

### S3 Homework – Expressions and Formulae

#### SURDS

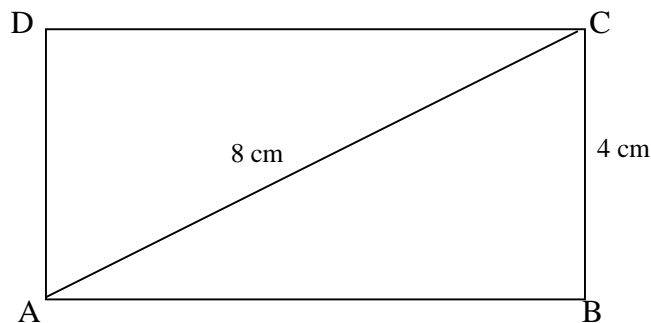
1. Simplify (a)  $\sqrt{147} - 5\sqrt{3}$  (b)  $\sqrt{2}(\sqrt{3} + \sqrt{2}) - \sqrt{6}$  (2,2)

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

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

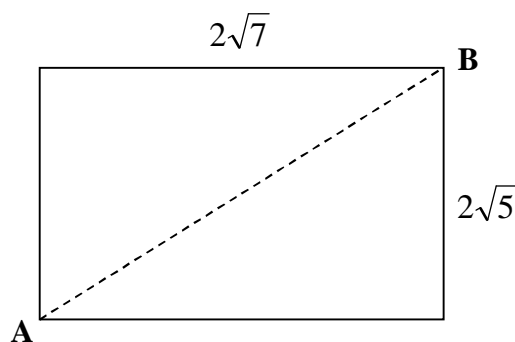
4. Express as a fraction with a rational denominator  $\frac{5}{4 - \sqrt{3}}$  (3)

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**

## S3 Homework – Expressions and Formulae

### INDICES

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

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

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

3. Express

$$p^3(p^2 - p^{-3}) \quad \text{in its simplest form.} \quad (2)$$

4. Simplify

$$\frac{3a^2 \times 2a}{a^2} \quad (3)$$

5. Express in its simplest form

$$\frac{y^4 \times y}{y^{-2}} \quad (2)$$

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

7. Simplify, expressing your answer with positive indices.

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

8. Simplify

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

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

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

**20 marks**

## S3 Homework – Expressions and Formulae

### 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  $3.2 \times 10^8$  (1)
  - (b) The size of a molecule of water is roughly  $1 \times 10^{-3}$  (1)
  
3. Calculate each of the following, giving your answers in standard form.
  - (a)  $(4.2 \times 10^{10}) \times (3 \times 10^{-2})$       (b)  $\frac{4.2 \times 10^5}{8 \times 10^{-1}}$
  
  - (c)  $\frac{(3.2 \times 10^2) \times (4.5 \times 10^{-3})}{3 \times 10^{-6}}$  (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  $\text{£}1.2 \times 10^8$ .  
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)  $8.4 \div (9.6 - 5.7)$       (b)  $20 \times (2.1 \div 5.9)$
  - (c)  $\frac{58}{(1.2 \times 14)}$       (d)  $2500 \times 1.045^3$  (1, 1, 1, 1)

**20 marks**

### S3 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**

## S3 Homework – Expressions and Formulae

### 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

### S3 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

## S3 Homework – Expressions and Formulae

### ALGEBRAIC FRACTIONS

1. Simplify:

$$(a) \frac{19}{57} \quad (b) \frac{w^3}{w} \quad (c) \frac{5x}{10} \quad (d) \frac{12x^2}{36x} \quad (4)$$

