w - 9)(w + 1)$ (c) $(4x - 3)(x - 2)$

4. (a) $4(3x + 1)(x + 1)$ (b) $3(m - 3)(m + 1)$ (c) $3(1 - 4x)(1 + 3x)$

5. (a) $x(x^2 + 9)(x - 3)(x + 3)$ (b) $(a + b)(a + 2b)$

National 5 Homework – Expressions and Formulae

2.3 COMPLETING the SQUARE

1. (a) $(x + 3)^2 - 12$ (b) $(x - 2\cdot5)^2 - 5\cdot25$ (c) $20 - (x - 4)^2$ (d) $10 - (x + 3)^2$

2. $p = -8; q = -57$. Minimum value $= -57$ when $x = 8$

National 5 Homework – Expressions and Formulae

ALGEBRAIC FRACTIONS

1. **(a)** $\dfrac{1}{3}$ **(b)** w^2 **(c)** $\dfrac{x}{2}$ **(d)** $\dfrac{x}{3}$

2. **(a)** $\dfrac{1}{(2x-1)}$ **(b)** $(x+2)$ **(c)** $\dfrac{x-3}{x+2}$

3. **(a)** $\dfrac{9m}{20}$ **(b)** $\dfrac{7m+14}{10}$ **(c)** $\dfrac{3x+12}{x(x+3)}$ **(d)** $\dfrac{2x^2+2x-3}{(x+2)(x+1)}$

4. **(a)** 1 **(b)** $\dfrac{2}{15x}$ **(c)** $\dfrac{1}{2a}$ **(d)** $\dfrac{3}{2x}$

National 5 Homework – Expressions and Formulae

DETERMINING the GRADIENT of a STRAIGHT LINE given TWO POINTS

1. $-\dfrac{5}{6}$ **2.** $\dfrac{1}{2}$ **3.** Proof [gradients $-\dfrac{3}{2}$]

4. $k=6$ **5.** $-\dfrac{9}{11}$ **6.** $y=17$ **7.** $-\dfrac{1}{3}$ **8.** -6

National 5 Homework – Expressions and Formulae

WORKING with the LENGTH of ARC and AREA of a SECTOR of a CIRCLE

1. **(a)** 18·1cm **(b)** 72·6cm² **2.** **(a)** 29·0cm **(b)** 72·4cm²

3. 25·3cm **4.** 80° **5.** 785cm²

National 5 Homework – Expressions and Formulae

WORKING with the VOLUME of a SOLID SPHERE, CONE, PYRAMID

1. 1140cm³ **2.** 445cm³ **3.** **(a)** 1770cm³ **(b)** 1610cm³

4. 110cm³

National 5	**Surds**	**Homework Marking Scheme - EF**	

1. **(a)** $7\sqrt{3}$ — 1 — *simplifying* $\sqrt{147}$

$2\sqrt{3}$ — 1 — *answer*

(b) $\dfrac{\sqrt{6}+2-\sqrt{6}}{2}$ — 1 — *multiplying out brackets*

1 — *simplifying to answer* **[4 marks]**

2. $2\sqrt{5}+2\sqrt{5}-3\sqrt{5}$ — 1 — *simplifying* $\sqrt{45}$ and $\sqrt{20}$

$\sqrt{5}$ — 1 — *answer* **[2 marks]**

3. $\dfrac{5}{2\sqrt{3}}\times\dfrac{\sqrt{3}}{\sqrt{3}}$ — 1 — *knowing to multiply by* $\dfrac{\sqrt{3}}{\sqrt{3}}$

$\dfrac{5\sqrt{3}}{6}$ — 1 — *answer* **[2 marks]**

4. $\dfrac{5}{4-\sqrt{3}}\times\dfrac{4+\sqrt{3}}{4+\sqrt{3}}$ — 1 — *knowing to multiply by* $\dfrac{4+\sqrt{3}}{4+\sqrt{3}}$

