

National 5 Mathematics: S3 Exam Revision

1. Simplify, giving your answer in surd form:

- a) $\sqrt{12}$ b) $\sqrt{48}$ c) $\sqrt{500}$ d) $\sqrt{80}$ e) $\sqrt{490}$
f) $\sqrt{8} + \sqrt{18}$ g) $\sqrt{2} \times \sqrt{8}$ h) $\sqrt{5}(\sqrt{20} + \sqrt{5})$

2. Simplify:

- a) $\frac{x^3 \times x^4}{x^5}$ b) $\frac{4x \times x^5}{2x^2}$ c) $\frac{5x^2 \times 4x^7}{2x}$ d) $\frac{6x^8}{3x^2 \times x^3}$ e) $x^4(x^2 - x^{-5})$

3. Calculate, leaving your answer in scientific notation:

- a) $(6.5 \times 10^5) \times (8.3 \times 10^7)$ b) $(7.5 \times 10^6) \times (1.9 \times 10^{11})$ c) $(8.4 \times 10^6) \div (5.1 \times 10^3)$
d) $(2.998 \times 10^8) \times 3600$ e) $(6.022 \times 10^{23}) \times 1573.62$ f) $(8.3 \times 10^8) \times (2.76 \times 10^{13})$
g) $\frac{(1.45 \times 10^5) \times (3.014 \times 10^{17})}{8.19 \times 10^5}$ h) $\frac{(7.5 \times 10^{11}) \times (5.42 \times 10^9)}{1.11 \times 10^{-12}}$ i) $\frac{(1.01 \times 10^5) \times (9.21 \times 10^{-4})}{4.1 \times 10^{25}}$

4. Expand and simplify where appropriate:

- a) $(x + 2)^2$ b) $(2x - 3)^2$ c) $(7 - x)^2$ d) $(x - 1)(x + 4)$
e) $(x + 3)(5x + 2)$ f) $(5 + x)(3 - 2x)$
g) $(x + 2)(x^2 + 6x + 1)$ h) $(x - 3)^3$

5. Factorise:

- a) $4x - 12$ b) $x^2 + 9x$ c) $x^2 - 16$ d) $25 - 4h^2$
e) $6x^2 - 54$ f) $g^2 + 5g + 4$ g) $h^2 + 4h + 4$ h) $m^2 - 11m + 12$
i) $k^2 - 3k - 10$ j) $y^2 + 7y - 30$ k) $4x^2 + 8x - 12$

6. Express in the form $(x + p)^2 + q$:

- a) $x^2 + 2x + 6$ b) $x^2 + 8x - 5$ c) $x^2 - 6x + 1$ d) $x^2 + 12x - 100$
e) $x^2 + 10x$ f) $x^2 + 22x + 41$ g) $x^2 + 3x$ h) $x^2 - 7x + 8$

7. Write each fraction in its simplest form.

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

8. Write each of the following as a single fraction in its simplest form (in all cases, letter terms $\neq 0$)

a) $\frac{6}{x} + \frac{1}{y}$ b) $\frac{9}{x} - \frac{4}{z}$ c) $\frac{3}{t} - \frac{1}{5r}$ d) $\frac{6x}{7} + \frac{2}{y}$ e) $\frac{4g}{3} + \frac{1}{h^2}$

f) $\frac{2}{x} + \frac{1}{x+1}$ g) $\frac{x}{x-3} + \frac{1}{x}$ h) $\frac{4}{y+1} + \frac{1}{y-1}$ i) $\frac{5}{3b+2} - \frac{6}{b-1}$ j) $\frac{x+2}{x-3} - \frac{x+1}{5x}$

