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EDEXCEL INTERNATIONAL GCSE MATHS: QUESTIONS BY TOPIC

Powers, Roots, Standard Form & Surds (N3)

International GCSE Mathematics A (4MA1) · Foundation tier

46 questions · 162 marks · Mark schemes included

Past papers June 2018 - June 2025 · 3 sub-topics

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HOW TO USE THIS BOOKLET

Questions are grouped by sub-topic and run from the lowest to the highest mark tariff, then oldest paper first.

Click any row below to jump straight to that sub-topic or question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme; < QUESTION brings you back.

A gold bar in the left margin marks exactly where the question sits on the original page.

Diagrams, graphs, grids and tables are printed exactly as they appear in the original papers.

Each question is filed under its main topic; longer questions may also test skills from other topics.

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N3c SURDS

No questions on this sub-topic in the available past papers.



QUESTIONS

46 questions · 162 marks · 2 sub-topics

SUB-TOPIC N3a

POWERS, ROOTS & INDEX LAWS

Sub-topic N3a · 19 questions · 72 marks · lowest tariff first



22 (a) Factorise $x^2 - x - 42$

.....
(2)

(b) Solve the inequality $3x + 15 < 8x + 3$

Show clear algebraic working.

.....
(3)

(Total for Question 22 is 5 marks)

23 Given that $150^x = 1$

(a) write down the value of x .

$x =$
(1)

Given that $3^{-8} \div 3^{-6} = 3^n$

(b) find the value of n .

$n =$
(1)

(Total for Question 23 is 2 marks)



24 $\frac{2^k}{4^n} = 2^x$

Find an expression for x in terms of k and n

$x = \dots\dots\dots$

(Total for Question 24 is 2 marks)

- 25 A cinema increased the cost of an adult ticket by 12%
After the increase, the cost of an adult ticket was £18.20
Work out the cost of an adult ticket before the increase.

£.....

(Total for Question 25 is 3 marks)



22 (a) Simplify $(4^{-2})^0$

.....
(1)

$$3^{-14} \times 3^8 = 3^m$$

(b) Find the value of m

$m =$
(1)

(Total for Question 22 is 2 marks)



23 $\frac{3^{-2} \times 3^5}{3^{10}} = 3^n$

Find the value of n

$$n = \dots\dots\dots$$

(Total for Question 23 is 2 marks)

24 In a sale, all normal prices are reduced by 17%

The sale price of a fridge is 6225 rupees.

Work out the normal price of the fridge.

..... rupees

(Total for Question 24 is 3 marks)



17 (a) Simplify $\frac{x^9}{x^2}$

.....
(1)

(b) Write $\frac{7^8 \times 7^4}{7^3}$ as a single power of 7

.....
(2)

(Total for Question 17 is 3 marks)

18 Change 32.4 m^3 into cm^3

..... cm^3

(Total for Question 18 is 2 marks)



24 $\frac{8}{2^7} = 2^n$

(a) Find the value of n .

$$n = \dots\dots\dots (2)$$

$$(13^{-6})^4 \times 13^5 = 13^k$$

(b) Find the value of k .

$$k = \dots\dots\dots (2)$$

(Total for Question 24 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



- 21 There are 10 people in a lift.
These 10 people have a mean weight of 79.2 kg.

3 of these people get out of the lift.
These 3 people have a mean weight of 68 kg.

Work out the mean weight of the 7 people left in the lift.

..... kg

(Total for Question 21 is 3 marks)

- 22 (a) Simplify $t^9 \div t^3$

.....
(1)

- (b) Simplify $w^5 \times w^7$

.....
(1)

- (c) Simplify $(5xy^2)^3$

.....
(2)

(Total for Question 22 is 4 marks)



14 $\mathcal{E} = \{21, 22, 23, 24, 25, 26, 27, 28, 29, 30\}$

$A = \{22, 24, 26, 28, 30\}$

$B = \{21, 24, 27, 30\}$

(a) List the members of the set

(i) $A \cap B$

.....

(ii) A'

.....

(2)

$C = \{23, 25, 29\}$

(b) Using set notation, find an expression for C in terms of A and B .

.....

(1)

(Total for Question 14 is 3 marks)

15 (a) Simplify $(3k^2)^4$

.....

(2)

(b) Simplify $(21m^4n) \div (3n^{-5})$

.....

(2)

(Total for Question 15 is 4 marks)



16 Ravina leaves her home at 1 35 pm in her car.

Ravina drives 60 km from her home to get to an appointment.
She drives at an average speed of 80 km/h.

At what time does Ravina get to her appointment?

(Total for Question 16 is 3 marks)

17 (a) Write down the value of m , given that $3^4 \times 3^5 = 3^m$

$m =$
(1)

(b) Write down the value of n , given that $(5^3)^7 = 5^n$

$n =$
(1)

(c) Find the value of p , given that $\frac{7^8 \times 7^2}{7^p} = 7^6$

$p =$
(2)

(Total for Question 17 is 4 marks)



23 (a) Write down the value of x^0

.....
(1)

Given that $2^{-3} \times 2^9 = 2^n$

(b) find the value of n

$n =$
(1)

Given that $\frac{7^{206} \times 7^m}{7^{214}} = 7^{-3}$

(c) find the value of m

$m =$
(2)

(Total for Question 23 is 4 marks)



23 (a) Write 0.000 089 in standard form.

.....
(1)

(b) Write 8.34×10^4 as an ordinary number.

.....
(1)

(Total for Question 23 is 2 marks)

24 (a) Simplify $8 \times (4t)^0$

.....
(1)

$$x^6 \div x^{-5} = x^p$$

(b) Find the value of p

$p =$
(1)

(c) Simplify fully $(2k^2m^4)^3$

.....
(2)

(Total for Question 24 is 4 marks)



11 (a) Work out the value of $(4 + 3 + 6)^2$

.....
(1)

$$64 = 4^n$$

(b) Write down the value of n

$n =$
(1)

(c) Work out the value of $\frac{\sqrt{9.3 + 2.8^3}}{3.2 \times 1.2}$

Write down all the figures on your calculator display.

.....
(2)

(Total for Question 11 is 4 marks)

12 Last season, Alisha and Jaya scored goals for their team in the ratio 4 : 7
Jaya scored 39 more goals than Alisha.

Work out the number of goals Alisha scored.

.....
(Total for Question 12 is 3 marks)



21 Each time Evie plays a game against her computer, she will win or lose.

For each game, the probability that Evie will win is 0.74

Evie is going to play 300 games against her computer.

Work out an estimate for the number of games that Evie will lose.

(Total for Question 21 is 2 marks)

22 (a) Simplify $m^{10} \div m^3$

(1)

$$k^n \times k^4 = k^{12}$$

(b) Write down the value of n

$n =$
(1)

(c) Simplify $(3x^6y^8)^2$

(2)

(Total for Question 22 is 4 marks)



25 (a) Simplify $(2p)^0$ where $p > 0$

.....
(1)

$$y^9 \times y^{-3} = y^n$$

(b) Find the value of n

$n =$
(1)

(c) Simplify fully $(5a^4c^2)^3$

.....
(2)

(Total for Question 25 is 4 marks)



21 $x^5 \times x^7 = x^m$

(a) Find the value of m

$$m = \dots\dots\dots (1)$$

$$y^8 \div y^3 = y^n$$

(b) Find the value of n

$$n = \dots\dots\dots (1)$$

(c) Simplify fully $(5a^4r^2)^3$

$$\dots\dots\dots (2)$$

(Total for Question 21 is 4 marks)

22 In a sale, normal prices are reduced by 28%
The sale price of a watch is 198 euros.

Work out the normal price of the watch.

$\dots\dots\dots$ euros

(Total for Question 22 is 3 marks)



7 (a) Write $7 \times 7 \times 7 \times 7 \times 7$ as a power of 7

.....
(1)

(b) Show that 64 is both a square number and a cube number.