2. Simplify:

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

3. Simplify:

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

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

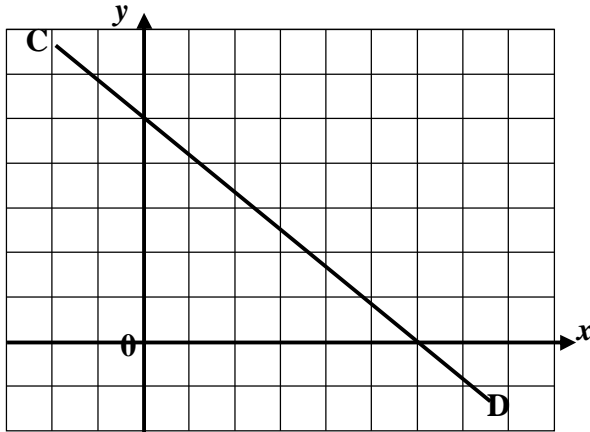
$$(a) \frac{7}{3k} \times \frac{9k}{21} \quad (b) \frac{3x}{5} \times \frac{2}{9x^2} \quad (c) \frac{1}{a^2} \div \frac{2}{a} \quad (d) \frac{2x}{y} \div \frac{4x^2}{3y} \quad (1, 2, 2, 2)$$

25 marks

### S3 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

**S3 Homework – Expressions and Formulae**

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

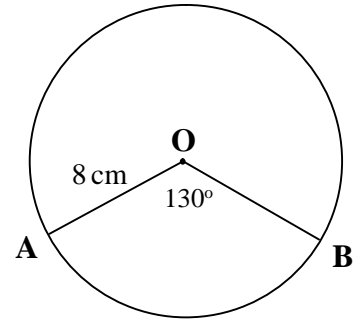
*Give your answers correct to 3 significant figures where necessary.*

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

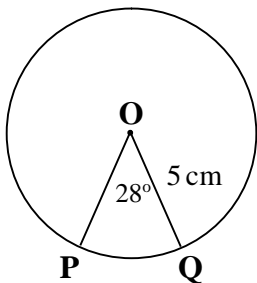
(3)

(b) Calculate the area of the minor sector AOB.

(3)



2.



(a) Find the length of the major arc PQ in this circle.

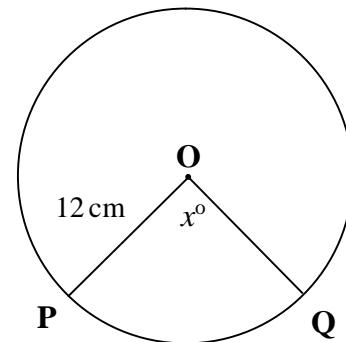
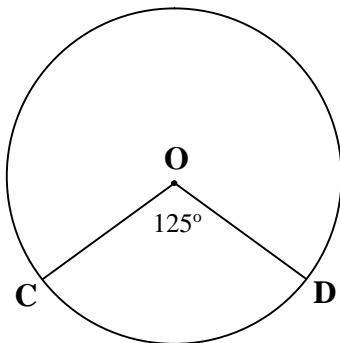
(3)

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

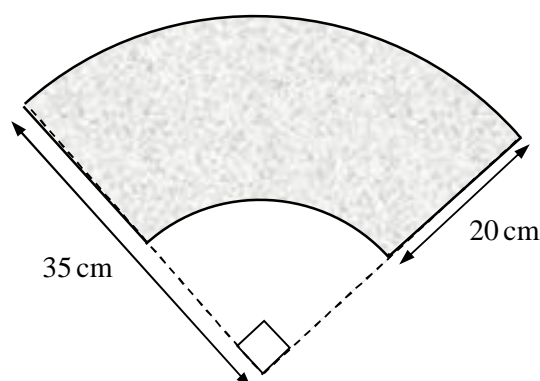
(3)

3. The length of arc CD is 8.8 cm. Calculate the circumference of the circle. (2)

4. The area of sector OPQ is  $100 \text{ cm}^2$ . Calculate the size of angle,  $x^\circ$ , to the nearest degree. (2)



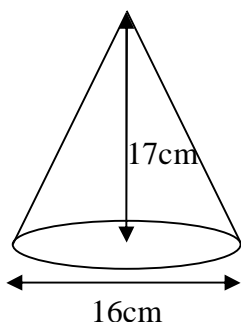
5. Ornamental paving slabs are in the shape of part of a sector of a circle. Calculate the area of the slab shown. (4)



**S3 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.

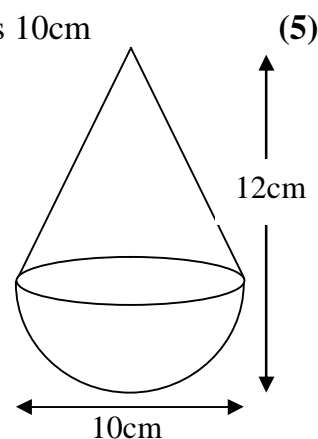
$$[\text{Volume of cone} = \frac{1}{3}\pi r^2 h] \quad (3)$$

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

Calculate the volume of lead required to make the sinker.

