



## ARITHMETIC & ALGEBRA

**Q1. [8 marks]**

Express in terms of  $a$ . Give your answer in exact form.

<b>Q1.1</b> $\sqrt[3]{a^{-2}a^8}$	$a^2$	<b>A1</b>
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<b>Q1.2</b> $\sqrt{a^6 \times (1\frac{1}{3})^{-2}}$	$\frac{3}{4}a^3$	<b>A1</b>
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<b>Q1.3</b> $(\frac{1}{4}a^{-2})^3 \div (\frac{1}{2}a^{-3})^4$	$\frac{1}{4}a^6$	<b>A1</b> for coefficient <b>A1</b> for the power of $a$
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<b>Q1.4</b> $\frac{(2a)^8(4a^2)^7}{(16a^3)^8 \div (-8a)^3}$	$\frac{2^8 a^8 2^{14} a^{14}}{2^{32} a^{24} \div (-2^9 a^3)} =$ $= -\frac{2^{22} a^{22}}{2^{23} a^{21}} =$ $= -\frac{1}{2}a$	<b>M1</b> for $\geq 2$ rules correctly applied <b>A1A1</b> (numerator, denominator) <b>A1</b>
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**Q2. [2 marks]**

Find the number whose 22% is equal 75. Give your answer to 2 decimal places.

$75 \div 0.22 \approx 340.91$	<b>M1A1</b>
<b>(M1 may be implied by awrt 341)</b>	

**Q3. [3 marks]**

Rationalize the denominator of the following fractions. Show your workings fully.

<b>Q3.1</b> $\frac{\sqrt{8}-4}{\sqrt{2}}$	$2 - \sqrt{2}$	<b>A1</b> cso (i.e. do not award a mark if solution not shown!)
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<b>Q3.2</b> $\frac{2a\sqrt{3}+a}{\sqrt{3}-2}$	$\frac{2a\sqrt{3}+a}{\sqrt{3}-2} \times \frac{\sqrt{3}+2}{\sqrt{3}+2} = \frac{6a+a\sqrt{3}+4a\sqrt{3}+2a}{3-4} =$ $= -8a - 5a\sqrt{3}$	<b>M1</b> (method should include an attempt to expand) <b>A1</b> cso
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**Q4. [4 marks]**

Expand and leave the answer in simplest form.

<b>Q4.1</b> $(4x + \frac{1}{2})^2$	$16x^2 + 4x + \frac{1}{4}$	<b>A1</b>
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<b>Q4.2</b> $(a - b + ab)^2$	$a^2 + b^2 + a^2b^2 - 2ab + 2a^2b - 2ab^2$	<b>A1</b>
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<b>Q4.3</b> $(a\sqrt{2} - 3)(a\sqrt{8} + 1) - (2a)(2a - 2\sqrt{2})$	$4a^2 + a\sqrt{2} - 6a\sqrt{2} - 3 - 4a^2 + 4a\sqrt{2} =$ $= -a\sqrt{2} - 3$	<b>M1</b> (at least 4 terms fully correct) <b>A1</b>
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## STATISTICS & PROBABILITY

**Q5. [3 marks]**

A fair cubic dice and a fair coin are tossed once. On one side of the coin there is a number 1 and on the other side there is a number 2. What is the probability that the sum of outcomes is larger than 4?

if 1 on the coin then dice: 4, 5 or 6	
if 2 on the coin then dice: 3, 4, 5 or 6	(M1)
$\frac{1}{2} \times \frac{3}{6} + \frac{1}{2} \times \frac{4}{6} =$	A1
$= \frac{7}{12}$	A1

**Q6. [4 marks]**

Consider four **different** whole numbers that have the following properties:

- their range is 6,
- their median is 7,
- their mean is 7.5.

Find the numbers.

$(a < b < c < d)$	
$d - a = 6$	
$\frac{b+c}{2} = 7$	
$\frac{a+b+c+d}{4} = 7.5$	M1
	(for at least 2 equations)
2 equations in terms of 2 variables	
e.g. $d - a = 6, a + d = 16$	M1
any 2 correct, e.g. $a = 5, d = 11$	A1
$b \& c: 7 \& 7$ or $6 \& 8$ or $5 \& 9$	
but all different, so $b = 6, c = 8$	A1

**Q7. [3 marks]**

In a group of 20 students 14 learn French, 9 learn German and 2 do not learn any of the two languages. A student is chosen at random from the group. What is the probability that he learns both French and German?