.....
(2)

(c) Find the value of 11^3

.....
(1)

(d) Find the value of $\sqrt{98.01}$

.....
(1)

(Total for Question 7 is 5 marks)

8 (a) Find the value of $25 - 4g$ when $g = -3$

.....
(2)

(b) Expand and simplify $x(2x + 1) + 3(x - 2) + 7$

.....
(3)

(Total for Question 8 is 5 marks)



6 (a) Find the value of 3.4^2

.....
(1)

(b) Find the cube root of 373 248

.....
(1)

(c) Write $7 \times 7 \times 7 \times 7 \times 7 \div 7$ as a single power of 7

.....
(1)

(d) Write one set of brackets in each calculation to make the answer correct.

(i) $5 + 3 \times 2 = 16$

(1)

(ii) $10 - 8 - 10 - 6 \div 2 = 0$

(1)

(Total for Question 6 is 5 marks)



22 (a) Write down the value of 5^0

.....
(1)

$$\frac{5^9 \times 5^{-3}}{5^{-2}} = 5^k$$

(b) Find the value of k

$k =$
(2)

(c) Simplify fully $(2d^4e^5)^3$

.....
(2)

(Total for Question 22 is 5 marks)



12 (a) Simplify $k + k + k + k$

.....
(1)

$$f = 9 \times 9 \times 9 \times 9$$

(b) (i) Write f as a single power of 9

.....
(2)

(ii) Write f as a single power of 3

.....
(1)

(c) Write $5^{17} \times 5^2$ as a single power of 5

.....
(2)

(d) Write 800 as a product of its prime factors.
Show your working clearly.

.....
(Total for Question 12 is 6 marks)



SUB-TOPIC N3b

STANDARD FORM

Sub-topic N3b · 27 questions · 90 marks · lowest tariff first



22 Here are the first four terms of an arithmetic sequence.

6 10 14 18

(a) Find an expression, in terms of n , for the n th term of this sequence.

.....
(2)

(b) Write down an expression, in terms of n , for the $(n + 1)$ th term of this sequence.

.....
(1)

(Total for Question 22 is 3 marks)

23 (a) Write 1 390 000 in standard form.

.....
(1)

(b) Write 0.005 in standard form.

.....
(1)

(Total for Question 23 is 2 marks)



21 (a) Factorise fully $15y^4 + 20uy^3$

.....
(2)

(b) Solve $4 - 3x = \frac{5 - 8x}{4}$

Show clear algebraic working.

$x =$
(3)

(Total for Question 21 is 5 marks)

22 (a) Write 2 840 000 000 in standard form.

.....
(1)

(b) Write 2.5×10^{-4} as an ordinary number.

.....
(1)

(Total for Question 22 is 2 marks)



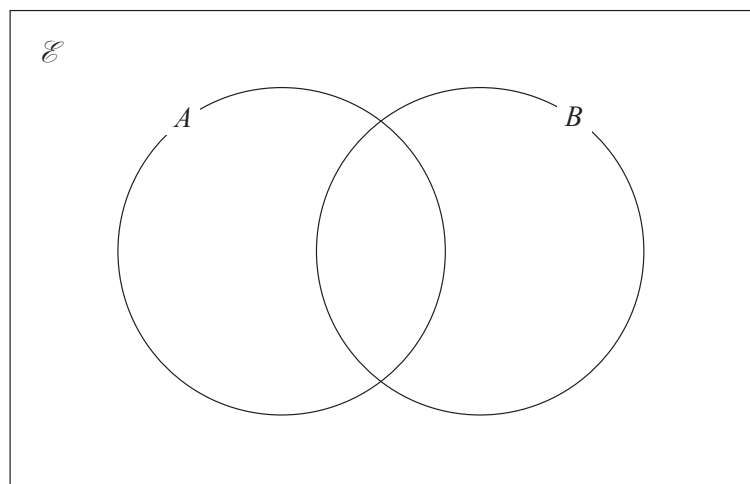
22 $\mathcal{E} = \{4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$

$$A \cap B = \{5, 10, 15\}$$

$$B' = \{7, 8, 9, 11, 12, 13, 14\}$$

$$A' = \{4, 6, 7, 8, 14\}$$

Complete the Venn diagram for this information.



(Total for Question 22 is 3 marks)

23

$$a = 4.2 \times 10^{-24}$$

$$b = 3 \times 10^{145}$$

Work out the value of $a \times b$

Give your answer in standard form.

(Total for Question 23 is 2 marks)



23 (a) Write 0.000 089 in standard form.

.....
(1)

(b) Write 8.34×10^4 as an ordinary number.

.....
(1)

(Total for Question 23 is 2 marks)

24 (a) Simplify $8 \times (4t)^0$

.....
(1)

$$x^6 \div x^{-5} = x^p$$

(b) Find the value of p

$p =$
(1)

(c) Simplify fully $(2k^2m^4)^3$

.....
(2)

(Total for Question 24 is 4 marks)



21 Nancy has some coins with a total value of 85 pence.

She has only 2 pence coins and 5 pence coins.

The ratio

$$\text{number of 2 pence coins} : \text{number of 5 pence coins} = 1 : 3$$

Nancy has more 5 pence coins than 2 pence coins.

How many more?

(Total for Question 21 is 4 marks)

22 (a) Write 76000000 in standard form.

(1)

(b) Write 5.4×10^{-4} as an ordinary number.

(1)

(Total for Question 22 is 2 marks)



18 (a) Write 8×10^4 as an ordinary number.

.....
(1)

(b) Work out $(3.5 \times 10^5) \div (7 \times 10^8)$
Give your answer in standard form.

.....
(2)

(Total for Question 18 is 3 marks)



23

$$A = 3^2 \times 5^4 \times 7 \qquad B = 3^4 \times 5^3 \times 7 \times 11$$

(a) Find the highest common factor (HCF) of A and B .

.....
(2)

(b) Find the lowest common multiple (LCM) of A and B .

.....
(2)

(Total for Question 23 is 4 marks)

24 (a) Write 840 000 in standard form.

.....
(1)

(b) Work out $(6 \times 10^7) \div (8 \times 10^{-2})$
Give your answer in standard form.

.....
(2)

(Total for Question 24 is 3 marks)



20 (a) Write 7.8×10^{-4} as an ordinary number.

.....
(1)

(b) Work out $\frac{5.6 \times 10^4 + 7 \times 10^3}{2.8 \times 10^{-3}}$

Give your answer in standard form.

.....
(2)

(Total for Question 20 is 3 marks)



19 The table gives the length of the coastline, in kilometres, of each of five oceans.

Ocean	Length of coastline (km)
Arctic	4.539×10^4
Atlantic	1.119×10^5
Pacific	1.357×10^5
Indian	6.653×10^4
Southern	1.797×10^4

(a) Which ocean has the greatest length of coastline?

.....
(1)

(b) Calculate the difference between the length of the Atlantic Ocean's coastline and the length of the Southern Ocean's coastline.
Give your answer in standard form.

..... km
(2)

(Total for Question 19 is 3 marks)

20 Solve $x^2 - 21x + 20 = 0$
Show your working clearly.

.....
(Total for Question 20 is 3 marks)



- 25 A rainwater tank contains 2.4×10^7 raindrops.
The rainwater tank also contains 1.75×10^6 bacteria.

Work out the number of bacteria per raindrop in the tank.
Give your answer in standard form correct to 2 significant figures.

(Total for Question 25 is 3 marks)

Turn over for Question 26



..... cm

(Total for Question 23 is 5 marks)

24 (a) Write 6.25×10^{-4} as an ordinary number.

.....
(1)

(b) Work out $(2.4 \times 10^{12}) \div (9.6 \times 10^4)$
Give your answer in standard form.

.....
(2)

(Total for Question 24 is 3 marks)



23 (a) Expand $4x(x - 5)$

.....
(1)

(b) Factorise $y^2 - 9y + 20$

.....
(2)

(Total for Question 23 is 3 marks)

24 (a) Write 5.6×10^{-3} as an ordinary number.

.....
(1)

(b) Work out $\frac{6 \times 10^3}{2.1 \times 10^{-4} + 9 \times 10^{-5}}$

Give your answer in standard form.

.....
(2)

(Total for Question 24 is 3 marks)



24 The table gives the amount of rice produced by each of two countries in 2020

Country	Amount of rice (tonnes)
Indonesia	3.5×10^7
Argentina	8.2×10^5

(a) Write 3.5×10^7 as an ordinary number.

.....
(1)

In 2020, Japan produced 6 780 000 more tonnes of rice than Argentina.

