Name: _____

Higher Maths GCSE
Calculator Sample Paper

Envision Tuition

MATHEMATICS TUTORS

Date:

Time: 90 Minutes

Total marks available: 80

Total marks achieved: _____

ENVISION TUITION

Questions

Q1.

A number, *n*, is rounded to 2 decimal places.
The result is 4.76

Using inequalities, write down the error interval for *n*.

.....

(Total for question = 2 marks)

Q2.

Lewis has a copper pipe with a length of 150 cm and a mass of 800 grams.

He cuts a piece of the copper pipe with a length of 90 cm.

Work out the mass of this piece of copper pipe.

..... grams

(Total for Question is 2 marks)

Q3.

Jane bought a house for £60 000
She then sold the house for a profit of 12%.

Work out how much Jane sold the house for.

£.....

(Total for question = 2 marks)

Q4.

Calculate the value of $\sqrt{\frac{\tan 60° + 1}{\tan 60° - 1}}$

Write down all the figures on your calculator display.
You must give your answer as a decimal.

.....

(Total for Question is 2 marks)

Q5.

Solve the simultaneous equations

$4x + 6y = 5$
$7x + 5y = -10.5$

x = ...

y = ...

(Total for question = 4 marks)

Q6.

Jack bought a new boat for £12 500

The value, £V, of Jack's boat at the end of n years is given by the formula

$$V = 12\,500 \times (0.85)^n$$

(a) At the end of how many years was the value of Jack's boat first less than 50% of the value of the boat when it was new?

.....

(2)

A savings account pays interest at a rate of R% per year.
Jack invests £5500 in the account for one year.

At the end of the year, Jack pays tax on the interest at a rate of 40%.
After paying tax, he gets £79.20

(b) Work out the value of R.

.....

(3)

(Total for question = 5 marks)

Q7.

* A supermarket has two special offers on lemonade.

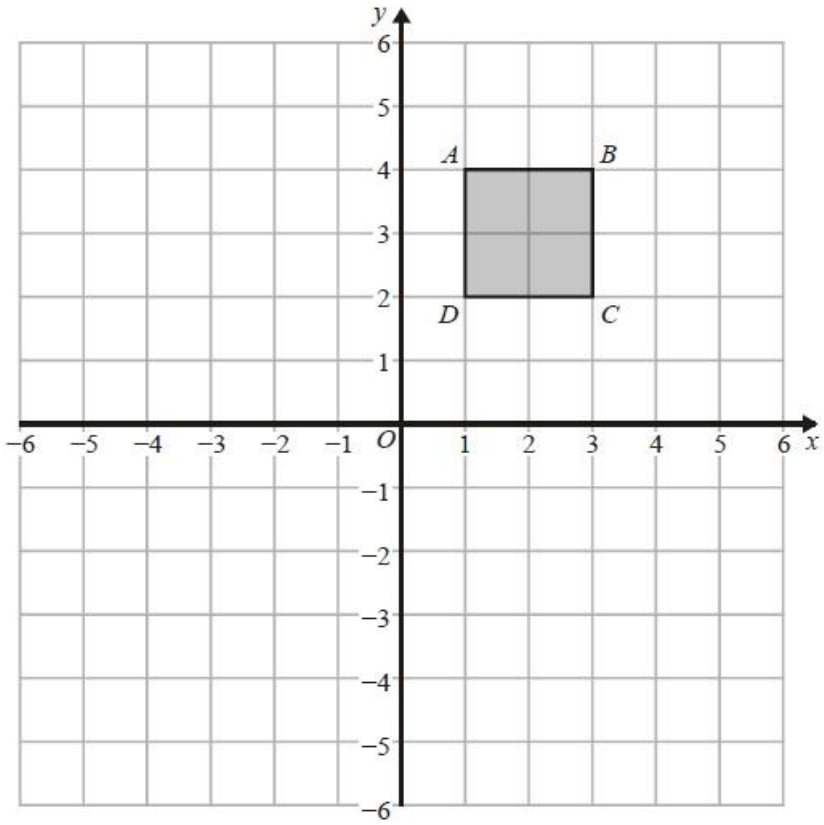
The normal price of a 2.5 litre bottle of lemonade is £1.60
The normal price of a 0.33 litre can of lemonade is 28p.