<p>e.g. <math>(2) + (14 - x) + (x) + (9 - x) = 20</math> or  <math>(14 + 9) - (20 - 2)</math>  <math>x = 5</math>  probability is <math>\frac{5}{20} = \frac{1}{4}</math></p>	<p>M1 A1 A1</p>	<p style="font-size: small;">A Venn diagram with two overlapping ovals labeled F and G. The left part of oval F is labeled 14 - x, the right part of oval G is labeled 9 - x, and the overlapping region is labeled x. Above the diagram, the number 2 is written, representing the elements outside both sets.</p>
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## EQUATION OF A LINE

**Q8. [2 marks]**

Consider the points  $(-3, 4)$  and  $(1, -3)$ .

**Q8.1** Find the gradient of the line passing through the points.

Give your answer as an exact fraction.

$-\frac{7}{4}$	<b>A1</b>
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**Q8.2** Find the distance between the points.

$(\sqrt{4^2 + 7^2}) = \sqrt{65} \approx (\text{awrt})8.1$	<b>A1</b>
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**Q9. [3 marks]**

Find the equation of a line perpendicular to  $y = 1.5x + 2$  and passing through point  $(6, -1)$ .

Give your answer in the form  $Ax + By + C = 0$ , where  $A$ ,  $B$  and  $C$  are integers.

$m = -\frac{2}{3}$	<b>B1</b>
e.g. $y = -\frac{2}{3}(x - 6) - 1$	<b>M1 ft</b>
$y = -\frac{2}{3}x + 3$ , so $2x + 3y - 9 = 0$	<b>A1 cso</b>

**Q10. [2 marks]**

Find the area of the triangle bounded by the line  $y = \frac{2}{3}x - 3$  and the coordinate axes.

intercepts are $(0, -3)$ and $(4.5, 0)$	<b>B1</b>
area is $\frac{1}{2}(3)(4.5) = \frac{27}{4}$ or 6.75	<b>A1</b>



## EQUATIONS & INEQUALITIES

**Q11. [3 marks]**

Find the set of common solutions of the following inequalities.

$$7 - 2x > 0 \quad \text{and} \quad 5x + 10 \geq 0 \quad \text{and} \quad |x| < 1$$

$x < 3.5, x \geq -2$ and $-1 < x < 1$	<b>M1A1</b>
(for correct attempt and solutions of at least 2 inequalities)	
$-1 < x < 1$	<b>A1</b> cao

**Q12. [7 marks]**

Solve the equations and inequalities. Give all answers in simplest form.

<b>Q12.1</b> $x^2 + 7x - 8 = 0$	$((x - 1)(x + 8) = 0)$ $x = 1$ or $x = -8$	<b>A1</b>
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<b>Q12.2</b> $\frac{x-1}{3} = \frac{2}{x-1}$	$((x - 1)^2 = 6)$ $x = 1 \pm \sqrt{6}$ accept awrt $-1.45, 3.45$	<b>A1</b>
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<b>Q12.3</b> $x + \frac{6}{x} = 7$	$x^2 - 7x + 6 = 0$ , so $(x - 1)(x - 6) = 0$ $x = 1$ or $x = 6$	<b>A1</b>
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<b>Q12.4</b> $x^2 = 5x$	$x = 0$ or $x = 5$	<b>A1</b>
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<b>Q12.5</b> $ x + 1  = 3$	$x = -4$ or $x = 2$	<b>A1</b>
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<b>Q12.6</b> $x^2 - 2x < 3$	$(x - 3)(x + 1) < 0$ $-1 < x < 3$	<b>M1A1</b> ( <b>A1</b> for zeroes, <b>M1</b> for the inner interval)
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**Q13. [1 marks]**

Make  $r$  the subject of the formula  $F = G \frac{m_1 m_2}{r^2}$ .

$r = (\pm) \sqrt{\frac{Gm_1 m_2}{F}}$	<b>A1</b>
(with or without a minus)	

**Q14. [2 marks]**

Solve the following equations simultaneously.

$$5x + 4y = 6 \quad \text{and} \quad 3x - 2y = 8$$

e.g. $(5x + 4y) + (6x - 4y) = 6 + 16$	<b>M1</b>
$x = 2, y = -1$	<b>A1</b> cso



## TRIGONOMETRY

You may like to use the cosine rule in this section:  $c^2 = a^2 + b^2 - 2ab \cos C$ .