(b) Work out the amount of rice Japan produced in 2020
Give your answer in standard form.

..... tonnes
(2)

(Total for Question 24 is 3 marks)

26 (a) Write 8.4×10^{-5} as an ordinary number.

.....
(1)

(b) Work out $(6.5 \times 10^{-40}) \times (8 \times 10^{185})$
Give your answer in standard form.

.....
(2)

.....
(Total for Question 26 is 3 marks)

Turn over for Question 27



18 The table shows the volumes, in km^3 , of four oceans.

Ocean	Volume (km^3)
Arctic Ocean	1.88×10^7
Atlantic Ocean	3.10×10^8
Indian Ocean	2.64×10^8
Southern Ocean	7.18×10^7

(a) Write 7.18×10^7 as an ordinary number.

(1)

(b) Calculate the total volume of these four oceans.

(2)

km^3

The volume of the South China Sea is $9\,880\,000\text{ km}^3$

(c) Write $9\,880\,000$ in standard form.

(1)

(Total for Question 18 is 4 marks)



21 (a) Write 5.7×10^6 as an ordinary number.

.....
(1)

(b) Write 0.004 in standard form.

.....
(1)

(c) Work out $\frac{2 \times 10^4 + 3 \times 10^5}{6.4 \times 10^{-2}}$

.....
(2)

(Total for Question 21 is 4 marks)

22 On 1st January 2016 Li bought a boat for \$170 000
The value of the boat depreciates by 8% per year.

Work out the value of the boat on 1st January 2019
Give your answer correct to the nearest dollar.

\$

(Total for Question 22 is 3 marks)



24 The table shows information about the surface area of each of the world's oceans.

Ocean	Surface area in square kilometres
Pacific	1.56×10^8
Indian	6.86×10^7
Southern	2.03×10^7
Arctic	1.41×10^7
Atlantic	1.06×10^8

(a) Write 1.56×10^8 as an ordinary number.

.....
(1)

(b) Which ocean has the least surface area?

.....
(1)

(c) Work out the difference, in square kilometres, between the surface area of the Atlantic Ocean and the surface area of the Indian Ocean.
Give your answer in standard form.

..... square kilometres
(2)

(Total for Question 24 is 4 marks)



18 (a) Write 5.7×10^{-3} as an ordinary number.

.....
(1)

(b) Write 800 000 in standard form.

.....
(1)

(c) Work out $\frac{3 \times 10^5 - 2.7 \times 10^4}{6 \times 10^{-2}}$

.....
(2)

(Total for Question 18 is 4 marks)

19 A rocket travelled 100 km at an average speed of 28 440 km/h.

Work out how long it took the rocket to travel the 100 km.
Give your answer in seconds, correct to the nearest second.

..... seconds

(Total for Question 19 is 3 marks)



16 (a) Write 2.46×10^6 as an ordinary number.

.....
(1)

(b) Write 0.000 74 in standard form.

.....
(1)

(c) Work out $(5.6 \times 10^6) + (2.3 \times 10^5)$

.....
(2)

(Total for Question 16 is 4 marks)



20 (a) Write down the value of y^0

.....
(1)

(b) Work out $\frac{9.6 \times 10^{141} + 6.4 \times 10^{140}}{3.2 \times 10^{16}}$

Give your answer in standard form.

.....
(3)

(Total for Question 20 is 4 marks)



23 The table shows the populations of five countries.

Country	Population
China	1.4×10^9
Germany	8.2×10^7
Sweden	9.9×10^6
Fiji	9.1×10^5
Malta	4.3×10^5

- (a) Work out the difference between the population of China and the population of Germany.
Give your answer in standard form.

.....
(2)

Given that

$$\text{population of Fiji} = \frac{1}{k} \times \text{population of Sweden}$$

- (b) work out the value of k .
Give your answer correct to the nearest whole number.

$k =$
(2)

(Total for Question 23 is 4 marks)



22 (a) Write 5×10^4 as an ordinary number.

.....
(1)

(b) Write 0.000 06 in standard form.

.....
(1)

(c) Work out $(4 \times 10^{512}) \div (1.6 \times 10^{700})$
Give your answer in standard form.

.....
(2)

(Total for Question 22 is 4 marks)



- 26 The table gives information about the population, correct to 2 significant figures, of each of five cities in 2018

City	Population (2018)
Ahmedabad	7.7×10^6
Barcelona	5.5×10^6
Chicago	8.8×10^6
Lagos	1.3×10^7
Tokyo	3.7×10^7

- (a) Write 8.8×10^6 as an ordinary number.

.....
(1)

- (b) Which of these cities had the least population in 2018?

.....
(1)

- (c) Work out the difference between the population of Tokyo and the population of Ahmedabad in 2018
Give your answer in standard form correct to 2 significant figures.

.....
(2)

(Total for Question 26 is 4 marks)



23 (a) Write 5.87×10^{-4} as an ordinary number.

.....
(1)

(b) Write 84 000 000 in standard form.

.....
(1)

The number of neurons in a human brain is 8.5×10^{10}

The number of neurons in a monkey brain is 1.47×10^9

The number of neurons in a human brain is $K \times$ the number of neurons in a monkey brain.

(c) Work out the value of K

Give your answer correct to one decimal place.

$K =$
(2)

(Total for Question 23 is 4 marks)



25 (a) Write 6.04×10^5 as an ordinary number.

.....
(1)

(b) Write 0.00007 in standard form.

.....
(1)

(c) Work out $\frac{7.6 \times 10^{10}}{4 \times 10^5 - 2 \times 10^4}$

Give your answer in standard form.

.....
(2)

(Total for Question 25 is 4 marks)

25 (a) Write 520 million in standard form.

.....
(1)

(b) Write 8.79×10^{-5} as an ordinary number.

.....
(1)

(c) Work out $(5 \times 10^{42}) \times (7 \times 10^{-180})$
Give your answer in standard form.

.....
(2)

(Total for Question 25 is 4 marks)



22 (a) Write 9.32×10^{-5} as an ordinary number.

.....
(1)

(b) Work out $3 \times 10^5 - 6 \times 10^4$
Give your answer in standard form.

.....
(2)

(c) Work out $(3 \times 10^{55}) \times (6 \times 10^{65})$
Give your answer in standard form.

.....
(2)

(Total for Question 22 is 5 marks)



MARK SCHEMES

official mark schemes, in the same order as the questions



22	(a)		2	M1	for $(x \pm 6)(x \pm 7)$
		$(x + 6)(x - 7)$		A1	for $(x + 6)(x - 7)$ or $(x - 7)(x + 6)$ isw roots given if candidate solves the quadratic = 0
	(b)	$3x - 8x < 3 - 15$ or $15 - 3 < 8x - 3x$	3	M1	accept as equation or with the wrong inequality sign.
		$-5x < -12$ or $12 < 5x$		M1	accept as equation or with the wrong inequality sign.
		$x > 2.4$		A1	Accept $2.4 < x$ or $x > \frac{12}{5}$ oe allow $(-\infty, 2.4)$ award M1 M1 A0 for 2.4 with = sign or no inequality or incorrect inequality sign.
Total 5 marks					
23	(a)	0	1	B1	condone 150^0
	(b)	-2	1	B1	condone 3^{-2}
Total 2 marks					
24	See appendix 1		3	M1	for $y = x$ correctly drawn
				M1	for $x = 4$ and $y = -2$ correctly drawn
		Correct region identified		A1	for correct region identified region may be shaded or left unshaded Condone missing label if region is clear and no contradictory labels
Total 3 marks					

(d)		$5cd^2(2c^2 + 3d^2)$	2	B2 for $5cd^2(2c^2 + 3d^2)$ B1 for a correct partial factorisation eg $5(2c^3d^2 + 3cd^4)$ or $cd^2(10c^2 + 15d^2)$ or $5d^2(2c^3 + 3cd^2)$ or $5c(2c^2d^2 + 3d^4)$ or $5cd(2c^2d + 3d^3)$ etc or $5cd^2$ (a 2 term expression with just one error)
				Total 8 marks
24	$(4^n =)(2^2)^n$ or $(4^n =)2^{2n}$ oe eg $2^k \div 2^{2n} = 2^x$ or $2^k = 4^{\frac{1}{2}k}$ and $2^x = 4^{\frac{1}{2}x}$ oe eg $\frac{4^{\frac{1}{2}k}}{4^n} = 4^{\frac{1}{2}x}$		2	M1 for writing 4^n as $(2^2)^n$ or 2^{2n} or for writing each term in terms of 4 ie $2^k = 4^{\frac{1}{2}k}$ and $2^x = 4^{\frac{1}{2}x}$ If these things are seen in working, award this mark even if followed by incorrect working – if not a choice of methods
		$k - 2n$		A1 allow 2^{k-2n}
				Total 2 marks