Jerry is going to buy 4 bottles of the lemonade on special offer or 30 cans of the lemonade on special offer.

Which special offer is the better value for money?

(Total for question = 5 marks)

Q8.



Square *ABCD* is transformed by a combined transformation of a reflection in the line $x = -1$ followed by a rotation.

Under the combined transformation, two vertices of the square *ABCD* are invariant.

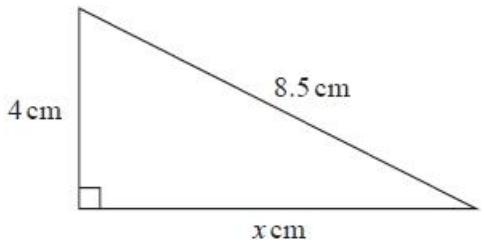
Describe fully one possible rotation.

.....

(Total for question = 2 marks)

Q9.

Here is a right-angled triangle.



Work out the value of *x*.

x = ...

(Total for question = 2 marks)

Q10.

The value of p is 4.3
The value of q is 0.4

Both p and q are given correct to the nearest 0.1

(a) Write down the lower bound for p.

.....

(1)

$$r = p + \frac{1}{q}$$

(b) Work out the upper bound for r.
You must show all your working.

.....

(3)

(Total for question = 4 marks)

Q11.

The diagram shows a pyramid.

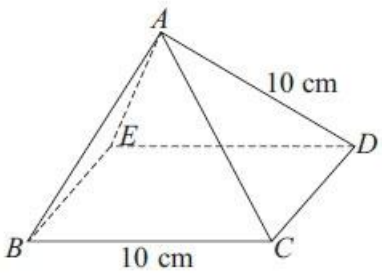


Diagram **NOT** accurately drawn

$BCDE$ is a square with sides of length 10 cm.
The other faces of the pyramid are equilateral triangles with sides of length 10 cm.

(a) Calculate the volume of the pyramid.
Give your answer correct to 3 significant figures.

. . . . . cm^3

(4)

(b) Find the size of angle DAB.

.....

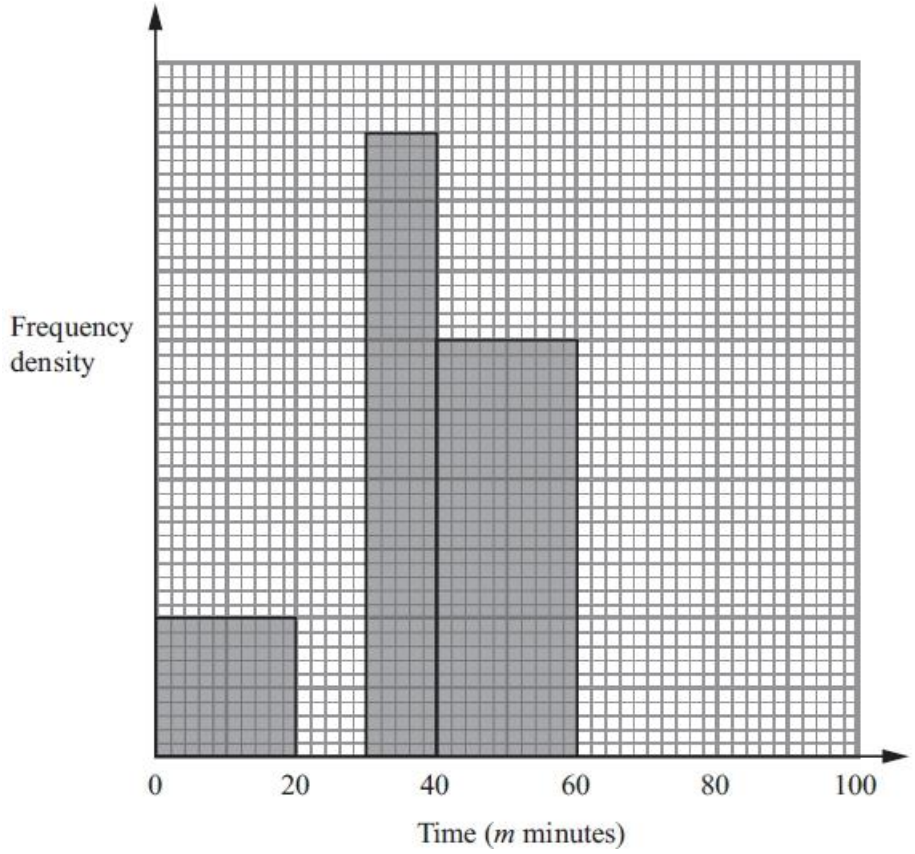
(2)

(Total for Question is 6 marks)

Q12.