**Q15. [3 marks]**

In triangle  $ABC$  the sides  $AB$  and  $BC$  are 6 and 4 respectively. The angle at  $A$  is  $35^\circ$ . Find the measure of the angle  $C$ .

$\frac{\sin C}{6} = \frac{\sin 35^\circ}{4}$	M1
$C = 59.35755\dots^\circ \approx \text{awrt } 59.4^\circ$	A1
or $C = 120.64\dots^\circ \approx \text{awrt } 121^\circ$	A1 ft

**Q16. [2 marks]**

Find the measure of the smallest angle in the triangle with sides 3, 5 and 7.

$\cos \theta = \frac{5^2 + 7^2 - 3^2}{2 \times 5 \times 7}$	M1
$\theta = 21.786789\dots^\circ \approx \text{awrt } 21.8^\circ$	

**Q17. [3 marks]**

**Q17.1** Find the obtuse angle  $B$  such that  $\sin B = \sin 40^\circ$ .

$140^\circ$	B1
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**Q17.2** Find an angle  $C$  such that  $\cos C = -\sin C$ .

$135^\circ$	A1
allow $-45^\circ + 180^\circ k$	

**Q17.3**  $D$  is an acute angle ( $0^\circ < D < 90^\circ$ ). Find the exact value of  $\cos D$  if  $\sin D = \frac{2}{3}$ .

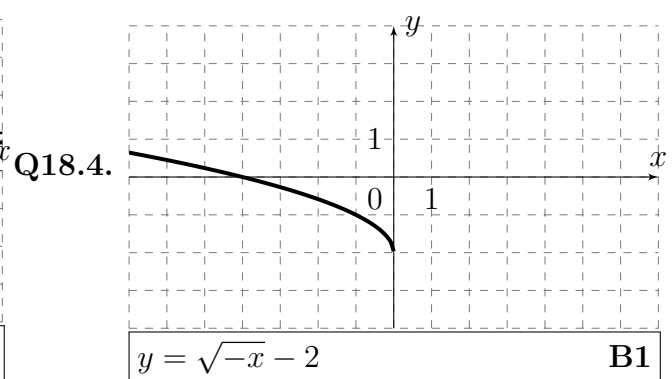
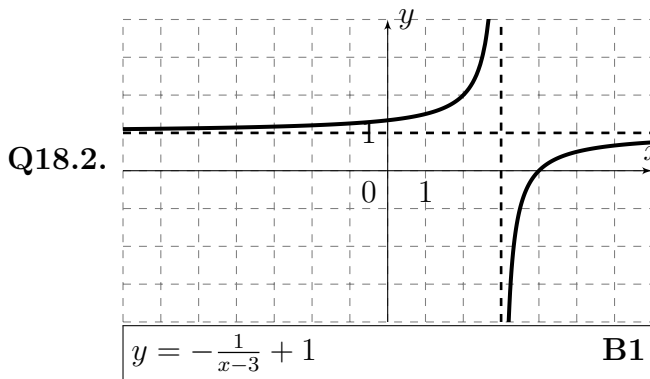
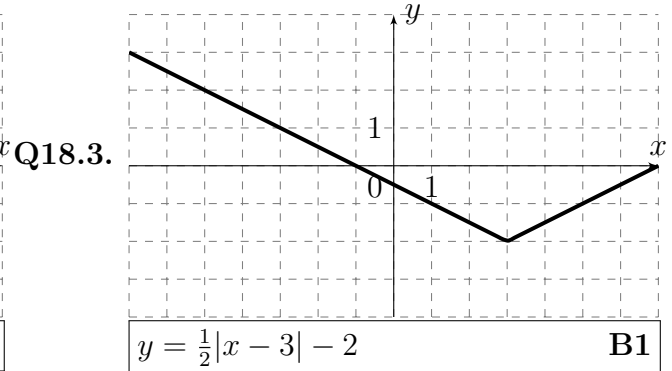
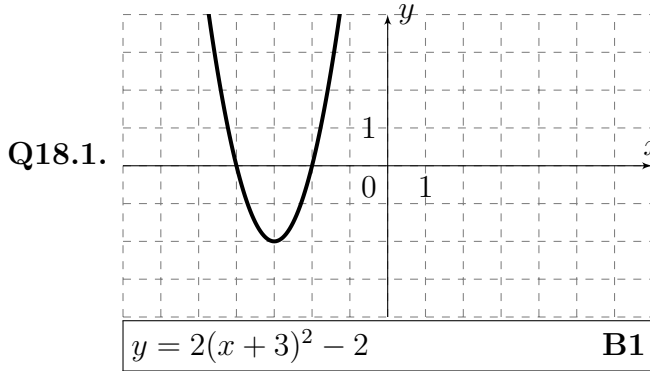
$\frac{\sqrt{5}}{3}$	B1
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### ADVANCED PART