22	(a)		1	1	B1 cao
	(b)		-6	1	B1 Allow 3^{-6}
					Total 2 marks

23	(a)	$-4x > 17 - 9$ or $-4x > 8$ or $9 - 17 > 4x$ or $-8 > 4x$ or $\frac{9}{4} - x > \frac{17}{4}$ oe or $-\frac{9}{4} + x < -\frac{17}{4}$ oe		2	M1 for a correct first step Condone = rather than > or any other sign for this mark.
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$x < -2$		A1 oe eg $-2 > x$ (sight of correct answer in working space and just $(x =) -2$ on answer line gains M1 only)
	(b)		$y \geq 2$ $x \leq 6$ $y \leq x$	3	B3 for all 3 correct Allow $2 \leq y, 6 \geq x$ and $x \geq y$ B2 for 2 correct B1 for 1 correct Allow < and > signs SCB2: $y \leq 2, y \geq x$ and $x \geq 6$ (for all 3) Allow < and > signs
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>			Total 5 marks



23	eg 3^3 or $(3^{-2}) \times 3^{-5}$ or $\frac{3^3}{(3^{10})}$ or $\frac{(3^5)}{3^{12}}$ or $\frac{(3^{-2})}{3^5}$ or $3^{-12}(\times 3^5)$ oe or $-2 + 5 - 10$ oe or $-12 + 5$ oe or $3 - 10$ oe		2	M1 for a correct application of an index rule as a first step or a correct calculation for n
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	-7		A1 Allow 3^{-7}
				Total 2 marks

24	$1 - 0.17$ or 0.83 or $\frac{83}{100}$ or $100(\%) - 17(\%)$ or $83(\%)$ or $\frac{6225}{83} (= 75)$ oe		3	M1
	$6225 \div "0.83"$ or $6225 \div "83" \times 100$ or $6225 \times 100 \div "83"$ oe or 75×100			M1
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	7500		A1
				Total 3 marks



16			3	B3 B3 for all 4 correct regions B2 or 2 or 3 correct regions B1 for 1 correct regions
Total 3 marks				

17	(a)		x^7	1	B1
	(b)	eg $7^8 \times 7^4 = 7^{12}$ or $7^8 \div 7^3 = 7^5$ or $7^5 \times 7^4$ or $7^4 \div 7^3 = 7$ or $7^8 \times 7$ or $7^{12} \div 7^3 = 7^{12-3}$		2	M1 for one correct step – must be written as a power of 7
			7^9		A1 for 7^9
Total 3 marks					

18	32.4×100^3		2	M1 for 32.4×100^3 oe
		32 400 000		A1 for 32 400 000 accept 3.24×10^7
Total 2 marks				

Question	Working	Answer	Mark	Notes
24 (a)	$\frac{2^3}{2^7}$ or $2^3 \times 2^{-7}$ or $\frac{1}{2^4}$ or $(\frac{1}{16} \text{ and } 16 = 2^4)$		2	M1
		-4		A1 Accept 2^{-4}
(b)	$13^{-24} \times 13^5$		2	M1 for 13^{-24} or for $k = -6 \times 4 + 5$
		-19		A1 Accept 13^{-19}
				Total 4 marks



22	(a)		t^6	1	B1
	(b)		w^{12}	1	B1
	(c)		$125x^3y^6$	2	B2 (B1) for 2 correct terms as part of a product
					Total 4 marks

23	$22 \times 60 \times 60 (= 79\,200)$ oe or $22 \div 1000 (= 0.022)$ oe		3	M1 for converting from m/s to m/h or from m to km	M2 for 22×3.6 oe
	$22 \times 60 \times 60 \div 1000$ oe			M1 for a complete method	
		79.2		A1 oe, dep on at least M1	
					Total 3 marks

14	(a) (i)		24, 30	1	B1 No repeats
	(ii)		21, 23, 25, 27, 29	1	B1 No repeats
	(b)		$(A \cup B)'$ or $A' \cap B'$	1	B1 or $(B \cup A)'$ or $B' \cap A'$
Total 3 marks					
15	(a)		$81k^8$	2	B2 B1 for 81 or k^8 seen in their final answer.
	(b)		$7m^4n^6$	2	B2 B1 for $7m^4$ or n^6 in a product with no other terms in m or n
Total 4 marks					
16	(a)	vertices at $(-9, 6)$ $(-9, 9)$ $(-3, 9)$ $(-6, 6)$	Shape in correct position	2	B2 B1 for congruent shape in correct orientation but wrong position or quadrilateral with 2 or 3 vertices correct.
	(b)	vertices at $(7, 3)$ $(10, 6)$ $(13, 6)$ $(13, 3)$	Shape in correct position	1	B1
	(c)		enlargement scale factor 2 centre $(-3, 3)$	3	B1 for enlargement, enlarge, etc so long as no mention of rotation, reflection or translation, flip, move etc. B1 SF 2, double, two times etc. B1 $(-3, 3)$ stated. Accept about, from etc. with no mention of line, or column vector.
Total 6 marks					

16	$80 = \frac{60}{\text{time}}$		3	M1 for substituting correctly into the speed formula
	$(\text{time}) = \frac{60}{80} \text{ or } \frac{3}{4} \text{ or } 0.75 \text{ or } 45$			M1 for correctly rearranging the speed formula for time
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	2 20 (pm)		A1 Accept 14 20
Total 3 marks				

17 (a)		9	1	B1 allow 3^9
(b)		21	1	B1 allow 5^{21}
(c)	$8 + 2 - p = 6$ oe eg $8 + 2 = 6 + p$ or $7^{8+2-p} = 7^6$ oe		2	M1 (or embedded eg $8 + 2 = 10$, $10 - 4 = 6$)
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	4		A1 allow 7^4
Total 4 marks				



23	(a)		1	1	B1
	(b)		6	1	B1
	(c)	$206 + m - 214 = -3$ oe or $\frac{7^{-3} \times 7^{214}}{7^{206}}$ or $\frac{7^{211}}{7^{206}}$ oe		2	M1 allow $7^{206+m-214} = 7^{-3}$ oe (must be in the form $7^x = 7^y$ where x and y are correct expressions)
			5		A1 accept 7^5
Total 4 marks					



22	$1.4 = \frac{72}{(\text{area})}$ oe		4	M1
	$(\text{area}) = \frac{72}{1.4} (= \frac{360}{7} = 51.4\dots)$ oe			M1 (51.4 or better)
	"51.4..." $\times 18$ or $r = \sqrt{\frac{51.4\dots}{\pi}} (= 4.046\dots)$ and $\pi \times 4.046^{n2} \times 18$			M1 allow use of πr^2 to find the radius and then using $\pi r^2 h$ to find the volume
		926		A1 Allow 925 – 928
				Total 4 marks

23	(a)	8.9×10^{-5}	1	B1
	(b)	83 400	1	B1
				Total 2 marks

24	(a)	8	1	B1
	(b)	11	1	B1 accept x^{11}
	(c)	$8k^6m^{12}$	2	B2 for all correct B1 for two correct from 8 or k^6 or m^{12}
				Total 4 marks



11	(a)		169	1	B1
	(b)		3	1	B1
	(c)		1.45582(0007)	2	B2 (B1 for 5.590... or 3.84 or 1.45, 1.46, 1.455, 1.456, 1.4558)
Total 4 marks					