$\dfrac{5(4+\sqrt{3})}{(4-\sqrt{3})(4+\sqrt{3})}$ — 1 — *multiplying*

$\dfrac{5(4+\sqrt{3})}{13}$ — 1 — *simplifying* **[3 marks]**

5. **(a)** $x^2=8^2-4^2$ — 1 — *using Pythagoras*

$x^2=48$

$x=\sqrt{48}$ — 1 — *finding x*

$x=\sqrt{16}\sqrt{3}$

$x=4\sqrt{3}$ — 1 — *simplifying* **[3 marks]**

(b) $A=\frac{1}{2}\,bh$

$=\frac{1}{2}\times4\times4\sqrt{3}$ — 1 — *substituting*

$=8\sqrt{3}$ — 1 — *answer* **[2 marks]**

6. $(2\sqrt{7})^2+(2\sqrt{5})^2$ — 1 — *using Pythagoras*

$28+20=48$ — 1+1 — *squaring surds*

$4\sqrt{3}$ — 1 — *simplifying* **[4 marks]**

Total: 20 marks

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1. m^2

1   *answer*   **[1 mark]**

2. m^{-3}

$\dfrac{1}{m^3}$

1   *simplifying*

1   *writing with positive power*   **[2 marks]**

3. $p^5 - p^0$

$p^5 - 1$

1   *multiplying brackets*

1   *simplifying*   **[2 marks]**

4.   6

a^3

6a

1   *number*

1   *multiplying letter*

1   *answer*   **[3 marks]**

5. y^5

y^7

1   *simplifying numerator*

1   *answer*   **[2 marks]**

6. $\sqrt[4]{16^3}$

8

1   *knowing how to find fractional power*

1   *answer*   **[2 marks]**

7. $x^5 y^{-2}$

$\dfrac{x^5}{y^2}$

1   *simplifying*

1   *writing with positive powers*   **[2 marks]**

8. k^{-6}

k^2

1   *simplifying bracket*

1   *answer*   **[2 marks]**

9. $a^{\frac{4}{3}} - a^0$

$a^{\frac{4}{3}} - 1$

1   *multiplying brackets*

1   *simplifying*   **[2 marks]**

10. $a^{\frac{4}{3}} - a^0$

$a^{\frac{4}{3}} - 1$

1   *multiplying brackets*

1   *simplifying*   **[2 marks]**

Total: 20 marks

1.	**(a)**	$7 \cdot 925 \times 10^{22}$		*1*	*each part*
	(b)	$8 \cdot 99 \times 10^{-6}$		*1*	*each part*　　**[4 marks]**
2.	**(a)**	320 000 000		*1*	*answer*
	(b)	0·001		*1*	*answer*　　**[2 marks]**
3.	**(a)**	1 260 000 000		*1*	*answer*
		$1 \cdot 26 \times 10^{9}$		*1*	*scientific notation*　　**[2 marks]**
	(b)	525 000		*1*	*answer*
		$5 \cdot 25 \times 10^{5}$		*1*	*scientific notation*　　**[2 marks]**
	(c)	4 800 000		*1*	*answer*
		$4 \cdot 8 \times 10^{5}$		*1*	*scientific notation*　　**[2 marks]**
4.		$93\ 000\ 000 \times 5 \cdot 2$		*1*	*correct calculation*
		$4 \cdot 836 \times 10^{8}$		*1*	*answer in scientific notation*　**[2 marks]**
5.		$1 \cdot 2 \times 10^{8} \div 365$		*1*	*correct calculation*
		£328 767		*1*	*answer correctly rounded*　　**[2 marks]**
6.	**(a)**	2·15	**(b)** 7·12		
	(c)	3·45	**(d)** 2 850	*1*	*each answer*　　**[2 marks]**

<u>**Total: 20 marks**</u>

1. (a) $5x + 21$ *1*   (b) $6y - 15$ *1*
    (c) $7s - 27$ *1*   **[3 marks]**

2. (a) $x^4 + 2x$ *1*   (b) $24m - 3m^2$ *1*
    (c) $2y^2w - 10y^3$ *1*   **[3 marks]**

3. (a) $23a + 94$ *1*   (b) $-8y - 26$ *2*   **[3 marks]**

4. (a) $x^2 + 11x + 28$ *1*   (b) $y^2 - 12y + 27$ *1*

    (c) $s^2 + 10s - 24$ *1*   (d) $2a^2 + 23a + 45$ *1*

    (e) $6w^2 - 13w - 8$ *1*   (f) $16x^2 - 24x + 9$ *1*   **[6 marks]**

5. (a) $x^3 + x$ *1*
          $x^2 + 1$ *1*

    (b) $2x^3 - 3x^2 - 2x$......   *1*
          $- 4x^2 + 6x + 4$ *1*
          $2x^3 - 7x^2 + 4x + 4$ *1*   **[5 marks]**