Q18. [4 marks]

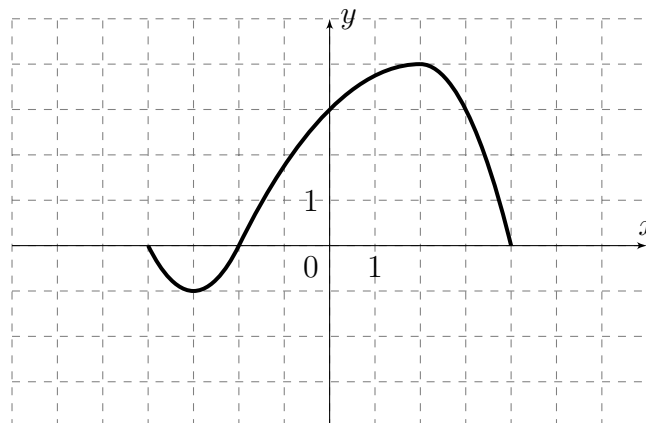
Write down an equation of each of the curves shown below.



**note:** allow half-marks in this question (e.g. for correct shift but incorrect stretch), but then round **down** so that the total for the question is integer.

Q19. [3 marks]

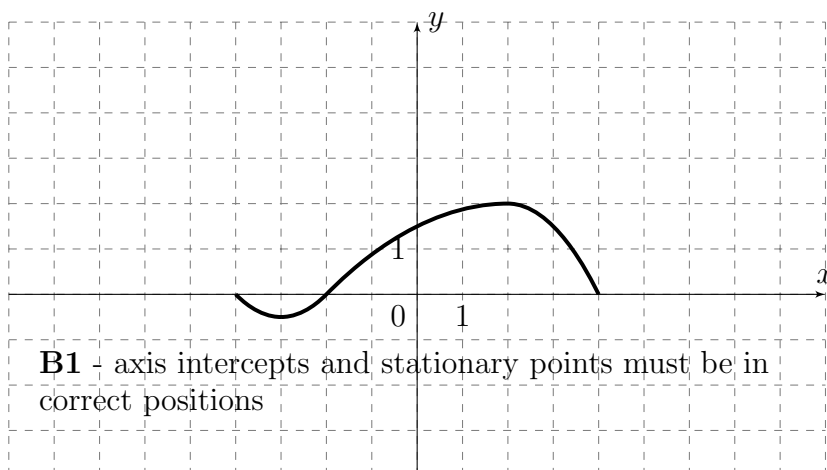
Consider the graph of the function  $y = f(x)$  shown below.



In the diagrams on the next page sketch the graphs of the curves with given equations.



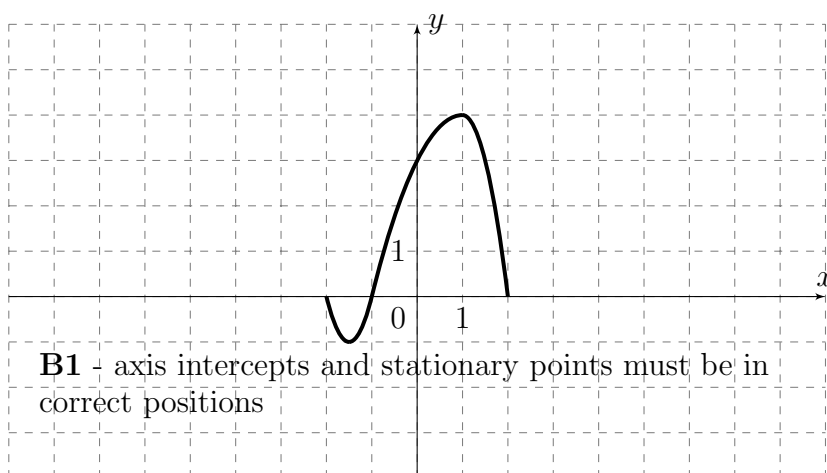
Q19.1.