The table and the histogram show some information about the time, in minutes, taken by a group of students to travel to college in one week.

Time (m minutes)	Frequency
$0 < m \leqslant 20$	20
$20 < m \leqslant 30$	30
$30 < m \leqslant 40$	
$40 < m \leqslant 60$	
$60 < m \leqslant 100$	48



(a) Use the histogram to complete the table.

(2)

(b) Use the table to complete the histogram.

(2)

(c) Work out an estimate for the median time.

..... minutes

(2) (Total for Question is 6 marks)

Q13.

There are 95 girls and 87 boys in Year 13 at a school.

One girl is going to be chosen for the role of Head Girl.
A different girl is going to be chosen for the role of Deputy Head Girl.
One boy is going to be chosen for the role of Head Boy.
A different boy is going to be chosen for the role of Deputy Head Boy.

Work out how many different ways this can be done.

.....

(Total for question = 3 marks)

Q14.
ABC is an isosceles triangle.

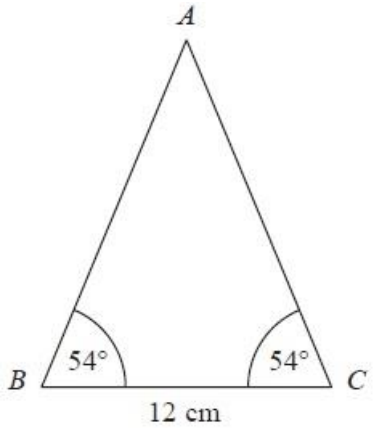


Diagram **NOT** accurately drawn

Work out the area of the triangle.

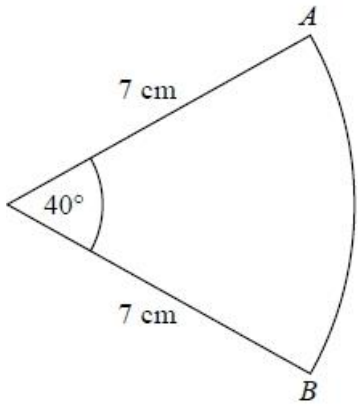
Give your answer correct to 3 significant figures.

..... cm^2

(Total for Question is 4 marks)

Q15.

The diagram shows a sector of a circle of radius 7 cm.

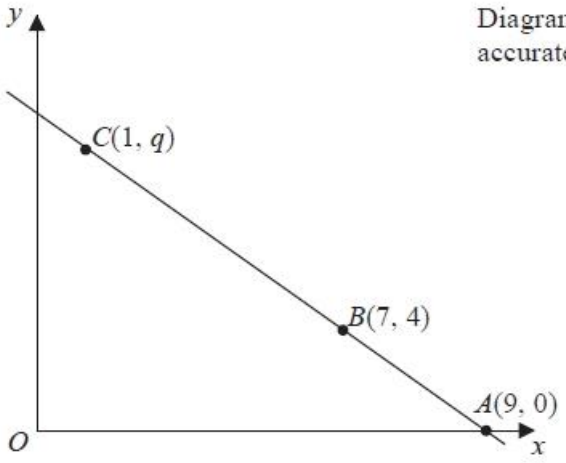


Work out the length of arc *AB*.
Give your answer correct to 3 significant figures.

..... cm

(Total for question = 2 marks)

Q16.



The points *A*, *B* and *C* lie on a straight line.

The coordinates of *A* are (9, 0).
The coordinates of *B* are (7, 4).
The coordinates of *C* are (1, *q*).

Work out the value of *q*.

.....

(Total for Question is 3 marks)

Q17.

Write $x^2 + 6x - 7$ in the form $(x + a)^2 + b$ where a and b are integers.

.....

(Total for question = 2 marks)

Q18.

The density of ethanol is 1.09 g/cm^3
The density of propylene is 0.97 g/cm^3

60 litres of ethanol are mixed with 128 litres of propylene to make 188 litres of antifreeze.