12	$\frac{39}{n}$ where $n = 3, 4$ or 7 or “ $(7 - 4)$ ” or for 13 or 9.75 or 5.57... or 4 : 7 8 : 14 12 : 21 16 : 28 20 : 35 etc to 32 : 56 or more (don't have to include all trials; ratios must be correct)		3	M1 or allow for this mark eg $\frac{39 \times 4}{7} (= \frac{156}{7} = 22.8)$ or $\frac{39 \times 7}{4} (= \frac{273}{4} = 68.25)$
	$\frac{39}{7-4} \times 4$ or eg $\frac{4}{3} \times 39$ or for 52 : 91			M1 working with figures obtained from a correct method
	Correct answer scores full marks (unless from obvious incorrect working)	52		A1 (52 : 91 or 91 is M2 unless Alisha = 52 clearly shown in working)
Total 3 marks				



21	eg $0.74 \times 300 (= 222)$ or $1 - 0.74 (= 0.26)$ seen or $\frac{78}{300}$		2	M1 for a method to work out an estimate for the number of games Evie will win or the probability that Evie will lose or an answer of $\frac{78}{300}$
	Correct answer scores full marks (unless from obvious incorrect working)	78		A1 cao
				Total 2 marks

22	(a)	m^7	1	B1
	(b)	8	1	B1 Allow k^8
	(c)	$9x^{12}y^{16}$	2	B2 B1 for a product in the form $ax^p y^q$ where 2 from a , p or q are correct eg $3x^{12}y^{16}$ (Allow $9x^{12}$ or $9y^{16}$ or $x^{12}y^{16}$ so as long as not added to any other terms)
				Total 4 marks



25	(a)		1	1	B1
	(b)		6	1	B1
	(c)		$125a^{12}c^6$	2	B2 for $125a^{12}c^6$ B1 for a product in the form ka^pc^q where 2 from k , p or q are correct eg $5a^{12}c^6$ or $125a^{12}3c^6$ Accept multiplication signs between terms (Allow $125a^{12}$ or $125c^6$ or $a^{12}c^6$ as long as not added to any other terms)
Total 4 marks					

26	$(CM)^2 + (12 \div 2)^2 = 9^2$ oe or $9^2 - (12 \div 2)^2 (= 81 - 36 = 45)$		4	M1 $AM = MB$ $CAM = CBM$	M2 for $(\cos^{-1}(CAM) =) \frac{12 \div 2}{9} = 48.1(896\dots)$
	$\sqrt{9^2 - (12 \div 2)^2}$ oe $(= \sqrt{81 - 36} = \sqrt{45} = 3\sqrt{5} = 6.7(08\dots))$			M1	and $(CM =) (12 \div 2) \times \tan 48.1\dots (= 6.7\dots)$ or $(CM =) 9 \times \sin 48.1\dots (= 6.7\dots)$
	$(“7” + 9 + 9 + 12) \times 21.5(0)$ oe			M1	
	Working required	795.5(0)		A1 dep on M2 SC B3 for awrt 789 for using 6.7...	
Total 4 marks					



20	eg $360 - (148 + 50) (= 162)$ or $180 - 50 (= 130)$ or $180 - 148 (= 32)$			4	M1 for method to find the interior angle of the polygon or start to the method of finding the exterior angle of the polygon
	eg $180 - "162" (= 18)$ or $148 - "130" (= 18)$ or $50 - "32" (= 18)$	eg $180(n - 2) = "162"n$ or $180(n - 2) \div n = "162"$			M1 for method to find the exterior angle or for setting up an equation using sum of interior angles formula
	eg $360 \div "18"$	eg $(n =) 360 \div (180 - "162")$			M1 for a complete method
	Working required		20		A1 dep on M1
					Total 4 marks

21	(a)		12	1	B1 accept x^{12}
	(b)		5	1	B1 accept y^5
	(c)		$125a^{12}r^6$	2	B2 for $125a^{12}r^6$ (B1 for a product in the form ka^pr^q where 2 from k , p or q are correct eg $5a^{12}r^6$ Allow $125a^{12}$ or $125r^6$ or $a^{12}r^6$ so as long as not added to any other terms)
					Total 4 marks

Question	Working	Answer	Mark	Notes
7 (a)		7^5	1	B1
(b)	$64=8^2$ or $64=4^3$ or $\sqrt{64}=8$ or $\sqrt[3]{64}=4$ or $8 \times 8 = 64$ or $4 \times 4 \times 4 = 64$ or 1, 4, 9, 16, 25, 36, 49, 64 or 1, 8, 27, 64		2	M1
		$64=8^2$ and $64=4^3$		A1 or $\sqrt{64}=8$ and $\sqrt[3]{64}=4$ or correct list of square & cube numbers to 64
(c)		1331	1	B1
(d)		9.9	1	B1
				Total 5 marks
8 (a)	$25 - 4 \times -3$ or $25 - -12$ or $25 + 12$		2	M1 Correct substitution
		37		A1
(b)	$2x^2 + x$		3	M1
	$(+)3x - 6$			M1 indep
		$2x^2 + 4x + 1$		A1 cao
				Total 5 marks



5	5×1000 or 5000 or $280 \div 1000$ or 0.28	M2 for		3	M1 for a correct conversion between ml and litres
	eg $5000 \div 280$ or $5 \div 0.28$ or $17.8\ldots$ or $\frac{125}{7}$ or $17\frac{6}{7}$ oe	17×280 or 4760 or 17×0.28 oe or 4.76 oe			M1 for a complete method ft incorrect conversion but an attempt must have been made to convert
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>		17		A1
	Total 3 marks				

6	(a)		11.56	1	B1 oe eg $\frac{289}{25}$ or $11\frac{14}{25}$
	(b)		72	1	B1
	(c)		7^4	1	B1
	(d)(i)		$(5 + 3) \times 2 = 16$	1	B1
	(ii)		$10 - 8 - (10 - 6) \div 2 = 0$	1	B1
					Total 5 marks

22	(a)		1	1	B1	cao
	(b)	eg $(5^9 \div 5^{-3} =) 5^6$ or $(5^9 \cdot 5^{-2} =) 5^{11}$ or $(5^{-3} \cdot 5^{-2} =) 5^{-1}$ or $(5^k \div 5^{-2} =) 5^{k+2}$ or $9 - 3 = k - 2$ oe or $9 - 3 = -2$ or $9 - 3 + 2$ <i>Correct answer scores full marks (unless from obvious incorrect working)</i>	8	2	M1	for one correct application of an index rule (must be seen in powers of 5) this could be after an initial mistake – working will need to be clearly seen or for forming a correct equation in the indices alone or for a complete method for the value of k
					A1	condone 5^8
	(c)		$8d^{12}e^{15}$	2	B2	for a correct answer (B1 for answer of the form $kd^m e^n$ where at least two of $k = 8$, $m = 12$ and $n = 15$ are correct)
Total 5 marks						
23		$10.5 = \frac{48.3}{v}$ or $10.5v = 48.3$ or $(v =) \frac{48.3}{10.5}$		2	M1	oe for substituting 10.5 and 48.3 correctly into a correct formula for density; may use any letter for the volume
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	4.6		A1	allow $\frac{23}{5}$ or $4\frac{3}{5}$ oe
Total 2 marks						
24		$60 \times 7 (= 420)$ or $46 \times 3 (= 138)$		3	M1	may be embedded within an equation
		“420” – “138” (= 282)			M1	for a method to find the sum of the 4 numbers Allow this mark if they do further incorrect work using 282
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	70.5		A1	allow $\frac{141}{2}$ oe eg $\frac{282}{4}$ or $70\frac{1}{2}$
Total 3 marks						

Question	Working	Answer	Mark	Notes
11 (a)		3720	1	B1
(b)		95	1	B1
(c)	$\frac{651}{9.3} \times 4.4$		2	M1
		308		A1
Total 4 marks				
12 (a)		$4k$	1	B1
(b) (i)		9^4	1	B1
(ii)		3^8	1	B1
(c)		5^{19}	1	B1
(d)			2	M1 A factor tree / division ladder of 3 or more factors ($\neq 1$), multiplying to 800, which must include 2 and 5. Condone 1 error when product $\neq 800$
		$2 \times 2 \times 2 \times 2 \times 5 \times 5$		A1 Dep on M1 oe eg $2^3 \times 5^2$
13	$0.4 \times 75 (= 30)$ oe		4	M1 M2 for $0.6 \times 75 (= 45)$ oe
	$75 - 30 (= 45)$			M1
	(T-Shirt $\Rightarrow \frac{45-12}{2}$ or (Bag $\Rightarrow \frac{45+12}{2}$ oe or $t + (t + 12) = 45$ oe			M1 (T-shirt = \$16.50)
		28.5(0)		A1
Total 4 marks				