$$y = \frac{1}{2}f(x)$$

**B1** - axis intercepts and stationary points must be in correct positions

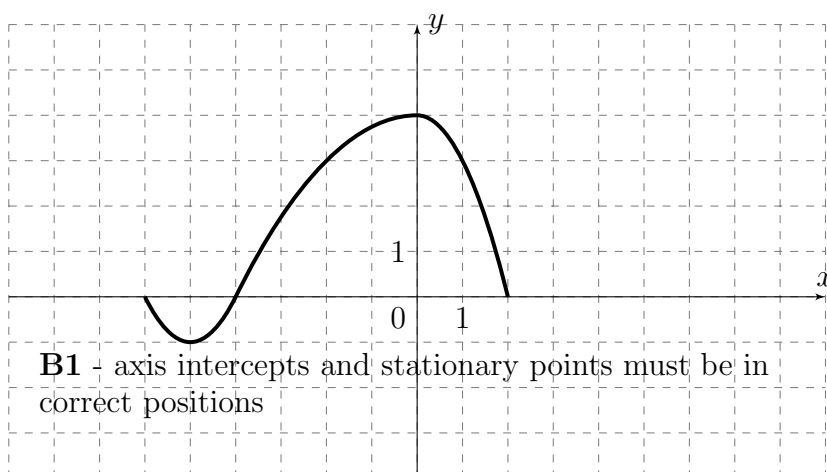
Q19.2.



$$y = f(2x)$$

**B1** - axis intercepts and stationary points must be in correct positions

Q19.3.



$$y = f(x + 2)$$

**B1** - axis intercepts and stationary points must be in correct positions



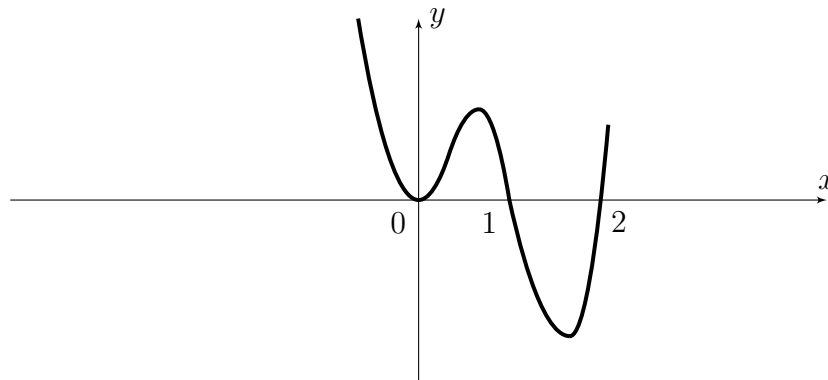
**Q20. [2 marks]**

Sketch the graph of

$$y = x^2(x - 1)(x - 2)$$

and hence or otherwise solve the inequality

$$x^2(x - 1)(x - 2) < 0.$$



graph

$$1 < x < 2$$

**B1**

**B1 ft**

**Q21. [3 marks]**

Which of the numbers is larger?

**Q21.1.**  $\log_{(a^2)}(a^3)$  or  $\log_{(a^3)}(a^2)$

$$\log_{(a^2)}(a^3)$$

**B1**

**Q21.2.**  $\left(\frac{1}{2}\right)^x$  or  $\left(\frac{1}{2}\right)^{x+1}$

$$\left(\frac{1}{2}\right)^x$$

**B1**

**Q21.3.**  $\log_a b$  or  $\log_{(2a)} b$  when  $a > 1$

$$\log_a b$$

**B1**

**Q22. [1 marks]**

Find the distance of the centre of the circle  $(x + 6)^2 + (y - 8)^2 = 11$  from the origin.

$$\sqrt{(-6)^2 + 8^2} = 10$$

**B1**

**Q23. [3 marks]**

Find the coordinates of the points where the circle  $(x - 2)^2 + (y + 8)^2 = 100$  intersects the  $x$ -axis.

$$(x - 2)^2 + 8^2 = 100$$

**M1**

$$(x - 2)^2 = 36$$

$$x - 2 = \pm 6$$

$$(-4, 0) \text{ and } (8, 0)$$

**A1A1 cso**

**note** accept the use of the coordinates of the centre, the radius and the Pythagoras' theorem

**Q24. [2 marks]**

What is the constant term of the expansion  $\left(x + \frac{2}{x}\right)^6$ ?

$$\binom{6}{3} (x^3) \left(\frac{2}{x}\right)^3 =$$

**M1**

$$= 160$$

**A1**