Work out the density of the antifreeze.
Give your answer correct to 2 decimal places.

..... g/cm^3

(Total for question = 4 marks)

Q19.

Brian is x years old.
Peter is 4 years older than Brian.
Amy is 2 years younger than Brian.

The total of their ages is 26 years.

Work out the value of x.

.....

(Total for Question is 4 marks)

Q20.

There are only red sweets and yellow sweets in a bag.

There are n red sweets in the bag.
There are 8 yellow sweets in the bag.

Sajid is going to take at random a sweet from the bag and eat it.

He says that the probability that the sweet will be red is $\frac{7}{10}$

(a) Show why the probability cannot be $\frac{7}{10}$

(3)

After Sajid has taken the first sweet from the bag and eaten it, he is going to take at random a second sweet from the bag.

Given that the probability that both the sweets he takes will be red is $\frac{3}{5}$

(b) work out the number of red sweets in the bag.

You must show all your working.

(5)

(Total for question = 8 marks)

Q21.

$f(x) = x^3$
$g(x) = 4x - 1$

(a) Find fg(2)

.....

(2)

$h(x) = fg(x)$

(b) Find an expression for $h^{-1}(x)$

$h^{-1}(x)$ = ...

(3)

(Total for question = 5 marks)

Q22.

At the start of year n, the quantity of a radioactive metal is P_n
At the start of the following year, the quantity of the same metal is given by

$P_{n+1} = 0.87P_n$

At the start of 2016 there were 30 grams of the metal.

What will be the quantity of the metal at the start of 2019?
Give your answer to the nearest gram.

..... grams

(Total for question = 3 marks)

Mark Scheme

Q1.

Question	Working	Answer	Mark	Notes
		$4.755 \leq n < 4.765$	B2 [B1	for $4.755 \leq n < 4.765$ for 4.755 or 4.765 or $4.764\dot{9}$]

Q2.

PAPER: 5MB3H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
		480	2	M1 for using a correct ratio of $\frac{800}{150}$ oe or $\frac{150}{800}$ oe or $\frac{90}{150}$ oe or $\frac{150}{90}$ oe A1 cao [SC: B1 for $477 \leq$ answer < 480 if no working and M0 scored]

Q3.

PAPER: 5MB3H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
		67200	2	M1 for 0.12×60000 (= 7200) oe A1 cao

Q4.

		Working	Answer	Mark	Notes
		$\sqrt{\frac{2.73\ldots}{0.732\ldots}}$	1.931851...	2	M1 for 2.73... or 0.732...or 3.73...or 1.931 or 1.932 or 1.93 or $(1+\sqrt{3})$ or $(\sqrt{3}-1)$ or $(2+\sqrt{3})$ **or** 1.65... **or** 0.855... A1 for 1.9318(5...) SC: B1 for 2.5127(17...)

Q5.

Question	Working	Answer	Mark	Notes
		$x = -4$ $y = 3.5$	M1	process to eliminate one variable or rearrangement of one equation leading to substitution (condone 1 arithmetic error)
			A1	for either $x = -4$ or $y = 3.5$
			M1	(dep on M1) correct substitution of found value or a correct process after starting again (condone one arithmetic error)
			A1	cao

Q6.

Question	Working	Answer	Mark	Notes
9 (a)		5	M1	evaluates $(0.85)^n$ or $12\,500 \times (0.85)^n$ for at least one value of n
			A1	cao
(b)		2.4	P1	for a process to find the amount of interest before tax, eg $79.20 \div 0.6$ (= 132)
			P1	for a process to find value of R, eg "132"÷5500×100
			A1	cao

Q7.

5MB3H_01 November 2015					
Question		Working	Answer	Mark	Notes
*			Bottle with reason	5	**Cans** M1 for 30×0.28 – 10×0.25 (=5.9) oe **Bottles** M1 0.15 × 1.60 (=£0.24) oe or 0.15 × 6.40 (=0.96) oe M1 (dep) for 1.60 – 0.24 (=£1.36 per bottle, or £5.44 for 4 bottles) oe **Best value** M1 for "1.36" ÷ 2.5 (=0.544 £/litre) and "5.9" ÷ 9.9 (=0.595…£/litre) oe C1 (dep on M1) for 0.544 and 0.595… and bottle identified OR M1 for 2.5 ÷ "1.36 (=1.83… litres/£) and 9.9 ÷"5.9" (=1.67… litres/£) C1 (dep on M1) for 1.67... and 1.83… and bottle identified

Q8.