22	(a)		$4n + 2$	2	M1 for $4n + k$ (k may be 0 or absent) oe
					A1 oe e.g $6 + (n - 1)4$
	(b)		$4n + 6$	1	B1 oe ft part (a) providing M1 in part (a) is awarded e.g $4(n + 1) + 2$
					Total 3 marks

23	(a)		1.39×10^6	1	B1
	(b)		5×10^{-3}	1	B1
					Total 2 marks



21	(a)		$5y^3(3y + 4u)$	2	B2 for $5y^3(3y + 4u)$ (B1 for $5y(3y^3 + 4uy^2)$ or $5y^2(3y^2 + 4uy)$ or $y^2(15y^2 + 20uy)$ or $y^3(15y + 20u)$ or $5y^3(\dots)$ where there is only one mistake in the brackets)
	(b)	$4 \times (4 - 3x) = 5 - 8x$ oe or $16 - 12x = 5 - 8x$ oe or $4 - 3x = \frac{5}{4} - 2x$ oe		3	M1 for removal of fraction in a correct equation
		e.g. $16 - 5 = 12x - 8x$ or $11 = 4x$ oe or $4 - \frac{5}{4} = 3x - 2x$			M1 for terms in x on one side and numbers on the other side in an equation, allow correct rearrangement of their equation in the form $ax + b = cx + d$
			2.75		A1 (dep on M1) oe e.g. $2\frac{3}{4}$ or $\frac{11}{4}$
Total 5 marks					

22	(a)		2.84×10^9	1	B1
	(b)		0.000 25	1	B1
Total 2 marks					



23	$12.6 \times 10^{(-24+145)}$ or 12.6×10^{121} or 1.26×10^n		2	M1
		1.26×10^{122}		A1 allow 1.3×10^{122}
Total 2 marks				

24	$17.5^2 - 14^2 (= 110.25)$		4	M1 or for use of cosine rule to find one of the angles eg $28^2 = 17.5^2 + 17.5^2 - 2 \times 17.5 \times 17.5 \times \cos A$ or eg $\cos B = \frac{14}{17.5}$
	$\sqrt{17.5^2 - 14^2} (= 10.5)$			M1 or for rearranging the cosine rule to eg $\cos A = \frac{17.5^2 + 17.5^2 - 28^2}{2 \times 17.5 \times 17.5}$ ($A = 106.26...$) or eg $B = \cos^{-1}(\frac{14}{17.5})$ ($= 36.86...$)
	$0.5 \times 28 \times "10.5"$ oe			M1 or for $0.5 \times 17.5 \times 17.5 \times \sin 106.26...$ oe eg $0.5 \times 17.5 \times 28 \times \sin 36.86...$ [clear use of Heron's formula: M1 for $S = 0.5(17.5 + 17.5 + 28)(=31.5)$ M2 for $\sqrt{31.5("31.5"-17.5)^2("31.5"-28)}$ oe]
		147		A1 accept awrt 147
Total 4 marks				

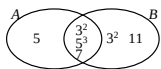
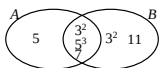


22	(a)		7.6×10^7	1	B1
	(b)		0.000 54	1	B1
Total 2 marks					

23	$DCO = 90$ (or right (angle)) or $DAO = 90$ (or right (angle)) Could also be awarded for $CAO + CAD = 90$ or $DAC + CAO = 90$		3	M1 may be marked on diagram – also allow right angle 'square' symbol on diagram M1 dep on M1 being awarded may be marked on diagram	M2 implied by $360 - 90 - 90 - 48$ or $360 - 228$
	Obtuse $AOC = 360 - 90 - 90 - 48 (= 132)$ oe or Obtuse $AOC = 2(180 - (0.5 \times 48) - 90) (= 132)$ or Obtuse $AOC = 180 - "24" - "24" \text{ or } 180 - 48$ (if working with $\triangle DAC$ and $\triangle OAC$) or Reflex $AOC = 90 + 90 + 48$				
	Correct answer scores full marks (unless from obvious incorrect working)	228		A1 SC if no other marks awarded 132 gains B1	
Total 3 marks					

Question	Working	Answer	Mark	Notes
18 a		80 000	1	B1
b	$0.5 \times 10^{5-8}$ or 0.0005 or 5×10^n or 5.0×10^n	5×10^{-4}	2	M1 A1 for 5×10^{-4} or 5.0×10^{-4} SC : B1 for $\frac{1}{2000}$ or $\frac{1}{2 \times 10^3}$



Question		Working	Answer	Mark	Notes	
23	(a)		7875	2	M1	$3^2 \times 5^3 \times 7$ oe or correct Venn diagram
					A1	
	(b)		3 898 125	2	M1	$3^4 \times 5^4 \times 7 \times 11$ oe or correct Venn diagram
					A1	
						Total 4 marks
24	(a)		8.4×10^5	1	B1	
	(b)	$\frac{600000000}{0.08}$ or 750000000 oe (e.g 0.75×10^9)	7.5×10^8	2	M1	M1 for 60000000 or 0.08
					A1	
						Total 3 marks
25		150000×0.82^3	82705	3	M2	If not M2 then M1 for 1st year e.g $150000 \times 0.82 \{= 123000\}$ or $150000 \times 0.18 \{= 27000\}$ SC B1 for $150000 \times 1.18 \{= 177000\}$ or $150000 \times 1.18^3 \{= 246454.8\}$ or $150000 \times 0.54 \{= 81000\}$ or $150000 \times 0.46 \{= 69000\}$
					A1	Accept 82705.2
						Total 3 marks

19			Trapezium with vertices at (6, 3) (8, 3) (8, 6) (4, 6)	2	B2 If not B2 then award B1 for shape of correct size and orientation or 3 or 4 points plotted correctly
					Total 2 marks

20	(a)		0.000 78	1	B1
	(b)	22 500 000 oe e.g. 22.5×10^6 or 2.25×10^n $n \neq 7$		2	M1
			2.25×10^7		A1
					Total 3 marks



19	(a)		Pacific	1	B1 Accept 1.357×10^5
	(b)	$1.119 \times 10^5 - 1.797 \times 10^4$		2	M1 Accept 111 900 – 17 970 oe or 93 930 or –93 930
			$9.393(0) \times 10^4$		A1 Accept $(\pm) 9.393(0) \times 10^4$ or $(\pm) 9.39 \times 10^4$ or $(\pm) 9.4 \times 10^4$
Total 3 marks					

20	eg $(x \pm 20)(x \pm 1)$	$\frac{-(-21) \pm \sqrt{(-21)^2 - 4 \times 1 \times 20}}{2 \times 1}$ or $\left(x - \frac{21}{2}\right)^2 - \left(\frac{21}{2}\right)^2 + 20 = 0$		3	M1 If factorising, allow brackets which expanded give 2 out of 3 terms correct – if using formula or completing the square allow one sign error and some simplification – allow as far as eg $\frac{21 \pm \sqrt{441 - 80}}{2}$ or eg $\left(x - \frac{21}{2}\right)^2 - \frac{361}{4} = 0$ oe
	$(x - 20)(x - 1)$	eg $\frac{21 \pm \sqrt{441 - 80}}{2}$ or $\frac{21 \pm \sqrt{361}}{2}$ or $\frac{21 \pm 19}{2}$ or $x = \pm \sqrt{\frac{361}{4}} + \frac{21}{2}$ oe			M1 dep on M1 for correct factorisation, or a correct expression for x if completing the square, or a correct substitution into quadratic formula with some processing.
			1, 20		A1 for both correct values, dep on 1st M1 with no incorrect working.
Total 3 marks					

24	(a)		1	1	B1
	(b)(i)	$(x \pm 4)(x \pm 9) (= 0)$		2	M1 or $(x + a)(x + b)$ where $ab = -36$ or $a + b = -5$
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$(x + 4)(x - 9)$		A1 (isw if they also solve the equation in this part)
	(ii)	<i>Answers must fit from (b)(i)</i>	-4 and 9	1	B1 ft Answer must fit from their $(x + p)(x + q)$ in (b)(i) Award B0 for -4 and 9 if no marks scored in (i)
					Total 4 marks