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



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  $\text{cm}^3$ ]  
(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

### S3 Homework – Expressions and Formulae

#### SURDS

1. (a)  $2\sqrt{3}$  (b) 2
2.  $\sqrt{5}$  3.  $\frac{5\sqrt{3}}{6}$
4.  $\frac{5(4+\sqrt{3})}{13}$  5. (a)  $4\sqrt{3}$  (b)  $8\sqrt{3}$
6.  $4\sqrt{3}$

### S3 Homework – Expressions and Formulae

#### INDICES

1.  $m^2$  2.  $\frac{1}{m^3}$  3.  $p^5 - 1$
4.  $6a$  5.  $y^7$  6. 8
7.  $\frac{x^5}{y^2}$  8.  $k^2$  9.  $a^{\frac{4}{3}} - 1$  10.  $a^{\frac{3}{2}} + a^{-\frac{1}{2}}$

### S3 Homework – Expressions and Formulae

#### SCIENTIFIC NOTATION / SIGNIFICANT FIGURES

1. (a)  $7.925 \times 10^{22}$  (b)  $8.99 \times 10^{-5}$
2. (a) 320 000 000 (b) 0.001
3. (a)  $1.26 \times 10^9$  (b)  $5.25 \times 10^5$  (c)  $4.8 \times 10^5$
4.  $4.836 \times 10^8$  5. £328 767
6. (a) 2.15 (b) 7.12 (c) 3.45 (d) 2 850

### S3 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)  $2x^3 - 7x^2 + 4x + 4$

### S3 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)  $(a + b)(a + 2b)$

### S3 Homework – Expressions and Formulae

#### 2.3 COMPLETING the SQUARE

1. (a)  $(x + 3)^2 - 12$  (b)  $(x - 2.5)^2 - 5 \cdot 25$  (c)  $20 - (x - 4)^2$  (d)  $10 - (x + 3)^2$
2.  $p = -8$ ;  $q = -57$ . Minimum value =  $-57$  when  $x = 8$

### S3 Homework – Expressions and Formulae

#### ALGEBRAIC FRACTIONS

1. (a)  $\frac{1}{3}$  (b)  $w^2$  (c)  $\frac{x}{2}$  (d)  $\frac{x}{3}$
2. (a)  $\frac{1}{(2x-1)}$  (b)  $(x+2)$  (c)  $\frac{x-3}{x+2}$
3. (a)  $\frac{9m}{20}$  (b)  $\frac{7m+14}{10}$  (c)  $\frac{3x+12}{x(x+3)}$  (d)  $\frac{2x^2+2x-3}{(x+2)(x+1)}$
4. (a) 1 (b)  $\frac{2}{15x}$  (c)  $\frac{1}{2a}$  (d)  $\frac{3}{2x}$

### S3 Homework – Expressions and Formulae

#### DETERMINING the GRADIENT of a STRAIGHT LINE given TWO POINTS

1.  $-\frac{5}{6}$  2.  $\frac{1}{2}$  3. Proof [gradients  $-\frac{3}{2}$ ]
4.  $k = 6$  5.  $-\frac{9}{11}$  6.  $y = 17$  7.  $-\frac{1}{3}$  8.  $-6$

### S3 Homework – Expressions and Formulae

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

1. (a) 18.1cm (b) 72.6cm<sup>2</sup> 2. (a) 29.0cm (b) 72.4cm<sup>2</sup>
3. 25.3cm 4. 80° 5. 785cm<sup>2</sup>

### S3 Homework – Expressions and Formulae

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

1. 1140cm<sup>3</sup> 2. 445cm<sup>3</sup> 3. (a) 1770cm<sup>3</sup> (b) 1610cm<sup>3</sup>
4. 110cm<sup>3</sup>