Question	Answer	Mark	Mark scheme	Additional guidance
	Description	C2	for (rotation) 90° clockwise about (–1, 0) or (rotation) 90° anticlockwise about (–1, 6) or (rotation) 180° about (–1, 2) or (rotation) 180° about (–1, 4)	Award 0 marks if there is reference to other transformations eg coordinates given as vectors (which is a translation)
		(C1	for (–1, 0) or (–1, 6) or (–1, 2) or (–1, 4))	

Q9.

Question	Answer	Mark	Mark scheme	Additional guidance
	7.5	M1 A1	for correct use of Pythagoras, eg. $8.5^2 - 4^2$ (= 56.25) or $4^2 + x^2 = 8.5^2$ for 7.5 or $7\frac{1}{2}$ or $\frac{15}{2}$	Must have values substituted Trigonometry may be used but M1 only awarded when complete method shown.

Q10.

Question		Working	Answer	Mark	Notes
	(a)		4.25	1	B1 cao
	(b)		7.20-7.21	3	B1 4.35 or 0.35 M1 for $4.35 + \frac{1}{0.35}$ A1 7.2(0)-7.21 or $\frac{1009}{140}$ from a correct method seen

Q11.

Question		Working	Answer	Mark	Notes
	(a)	Let O be the centre of the base. $OB^2 + OC^2 = 10^2$; $OB^2 = 50$ $AO^2 = AB^2 - OB^2 = 50$ Vol = $\frac{1}{3} \times 10^2 \times \sqrt{50}$ **OR** Let M be the midpt of side BC and let O be the centre of the base. $AM^2 + MC^2 = 10^2$; $AM^2 = 75$ $AO^2 = AM^2 - MO^2 = 50$ Vol = $\frac{1}{3} \times 10^2 \times \sqrt{50}$	236	4	M1 correct method to start to find BD or BO using triangle OBC or triangle BCD (oe) Eg. $OB^2 + OC^2 = 10^2$ **or** $BO^2 = 50$ **or** $BO = \sqrt{50}$ (=7.07..) **or** $BO = \frac{\sqrt{200}}{2}$ **or** $10^2 + 10^2 = BD^2$ **or** $BD^2 = 200$ **or** $BD = \sqrt{200}$ (=14.1..) M1 (dep) correct method to find height of pyramid using triangle AOB Eg. $AO^2 = 10^2 - '\sqrt{50}'^2$ **or** $AO^2 = 50$ **or** $AO = \sqrt{50}$ (=7.07..) M1 (indep) $\frac{1}{3} \times 10^2 \times '\sqrt{50}'$ (but **not** $\frac{1}{3} \times 10^2 \times 10$) A1 235 – 236 **OR** M1 correct method to start to find height of a face using triangle AMC (oe) Eg. $AM^2 + 5^2 = 10^2$ **or** $AM^2 = 75$ **or**

					$AM = \sqrt{75}$ (=8.66...) M1 (dep) correct method to find height of pyramid using triangle *AOM* Eg. $AO^2 = '\sqrt{75}'^2 - 5^2$ **or** $AO^2 =$ 50 **or** $AO = \sqrt{50}$ (=7.07..) M1 (indep) $\frac{1}{3} \times 10^2 \times '\sqrt{50}'$ (but **not** $\frac{1}{3} \times 10^2 \times 10$) A1 235 – 236 **OR** M1 for sin 45 = $\frac{x}{10}$ **or** cos 45 = $\frac{x}{10}$ M1 for $h = 10 \times \sin 45$ **or** $h = 10 \times \cos 45$ (=7.07..) M1 (indep) $\frac{1}{3} \times 10^2 \times$'7.07...' (but **not** $\frac{1}{3} \times 10^2 \times 10$) A1 235 – 236
	(b)	Angle *ABO* = 45° Angle *DAB* = 180 – 45 – 45 **OR** In Δ*BAD*, cos *A* = $\frac{10^2 + 10^2 - '\sqrt{200}'^2}{2 \times 10 \times 10} = 0$ **OR** In Δ*BOA*, cos *B*= $\frac{'\sqrt{50}'}{10}$ Angle *BAD* = 180 – '45' – '45' **OR** sin *A* = $\frac{'\sqrt{50}'}{10}$ *A* = 45 Angle *BAD* = 2 × '45'	90	2	M1 Angle *DAB* = 180 – 2× '45' A1 89.98 – 90 **OR** M1 cos *BAD* = $\frac{10^2 + 10^2 - '\sqrt{200}'^2}{2 \times 10 \times 10}$ A1 89.98 – 90 **OR** M1 sin *A* = $\frac{'\sqrt{50}'}{10}$ A1 89.98 - 90

Q12.