9. Calculate the gradient between the following pairs of points:

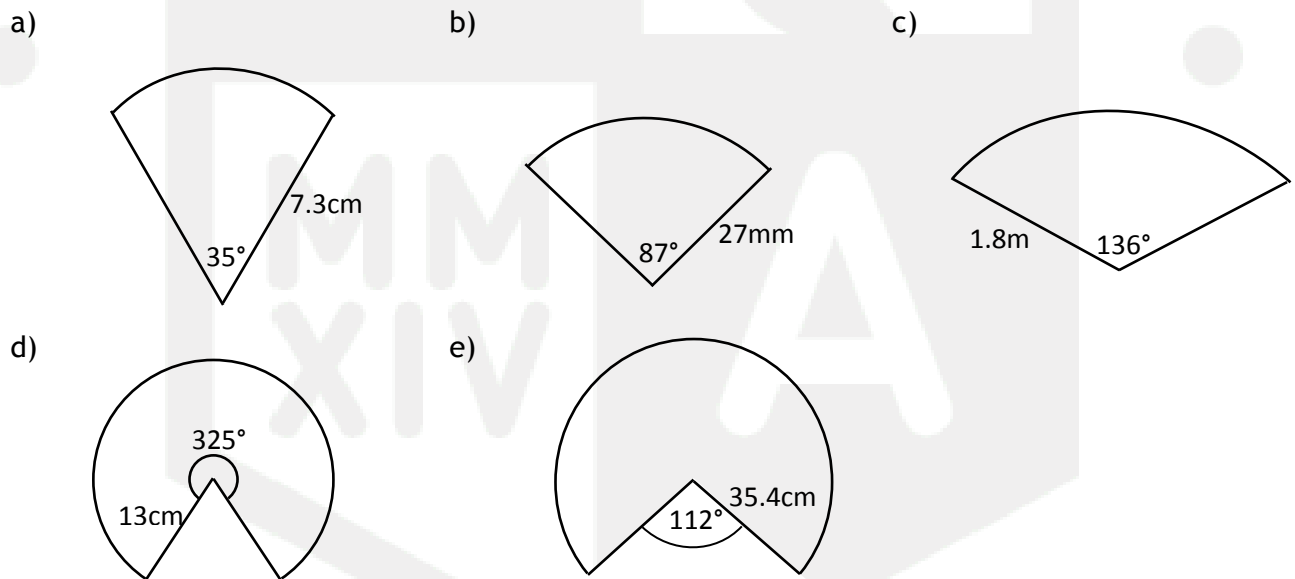
a) A (4, 2) b) C (8, 10) c) E (-3, 1) d) G (3, 4) e) I (-5, -1)
 B (3, 0) D (6, -2) F (-1, -2) H (5, 5) J (-3, 0)

f) K (-5, 3) g) M (-4, 1) h) P (0, 1) i) R (8, 26) j) T (3, 5)
 L (-3, -3) N (5, 1) Q (-4, -3) S (5, 2) U (3, -1)

10. Calculate the volume of the following solids, giving your answer correct to 2 significant figures.

- a) a sphere, radius 9.2cm b) a cone, radius 5cm and height 15cm
 c) a cylinder, diameter 12cm and height 5cm d) a hemisphere, radius 26mm
 e) a cone, diameter 4.6cm and height 22cm f) a cylinder, radius 3.5cm and height 7.5cm
 g) a sphere, diameter 9.1cm h) a cone, radius 48mm and height 3.5cm