Total: 20 marks

1.   **(a)** $y(y + 5)$ *1*

      (b) $(2x - 7)(2x + 7)$ *1*   *each bracket*

      (c) $5(s - 2)(s + 2)$ *1*   *each bracket*   **[5 marks]**

2.   **(a)** $(x + 5)(x + 5)$ *1*   *each bracket*

      (b) $(x - 12)(x + 2)$ *1*   *each bracket*

      (c) $(x + 6)(x - 1)$ *1*   *each bracket*   **[6 marks]**

3.   **(a)** $(4a - 3)(3a + 4)$ *1*   *each bracket*

      (b) $(7w - 9)(w + 1)$ *1*   *each bracket*

      (c) $(4x - 3)(x - 2)$ *1*   *each bracket*   **[6 marks]**

4.   **(a)** $4(3x + 1)(x + 1)$ *1*   *common factor*

      (b) $3(m - 3)(m + 1)$ *1*   *common factor*

                                        1   *brackets*

      (c) $3(1 - 4x)(1 + 3x)$ *1*   *common factor*

                                        1   *brackets*   **[6 marks]**

5.   **(a)** $x(x^2 + 9)(x^2 - 9)$ *1*   *common factor*

                                        1   *brackets*

          $x(x^2 + 9)(x - 3)(x + 3)$ *1*   *difference of 2 squares*

      (b) $(a + b)(a + 2b)$ *1*   *each bracket*   **[5 marks]**

__Total: 28 marks__

Correct brackets with signs
round the wrong way gains 1
mark.

1.   **(a)** $(x+3)^2$ *1*

          ...... -12 *1*

       (b) $(x-2\cdot5)^2$ *1*

          ...... $-5\cdot25$ *1*

       (c) 20 ....   *1*

          ...... $-(x-4)^2$ *1*

       (d) 10 ....   *1*

          .... $-(x+3)^2$ *1*   **[8 marks]**

2. $p = -8$;   *1*

       $q = -57$.   *1*

       Minimum value $= -57$ *1*

       when $x = 8$ *1*   **[4 marks]**

<div align="center">

Total: 12 marks

</div>

1.   **(a)** $\dfrac{1}{3}$ **(b)** w^2

  (c) $\dfrac{x}{2}$ **(d)** $\dfrac{x}{3}$ | 1 | *each answer* | **[4 marks]**

2.   **(a)** $\dfrac{1}{(2x-1)}$ | 1 | *answer*

  (b) $\dfrac{(x+2)(x+3)}{(x+3)} = x+2$ | 1 | *factorising numerator*

  | 1 | *cancelling to answer*

  (c) $\dfrac{(x-3)(x+2)}{(x+2)(x+2)} = \dfrac{x-3}{x+2}$ | 1 | *factorising numerator*

  | 1 | *factorising denominator*
  | 1 | *cancelling to answer*   **[6 marks]**

3.   **(a)** $\dfrac{9m}{20}$ | 1 | *answer*

  (b) $\dfrac{5(m+4)+2(m-3)}{10}$ | 1 | *correct denominator*

  $= \dfrac{7m+14}{10}$ | 1 | *correct numerator*

  (c) $\dfrac{4(x+3)-x}{x(x+3)}$ | 1 | *correct denominator*

  $= \dfrac{3x+12}{x(x+3)}$ | 1 | *correct numerator*

  (d) $\dfrac{(x+1)(x+1)+(x+2)(x-2)}{(x+2)(x+1)}$ | 1 | *correct denominator*

  $= \dfrac{x^2+2x+1+x^2-4}{(x+2)(x+1)}$ | 1 | *correct numerator*

  $= \dfrac{2x^2+2x-3}{(x+2)(x+1)}$ | 1 | *simplified numerator*   **[8 marks}**

4.   **(a)** 1 | 1 | *answer*

  (b) $\dfrac{6x}{45x^2}$ | 1 | *multiplying*

  $= \dfrac{2}{15x}$ | 1 | *simplifying*

  (c) $\dfrac{a}{2a^2}$ | 1 | *multiplying*

  $= \dfrac{1}{2a}$ | 1 | *simplifying*

(d) $\dfrac{3y}{4x^2}$ *1*   *inversion*

    $= \dfrac{3}{2x}$ *1*   *simplifying*   **[7 marks]**

<u>**Total: 25 marks**</u>

1. $m = -\dfrac{5}{6}$ 1   *answer*   **[1 mark]**

2. $m = \dfrac{1+4}{8+2} = \dfrac{1}{2}$ 1   *working*

                                      1   *answer*   **[2 marks]**

3. $m_{AB} = \dfrac{4+2}{-4+0} = -\dfrac{3}{2}$ 1   *gradient*

        $m_{AB} = \dfrac{-11-4}{6+4} = -\dfrac{3}{2}$ 1   *gradient*

        $m_{AB} = m_{BC}$ with B a common point so
        A, B and C are collinear.   1   *conclusion*   **[3 marks]**