5MB1H_01					
Question		Working	Answer	Mark	Notes
	(a)		(20), (30), 45, 60, (48)	2	M1 for frequency = fd × column width, can be implied by 1 frequency correct OR fd correctly marked on vertical axis 2cm=1unit OR identifying 1 cm^2 as frequency of 5oe A1 45 and 60 both correct
	(b)		histogram bars	2	B2 for 2 correct histogram bars; heights at 6cm and 2.4cm (B1 1 correct bar)
	(c)	Area method: Total area 40.6 cm^2 For median: ÷2 = 20.3 0 to 40 is 19 cm^2 median lies 41–43 OR Proportionality method: Total 203 ÷ 2 = 101.5; 0 to 40 is 95 40–60: 6.5÷60×20=2.16 Median is 40+2.16 = 42.16 OR 204÷2=102; 0 to 40 is 95 40-60: 7÷60×20=2.3… Median is 40+2.33=42.33	41 – 43	2	Area method: M1 ft for calculation of total area and division by 2 (eg 40.6÷2 or 20.3) A1ft answer 41–43 OR Proportionality method: M1 ft for 203÷2=101.5 and 6.5÷60×20=2.16 or 204÷2=102 and 7÷60×20=2.33… A1 ft answer 41–43

Q13.

Question		Working	Answer	Mark	Notes
			66 814 260	3	M1 method for combinations for any 2 roles 95 × 94 (= 8930) or 87 × 86 (7482) M1 method for all combinations 95 × 94 × 87 × 86 A1 66 814 260

Q14.

PAPER: 1MA0_2H				
Question	**Working**	**Answer**	**Mark**	**Notes**
		49.5	4	M1 for $\tan 54 = \frac{\text{height}}{6}$ M1 for (height =) 6 × tan54 (=8.2-8.3) M1 for $\frac{1}{2}$ × '8.258..' × 12 A1 for 49.2 - 50 **OR** M1 for $\cos 54 = \frac{6}{AC}$ M1 for $(AC =) \frac{6}{\cos 54}$ (=10.2(07...)) M1 for $\frac{1}{2}$ × 12 × '10.207' × sin54 A1 for 49.2 - 50 **OR** M1 for $\frac{AC}{\sin 54} = \frac{12}{\sin 72}$ M1 for $(AC =) \frac{12}{\sin 72}$ × sin54 (=10.2(07...)) M1 for $\frac{1}{2}$ × 12 × '10.207' × sin54 A1 for 49.2 – 50

Q15.

Paper 1MA1: 2H			
Question	**Working**	**Answer**	**Notes**
		4.89	M1 $\frac{40}{360} \times 2 \times \pi \times 7$ oe A1 4.8 – 4.9

Q16.

Paper: 5MB3H_01					
Question		Working	Answer	Mark	Notes
			16	3	M1 for a correct first step in a process to find q, eg. a right-angled triangle drawn with correct vertical and horizontal lengths shown or correctly finding the difference in x coordinates and the difference in y coordinates of any two of the three given points M1 for a complete method to find q A1 cao

Q17.

Question	Working	Answer	Mark	Notes
13		$(x + 3)^2 - 16$	M1	for $(x + 3)^2$ or $(x^2 + 6x - 7 =) x^2 + 2ax + a^2 + b$
			A1	cao

Q18.