11. For each diagram below, find to 3 s.f.: (i) the length of the arc
 (ii) The area of the sector



Answers

1. a) $2\sqrt{3}$ b) $4\sqrt{3}$ c) $10\sqrt{5}$ d) $4\sqrt{5}$ e) $7\sqrt{10}$ f) $5\sqrt{2}$ g) 4 h) 15
2. a) x^2 b) $2x^4$ c) $10x^8$ d) $\frac{2}{x^6 + x^{-1}}$ e)
3. a) 5.395×10^{13} b) 1.425×10^{18} c) 1.647×10^3 d) 1.079×10^{12} e) 9.476×10^{26}
 f) 2.291×10^{22} g) 5.336×10^{16} h) 3.662×10^{33} i) 2.269×10^{-24}
4. a) $x^2 + 4x + 4$ b) $4x^2 - 12x + 9$ c) $49 - 14x + x^2$ d) $x^2 + 3x - 4$ e) $5x^2 + 17x + 6$
 f) $15 - 7x - 2x^2$
5. a) $4(x - 3)$ b) $x(x + 9)$ c) $(x + 4)(x - 4)$ d) $(5+2h)(5 - 2h)$ e) $6(x+3)(x-3)$
 f) $(g + 4)(g + 1)$ g) $(h + 2)(h + 2)$ h) $(m - 12)(m+1)$ i) $(k - 5)(k + 2)$ j) $(y+10)(y - 3)$
 k) $4(x + 3)(x - 1)$
6. a) $(x + 1)^2 + 5$ b) $(x + 4)^2 - 21$ c) $(x - 3)^2 + 8$ d) $(x + 6)^2 - 136$ e) $(x + 5)^2 - 25$
 f) $(x + 11)^2 - 80$ g) $(x + 1.5)^2 - 2.25$ h) $(x - 3.5)^2 - 4.25$
7. a) $\frac{x - 3}{x + 4}$ b) $\frac{x + 2}{(x - 1)^3}$ c) $(x - 6)(3 - x)$
8. a) $\frac{6y + x}{xy}$ b) $\frac{9z - 4x}{xz}$ c) $\frac{15r - t}{5rt}$ d) $\frac{6xy + 2z}{7y}$ e) $\frac{4gh^2 + 3}{3h^2}$
 f) $\frac{3x + 2}{x(x + 1)}$ g) $\frac{x^2 + x - 3}{x(x - 3)}$ h) $\frac{5y - 3}{(y + 1)(y - 1)}$ i) $\frac{-13b - 17}{(3b + 2)(b - 1)}$ j) $\frac{4x^2 + 9x}{5x(x - 3)}$
9. a) $m_{AB} = 2$ b) $m_{CD} = 6$ c) $m_{EF} = -3/2$ d) $m_{GH} = 1/2$ e) $m_{IJ} = 1/2$
 f) $m_{KL} = -3$ g) $m_{MN} = 0$ h) $m_{PQ} = 1$ i) $m_{RS} = 24/3$ j) $m_{TU} = \text{undefined}$
10. a) 3300cm^3 b) 390cm^3 c) 570cm^3 d) 37000mm^3 e) 120cm^3
 f) 290cm^3 g) 390cm^3 h) 80cm^3
11. a) (i) 4.46cm b) (i) 41.0mm c) (i) 4.27m d) (i) 73.7cm e) (i) 153cm
 (ii) 16.3cm^2 (ii) 553mm^2 (ii) 3.85m^2 (ii) 479cm^2 (ii) 2710cm^2
12. a) $y = -3x + 3$ b) $y = 2x + 7$ c) $y = -x - 1$ d) $y = 2x - 5$ e) $y = -4x + 11$
13. a) $x > -4$ b) $x = -6$ c) $g \leq 3$ d) $f < 10/3$ e) $x = -3$
 f) $x = 3$ g) $g \geq -6$ h) $t < 16$ i) $d \geq 4$
14. a) $x = 4$ b) $x = 1$ c) $x = -2$ d) $x = 3$ e) $x = 2$ f) $p = 3$ g) $g = 16$ h) $t = 1/2$
 $y = 5$ $y = 4$ $y = -4$ $y = 1$ $y = -3$ $q = -5$ $h = -11$ $r = 1$
15. a) No b) No c) No d) Yes e) No f) Yes

12. Find the equation of the line passing through the given point with the stated gradient:

- a) $(0, 3)$; $m = -3$ b) $(0, 7)$; $m = 2$ c) $(0, -1)$; $m = -1$ d) $(4, 3)$; $m = 2$
e) $(4, -5)$; $m = -4$

13. Solve:

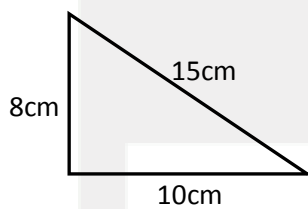
- a) $4x + 9 > x - 3$ b) $2(x - 5) = 3x - 4$ c) $6g - 4 \leq 2g + 8$
d) $5f < 2(f + 5)$
e) $6g + 3 \geq 45 - g$ f) $3(2t - 1) < 5t + 13$ g) $14d \leq 8(2d - 1)$

14. Solve the following simultaneous equations:

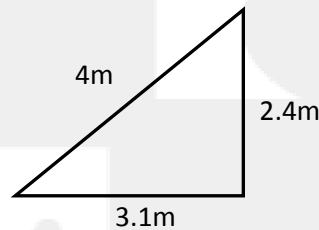
- a) $2x - y = 3$ b) $x - 2y = -7$ c) $x - 2y = 6$ d) $x - 2y = 1$
 $x + 2y = 14$ $3x + y = 7$ $3x - 2y = 2$ $2x + y = 7$
e) $2x + 5y = -11$ f) $4p - q = 17$ g) $-2h - 3g = 1$ h) $6t + 3r = 6$
 $3x - 2y = 12$ $3p - 2q = 19$ $5h + 7g = 3$ $4t + 5r = 7$

15. Use the Converse of Pythagoras' Theorem to state whether the following triangles are right angled.

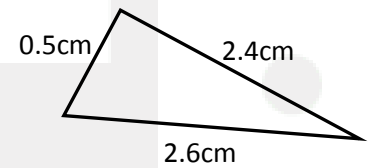
a)



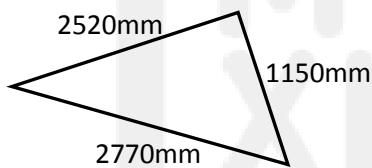
b)



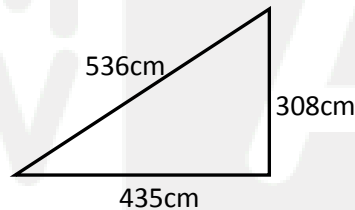
c)



d)



e)



f)