4. $m_{ST} = \dfrac{2-3}{10-k} = -\dfrac{1}{10-k}$

                                      1   *gradient*

        $m_{TU} = \dfrac{5-2}{-2-10} = -\dfrac{1}{4}$

                                      1   *gradient*

        $\dfrac{1}{10-k} = \dfrac{1}{4}$

                                      1   *equating gradients*

                                                                  [4 marks]
        $k = 6$ 1   *answer*

5. $m = \dfrac{2+7}{-8-3} = -\dfrac{9}{11}$ 1   *working*

                                      1   *answer*   **[2 marks]**

6. $m = \dfrac{-11-1}{-7+4} = \dfrac{-12}{-3} = 4$

                                      1   *gradient*

        $m = \dfrac{-3-y}{-3-2} = \dfrac{-3-y}{-5}$

                                      1   *gradient*

        $\dfrac{-3-y}{-5} = 4$

                                      1   *equating gradients*

        $y = 17$ 1   *answer*   **[4 marks]**

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7. $m_{perp} = -\dfrac{1}{3}$

1   *answer*   **[1 mark]**

8. $m = \dfrac{-4-2}{-6+2} = \dfrac{3}{2}$; $m_{perp} = -\dfrac{2}{3}$

1   *both gradients*

$\dfrac{b+2}{6} = -\dfrac{2}{3}$

1   *equating to perpendicular gradient*

$b = -6$

1   *answer*   **[3 marks]**

Total: 20 marks

1.   **(a)** $\dfrac{130}{360} \times 3 \cdot 14 \times 16 = 18 \cdot 1 \text{cm}$ *1*   *correct fraction*

                                                    1   *substitution*
                                                    1   *answer*

      (b) $\dfrac{130}{360} \times 3 \cdot 14 \times 8^2 = 72 \cdot 6 \text{cm}^2$ *1*   *correct fraction*

                                                    1   *substitution*
                                                    1   *answer*   **[6 marks]**

2.   **(a)** $\dfrac{332}{360} \times 3 \cdot 14 \times 10 = 29 \cdot 0 \text{cm}$ *1*   *correct fraction*

                                                    1   *substitution*
                                                    1   *answer*

      (b) $\dfrac{332}{360} \times 3 \cdot 14 \times 5^2 = 72 \cdot 4 \text{cm}^2$ *1*   *correct fraction*

                                                    1   *substitution*
                                                    1   *answer*   **[6 marks]**

3. $\dfrac{360}{125} \times 8 \cdot 8 = 25 \cdot 3 \text{cm}$ *1*   *working*

                                                    1   *answer*   **[2 marks]**

4. $\dfrac{x}{360} \times 3 \cdot 14 \times 144 = 100$ *1*   *relevant working*
      $x = 80^{\circ}$ *1*   *answer*   **[2 marks]**

5. $\dfrac{90}{360} \times 3 \cdot 14 \times 35^2 = 962 \text{cm}^2$ *1*   *substitution*

                                                    1   *answer*

      $\dfrac{90}{360} \times 3 \cdot 14 \times 15^2 = \underline{177 \text{cm}^2}$ *1*   *substitution and answer*

      Shaded area = 962 − 177 = $\underline{785 \text{cm}^2}$ *1*   *answer*   **[4 marks]**

                                          Total: 20 marks

1. $V = \dfrac{1}{3} \times \pi \times 8^2 \times 17$ *1*   *correct substitution*

        <u>1140cm³</u>   *1*   *answer correctly rounded*

                                       1   *units*   **[3 marks]**

2. $V = \dfrac{1}{3} \times \pi \times 5^2 \times 7$ *1*   *correct height*

        <u>183cm³</u>   *1*   *correct answer*

        $V = \dfrac{2}{3} \times \pi \times 5^3$ *1*   *correct substitution*

        <u>262cm³</u>   *1*   *correct answer*

        Total: <u>445 cm³</u>   *1*   *answer correctly rounded*   **[5 marks]**

3.   **(a)** $V = 15^3 =$ <u>3380 cm³</u> [accept 3375]   *1*   *dimension of 15*

                                               1   *answer*

      (b) $V = \dfrac{4}{3} \times \pi \times 7 \cdot 5^3$ *1*   *substitution*

              <u>1770cm³</u>   *1*   *answer*

              Wasted space = <u>1610cm³</u>   *1*   *answer correctly rounded*   **[5 marks]**

4. $V = \dfrac{1}{3} \times A \times h$ *1*   correct formula

        $V = \dfrac{1}{3} \times 6 \times 6 \times 9$ *1*   substitution

        <u>110cm³</u>   *1*   answer correctly rounded   **[3 marks]**

<u>**Total: 16 marks**</u>