Question	Answer	Mark	Mark scheme	Additional guidance
	1.01	P1	for 1.09×60 (= 65.4 or $\frac{327}{5}$) **or** 0.97×128 (= 124.16 or $\frac{3104}{25}$)	Note that the volumes may be converted to ml, eg 1.09×60000 (= 65400)
		P1	for 1.09×60 (= 65.4 or $\frac{327}{5}$) **and** 0.97×128 (= 124.16 or $\frac{3104}{25}$) **or** "65.4" + "124.16" (= 189.56 or $\frac{4739}{25}$)	
		P1	for a complete process to find the density of antifreeze eg ("65.4" + "124.16") ÷ 188 or 189.56 ÷ 188 or $\frac{4739}{25} \div 188$	Candidates working in ml must use 188,000
		A1	for answer in the range 1.00 to 1.01	If an answer within the range is seen in working but then rounded incorrectly award full marks. Accept 1 for 1.00 Note that the correct value is 1.008.....

Q19.

Question		Working	Answer	Mark	Notes
		$x + x + 4 + x - 2 = 26$ $3x + 2 = 26$ $3x = 24$ $x = 8$ OR $26 - 4 = 22$ $22 + 2 = 24$ $24 \div 3$	8	4	M1 $x + x + 4$ or $x + x - 2$ or $x + 4 + x - 2$ or "expression in x" + x + 4 = 26 or "expression in x" + x – 2 = 26 M1(dep) "3"x + "2" = 26 M1 "3"x = 26 - "2" A1 cao OR M1 26 – 4 or 26 + 2 M1 "22" + 2 or "28" - 4 M1 "24" ÷ 3 A1 cao OR M3 6 + 8 + 12 seen (M2 three ages that meet the criteria x, $x + 4$ and $x - 2$) (M1 two trials of three ages added or a set of three ages that would add to 26) A1 cao

Q20.

Question	Answer	Mark	Mark scheme	Additional guidance
(a)	Shown	M1	for $\frac{n}{n+8}$ **or** starts to work with ratios, eg 3:7	
		M1	forms equation and clears fractions, eg $10n = 7n + 56$ or $10n + 3(n + 8) = 10(n + 8)$ **or** equates $\frac{3}{10} = \frac{8}{x}$ or $\frac{3}{10} = \frac{8}{n+8}$ **or** continues to work with ratios, eg 3:7 = 24:56	
		C1	gives the total sweets eg $\frac{80}{3}$ oe **or** number of red sweets $n = \frac{56}{3}$ oe **or** gives number of red as $\frac{56}{3}$ **OR** award 3 marks for a complete written argument, eg, P(y) = $\frac{3}{10}$ and there are 8 yellows. This cannot work as 3 is not a factor of 8 (and $\frac{3}{10}$ is in its simplest form)	Does not have to restate the $\frac{7}{10}$; giving a different probability will suffice
(b)	28	P1	for $\frac{n}{n+8}$ and $\frac{n-1}{n+7}$ oe	
		P1	forms an appropriate equation, eg $\frac{n}{n+8} \times \frac{n-1}{n+7} = \frac{3}{5}$	
		P1	for correctly forming a quadratic ready for solving, eg $an^2 + bn + c$ (= 0), $2n^2 - 50n - 168$ (= 0), $n^2 - 25n - 84$ (= 0) oe	Note we do not need to see "= 0"; just the LHS is sufficient.
		P1	process to solve quadratic equation, ft a 3 term quadratic factorising eg $(n + 3)(n - 28)$ (=0) oe **or** completing the square **or** correct use of formula eg $\frac{--25 \pm \sqrt{25^2 - 4 \times -84}}{2}$, $\frac{--50 \pm \sqrt{50^2 - 4 \times 2 \times -168}}{2 \times 2}$	
		A1	cao	Award 0 marks for a correct answer with no supportive working.

Q21.

Question	Working	Answer	Mark	Notes
(a)		343	M1	for $g(2) = 7$ or $fg(x) = (4x - 1)^3$
			A1	cao
(b)		$\frac{\sqrt[3]{x}+1}{4}$	M1	for $h(x) = (4x - 1)^3$
			M1	for a correct first step to find inverse, e.g. $\sqrt[3]{x} = 4y - 1$
			A1	cao

Q22.

Question	Working	Answer	Mark	Notes
		19 or 20	M1	for correct method to find the quantity in 2017, e.g. 0.87×30 (= 26.1)
			M1	(dep) for complete iterative process, e.g. (quantity in 2018 =) $0.87 \times$ "26.1" (= 22.707), (quantity in 2019 =) $0.87 \times$ "22.707" (= 19.75509)
			A1	for answer of 19.75509 correctly rounded or truncated to the nearest whole number