25		$1.75 \times 10^6 \div 2.4 \times 10^7$ or $1\,750\,000 \div 24\,000\,000$ oe eg $\frac{1.75}{24}$		3	M1
		$0.0729(16\dots)$ or 0.072 or 0.073 or for $\frac{7}{96}$ or $7.29(16\dots)\%$ or 7.2% or 7.3%			A1
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	7.3×10^{-2}		A1 accept 7.3×10^{-2} or better ($7.29(16\dots) \times 10^{-2}$)
					Total 3 marks



23	$\cos 50 = \frac{18}{(AB)}$ or $\sin 40 = \frac{18}{(AB)}$ or $\frac{(AB)}{\sin 90} = \frac{18}{\sin 40}$		5	M1	M2 for $(AB =) \sqrt{18^2 + (18 \tan 50)^2}$ oe (= 28.0030...) or 28
	$(AB =) \frac{18}{\cos 50}$ (= 28.0030...) oe or 28 or $(AB =) \frac{18}{\sin 40}$ (= 28.0030...) oe or 28			M1	
	$\frac{1}{2} \times \pi \times "28.0030..."$ (= 43.9...) oe or 44 $\pi \times "28.0030..."$ (= 87.9...) oe or 88				M1 for use of πd or $\frac{1}{2} \pi d$ oe Allow any value of $AB > 18$ if M2 not scored
	"28..." + "43.9..." (= 71.9900...) or "28" + "44"				M1ft from previous M1 Allow their d + their $\frac{1}{2} \pi d$
	Correct answer scores full marks (unless from obvious incorrect working)	72			A1 awrt 72
					Total 5 marks
24	(a)	0.000 625	1	B1	
	(b) 25 000 000 oe e.g. 25×10^6 or 0.25×10^8 or 2.5×10^n $n \neq 7$		2	M1	
	Correct answer scores full marks (unless from obvious incorrect working)	2.5×10^7		A1	
					Total 3 marks



23	(a)		$4x^2 - 20x$	1	B1	or $-20x + 4x^2$
	(b)	$(y \pm 5)(y \pm 4)$ or $(5 \pm y)(4 \pm y)$ or $y(y-4) - 5(y-4)$ or $y(y-5) - 4(y-5)$		2	M1	for $(y \pm 5)(y \pm 4)$ or $(5 \pm y)(4 \pm y)$ or for $(y + a)(y + b)$ where $ab = 20$ or $a + b = -9$
		Correct answer scores full marks (unless from obvious incorrect working)	$(y - 5)(y - 4)$		A1	oe Allow any letter for y Accept $(5 - y)(4 - y)$
Total 3 marks						
24	(a)		0.0056	1	B1	
	(b)	20 000 000 oe eg 20×10^6 or 0.2×10^8 or 2×10^n $n \neq 7$ or $\frac{6 \times 10^{(3+5)}}{21+9}$ or $\frac{6 \times 10^8}{30}$ or $\frac{6 \times 10^3}{3 \times 10^{-4}}$ or $\frac{6000}{0.0003}$ or $\frac{6000}{3 \times 10^{-4}}$		2	M1	
		Correct answer scores full marks (unless from obvious incorrect working)	2×10^7		A1	
Total 3 marks						



23	$1575 = (\text{area}) \times 21$ oe or $(\text{area} =) 75$ or $1575 = \pi \times r^2 \times 21$ oe or $r^2 = \frac{1575}{21\pi} (= 23.8(732\dots))$ oe or $r = \sqrt{\frac{1575}{21\pi}} (= 4.88(602\dots))$ oe		3	M1 for finding the area using Vol = cross sectional area $\times$ height or finding r or r^2 using $\text{vol} = \pi r^2 h$ NB r^2 and r can be rounded or truncated
	$\frac{84}{\text{"75"}}$ oe or $\frac{84}{\pi \text{"4.88"}}$ oe or $\frac{84}{\pi \text{"23.8"}}$ oe			M1 for $\frac{84}{\text{area of circle}}$
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	1.12		A1 accept 1.06 – 1.121
				Total 3 marks

24	(a)	35 000 000	1	B1
	(b)	$8.2 \times 10^5 + 6\,780\,000$ oe or $820\,000 + 6\,780\,000$ oe or $7\,600\,000$ or 76×10^5 oe or 7.6×10^n where $n \neq 6$	2	M1 Allow correct mixture of ordinary numbers and standard form numbers
		7.6×10^5		A1
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>			
				Total 3 marks



26	(a)		0.000 084	1	B1 cao
	(b)	52×10^{145} or 5.2×10^n or $p \times 10^{146}$ where $1 \leq p < 10$		2	M1
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	5.2×10^{146}		A1
					Total 3 marks



Question	Working	Answer	Mark	Notes
18 (a)		71 800 000	1	B1
(b)	Eg $1.88 \times 10^7 + 3.10 \times 10^8 + 2.64 \times 10^8 + 7.18 \times 10^7$ or 18 800 000 + 310 000 000 + 264 000 000 + 71 800 000 with at least 3 numbers correct			M1 for a complete method or for digits 6646
		6.646×10^8 oe	2	A1 for 6.646×10^8 oe eg 664 600 000
(c)		9.88×10^6	1	B1
19	$\tan 20^\circ = \frac{AB}{12.6}$ (AB =) $12.6 \tan 20^\circ$ or 4.58(602...) or 4.6 ($BC^2 =$) $19.3^2 - 12.6^2$ or 372.49 – 158.76 or 213(.73) (BC =) $\sqrt{19.3^2 - 12.6^2}$ or $\sqrt{213.73}$ or 14.6(195...)			M1 or for $AD = 12.6/\cos 20^\circ$ (=13.4..) and $12.6^2 + AB^2 = 13.4^2$ M1 or for (AB =) $\sqrt{13.4^2 - 12.6^2}$ M1 M1
		19.2	5	A1 for 19.19 – 19.21



21	(a)		5 700 000	1	B1
	(b)		4×10^{-3}	1	B1
	(c)		5 000 000 or 5×10^6 oe	2	B2 If not B2 then award B1 for 320000 or 3.2×10^5 oe or 5×10^n oe where $n \neq 6$
					Total 4 marks

22		$0.08 \times 170\,000 (=13600)$ or $0.92 \times 170\,000 (=156400)$			M1 oe eg $170\,000 \div 12.5$	M2 for $170\,000 \times 0.92^3$
		e.g. $0.92 \times (0.92 \times "156400")$			M1 (dep)for a complete method	
			132377	3	A1 or 132376.96	
					(SCB2 for $170\,000 \times 0.92^4 (=121786.810)$) (SCB1 for $170\,000 \times 0.24 (=40\,800)$ or $170\,000 \times 0.76 (=129\,200)$ or $170\,000 \times 1.08 (=183\,600)$ or $170\,000 \times 1.08^3 (=214151)$ or an answer of 129 200 or an answer of 214 151 – 214151.1(0))	
						Total 3 marks



Question	Working	Answer	Mark	Notes
22	$20\,000 \times 0.81^3$			M2 M1 for $20\,000 \times 0.81$ (= 16 200) or $20\,000 \times 1.19$ (= 23 800) or $20\,000 \times 1.19^3$ (= 33 703.18))
		10 629		A1 Accept 10 628 → 10.629
Total 3 marks				
23	$30 = \frac{27}{1.2x}$		3	M2 M1 for $\frac{27}{1.2x}$
		0.75		A1 oe
Total 3 marks				
24 (a)		156 000 000	1	B1
(b)		Arctic	1	B1
(c)		3.74×10^7	2	B2 B1 for 37 400 000 (oe but not in standard form)
Total 4 marks				
25 (a)		-1, 0, 1, 2, 3, 4	2	B2 B1 for -2, -1, 0, 1, 2, 3, 4 or -1, 0, 1, 2, 3
(b)		$y \leq 6$ $x + y \geq 5$ $y \geq x - 3$	2	B2 for 3 correct inequalities B1 for 2 correct inequalities (In both cases allow < in place of ≤, and > in place of ≥)
Total 4 marks				



17	$\frac{x+10}{2}=9$ or $x=8$		4	M1 (indep)
	$\frac{4+7+x+10+y+y}{6}=11$ oe or '66' – 4 – 7 – 10 (= 45)			M1 where x may be a number $7 < x < 10$
	$(y=) (6 \times 11 - 4 - 7 - 10 - '8') \div 2$			M1 ft their ft their value of x provided $7 < x < 10$ for a fully correct method
		$x=8$ and $y=18.5$ oe		A1
				Total 4 marks

18	(a)	0.0057	1	B1
	(b)	8×10^5	1	B1
	(c)	$\frac{273000}{6 \times 10^{-2}}$	2	M1 for 273 000 or digits 455
		4 550 000		A1 for 4 550 000 or 4.55×10^6 oe
				Total 4 marks

19	$100 \div 28\,440 (= 0.0035\dots)$ or $28\,440 \div (60 \times 60) (= 7.9)$		3	M1
	'0.0035...' $\times 60 \times 60$ or $100 \div '7.9'$			M1
		13		A1 for 12.65 – 13
				Total 3 marks



16	(a)		2 460 000	1	B1	accept 2,460,000 or 246 0000
	(b)		7.4×10^{-4}	1	B1	
	(c)			2	M1	for correct value not in standard form e.g. 58.3×10^5 or 583×10^4 or 0.583×10^7 oe
			5 830 000		A1	5 830 000 or 5.83×10^6 do not isw.
Total 4 marks						

17				3	M1	for one of - 5 numbers with a median of 8 - 5 numbers with a mode of 5 - 5 numbers with a range of 10 - 5 numbers with a sum of 45
					M1	for two of - 5 numbers with a median of 8 - 5 numbers with a mode of 5 - 5 numbers with a range of 10 - 5 numbers with a sum of 45
			5, 5, 8, 12, 15		A1	Note: The numbers can be in any order
Total 3 marks						

20	(a)		1	1	B1
	(b)	$3 \times 10^{125} + 2 \times 10^{124}$ or digits 1024 $\times 10^9$ oe		3	M1
		32×10^{124} or $3 \times 10^{125} + 0.2 \times 10^{125}$ or $30 \times 10^{124} + 2 \times 10^{124}$			M1 oe 'correct' answer in incorrect form.
			3.2×10^{125}		A1
					Total 4 marks

21		$5 \times 398 (= 1990)$ or $6 \times 401 (= 2406)$		3	M1 Correct total for 5 or for 6 cocoa pods
		"2406" – "1990"			M1 (M2 for $398 + 6 \times 3$ or $401 + 5 \times 3$)
			416		A1
					Total 3 marks



23	(a)	$1.4 \times 10^9 - 8.2 \times 10^7$ or $1.4 \times 10^9 - 0.082 \times 10^9$ or $140 \times 10^7 - 8.2 \times 10^7 (= 131.8 \times 10^7)$		2	M1 or for 1 318 000 000 oe but not in standard form eg 1318×10^6 or 1.318×10^n where $n \neq 9$
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	1.318×10^9		A1 Allow 1.3×10^9 or 1.32×10^9
	(b)	$\frac{9.9 \times 10^6}{9.1 \times 10^5}$ oe		2	M1
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	11		A1 allow 10.8 – 11 (inclusive) SC: if M1 not scored, award B1 for an answer of $\frac{1}{11}$ allow 10.8 – 11 for the denominator
Total 4 marks					

21	$220 \div 80 (= 2.75 \text{ or } \frac{11}{4}) \text{ oe}$			M1 for a method to find the time from B to C
	$72 \times \frac{50}{60} (= 60) \text{ oe}$			M1 for a method to find the distance from C to D Allow 0.83(333...) to 2 dp truncated or rounded
	$\frac{245 + 220 + "60"}{2.5 + "2.75" + \frac{50}{60}} \left(= \frac{525}{\cancel{73}/12} \right) \text{ oe}$			M1 for a complete method to find the average speed for entire journey 0.83(333...) to 2 dp truncated or rounded 6.0(8333...) to 2 sf truncated or rounded
		86.3		A1 for 86.3 – 86.4
				Total 4 marks

22	(a)	50 000	1	B1
	(b)	6×10^{-5}	1	B1
	(c)	$2.5 \times 10^{512-700}$ or 2.5×10^p or 0.25×10^{-187} or $p \times 10^{-188}$ where $1 \leq p < 10$	2	M1
		2.5×10^{-188}		A1
				Total 4 marks



26	(a)		8 800 000	1	B1
	(b)		Barcelona	1	B1 accept 5.5×10^6
	(c)	$3.7 \times 10^7 - 7.7 \times 10^6$ or 29 300 000 oe or 37 000 000 – 7 700 000 or 29 000 000 oe or $0.29(3) \times 10^8$ or $29(.3) \times 10^6$		2	M1 allow $2.9(3) \times 10^n$ ($n \neq 7$)
			2.9×10^7		A1 accept -2.9×10^7 accept 2.93×10^7 or -2.93×10^7
Total 4 marks					



23	(a)		0.000 587	1	B1 allow 0.000 587(000...) or .000 587
	(b)		8.4×10^7	1	B1 allow $8.4(000...) \times 10^7$
	(c)	$8.5 \times 10^{10} \div 1.47 \times 10^9 (= \frac{8500}{147})$ or $85\,000\,000\,000 \div 1\,470\,000\,000 (= \frac{8500}{147})$		2	M1
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	57.8		A1 oe eg 5.78×10 awrt 57.8 allow 58 or 5.8×10 with correct working seen
					Total 4 marks



25	(a)		604 000	1	B1
	(b)		7×10^{-5}	1	B1
	(c)	380 000 or 3.8×10^5 or 38×10^4 oe		2	M1
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	2×10^5		A1 Accept 2.0×10^5 or 2.00×10^5 etc Accept a dot or a comma for a multiplication sign eg 2 , 10^5 2 . 10^5 SC B1 for 200 000 or 20×10^4 or 0.2×10^6 oe or 2×10^n where $n \neq 5$ when given as a final answer (not for incorrect simplification of the denominator)
Total 4 marks					



24	$3892 = \pi \times 8^2 \times h$ or $\pi \times 8^2 (= 64\pi = 201\dots)$		3	M1 allow use of 3.14... or $\frac{22}{7}$ for π
	$(h =) \frac{3892}{\pi \times 8^2}$ oe eg $3892 \div 64 = 60.8\dots$ and $60.8\dots \div \pi$			M1 allow use of 3.14... or $\frac{22}{7}$ for π
	Correct answer scores full marks (unless from obvious incorrect working)	19.4		A1 allow 19.3 – 19.4
				Total 3 marks

25	(a)	5.2×10^8	1	B1
	(b)	0.000 087 9	1	B1
	(c)	35×10^{-138} or $3.5 \times 10 \times 10^{-138}$ or 3.5×10^n where $n \neq -137$	2	M1
		Correct answer scores full marks (unless from obvious incorrect working)		A1
				Total 4 marks



21	eg $4x + 8y = 60$ or $3x + 6y = 45$ $- 4x - 6y = 4$ $+ 4x - 6y = 4$ $(14y = 56)$ $(7x = 49)$		3	M1	Correct method to eliminate x or y : coefficients of x or y the same and correct operator to eliminate selected variable (condone any one arithmetic error in multiplication) or correctly writing x or y in terms of the other variable and correctly substituting.
	eg $4x - 6\left(\frac{15-x}{2}\right) = 4$ or $4(15-2y) - 6y = 4$ oe			M1	dep correct method to find second variable using their value from a correct method to find first variable or for repeating above method to find second variable.
	eg $x + 2 \times 4 = 15$ or $7 + 2 \times y = 15$			A1	dep on M1
	Working required	$x = 7, y = 4$			Total 3 marks
22	(a)	0.000 0932	1	B1	
	(b)	2.4×10^5	2	B2	If not B2, then B1 for 240 000 or 24×10^4 oe or 2.4×10^a $a \neq 5$
	(c)	1.8×10^{121}	2	B2	If not B2, then B1 for 18×10^{120} or 1.8×10^b $b \neq 121$
					Total 5 marks

