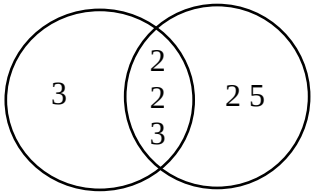
International GCSE Maths				
Apart from Questions 10, 14, 15, 22, 24 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.				
Q	**Working**	**Answer**	**Mark**	**Notes**
1 (a)		−2, −1, 0, 1, 2	2	B2 for −2, −1, 0, 1, 2 with no additions or repeats (B1 for 4 of −2, −1, 0, 1, 2 with no additions or repeats **or** for 6 values with no more than one incorrect value e.g. all of −2, −1, 0, 1, 2, 3 **or** for 5 values with one error)
(b)		Closed circle at $x = 1$ and a line with an arrow to the left	1	B1 for a closed circle at $x = 1$ and a line with an arrow of any length to the left Allow] for a closed circle Allow a line without an arrow if it reaches to at least −3
				Total 3 marks

2	0.65 × 300 oe			M1
		195		A1 (SCB1 for 105)
				Total 2 marks

3	$12.8^2 + x^2 = 16^2$ oe or $163.84 + x^2 = 256$ or $(x^2 =) 16^2 - 12.8^2$ $(= 92.16)$ or $(x^2 =) 256 - 163.84$ $(= 92.16)$		4	M1 for applying Pythagoras theorem correctly Allow $\cos^{-1}\left(\frac{12.8}{16}\right)(= 36.9...)$ **and** $\frac{x}{\sin(36.9...)} = \frac{16}{(\sin 90)}$
	$(x =) \sqrt{16^2 - 12.8^2}$ $(= \sqrt{92.16})$ $(= 9.6)$ or $(x =) \sqrt{256 - 163.84}$ $(= \sqrt{92.16})$ $(= 9.6)$			M1 for square rooting Allow $x = \frac{16}{(\sin 90)} \times \sin(36.9...)$
	(12.8 – "9.6") + "9.6" + "9.6" + 16 + 16 + 16 oe			M1 (dep on M1) for a complete method to find the perimeter
		70.4		A1 oe e.g. $\frac{352}{5}$
				Total 4 marks

4	(a)		15, 0, −1, 3	2	B2 for 4 correct values (B1 for 2 or 3 correct values)
	(b)	(−2, 15) (−1, 8) (0, 3) (2, −1) (3, 0) (4, 3)		2	M1 (dep on B1) ft from (a) for at least 5 points plotted correctly
			correct graph		A1 for a correct graph (clear intention to go through all the points and which must be curved at the bottom) **Note**: If a fully correct graph is shown, but an incomplete table is shown in (a), then award the marks for (a)
					Total 4 marks

5			4	B1 for 80
	for $\frac{a+75}{2}=74$ oe **or** 73			M1 for setting up an equation using the median **or** for 73
	for 80 – 16 (= 64) oe			M1 for using the range correctly **or** for 64
		64, 73, 80		A1 answers can be in any order
				Total 4 marks

6 (a)	36, 72, 108, ... **and** 120, 240, 360, ... **or** 2, 2, 3, 3 **and** 2, 2, 2, 3, 5 **or**  **or** $\frac{36\times120}{12}$ **or** 2, 2, 2, 3, 3, 5 oe		2	M1for any correct valid method e.g. for starting to list at least **three** multiples of each number 2, 2, 3, 3 **and** 2, 2, 2, 3, 5 seen (may be in a factor tree or a ladder diagram and ignore 1) (Allow 2 × 2 as 4) **or** a fully correct "Venn" diagram
		360		A1 or $2^3 \times 3^2 \times 5$ oe (allow $2^3 . 3^2 . 5$)
(b)		$5^2\times7^4\times11$	2	B2 for $5^2\times7^4\times11$ (in any order) (B1 for 660 275 or correct unsimplified product or $5^a\times7^b\times11^c$ where 2 of *a*, *b* and *c* are correct)
				Total 4 marks

2	36	120
2	18	60
3	9	30
	3	**10**

7	$220 \div 80$ (= 2.75 or $\frac{11}{4}$) oe			M1 for a method to find the time from B to C
	$72 \times \frac{50}{60}$ (= 60) oe			M1 for a method to find the distance from C to D Allow 0.83(333…) to 2 dp truncated or rounded
	$\frac{245+220+"60"}{2.5+"2.75"+\frac{50}{60}}\left(=\frac{525}{73/12}\right)$ 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

8	(a)		$50\,000$	1	B1
	(b)		6×10^{-5}	1	B1
	(c)	$2.5\times10^{512-700}$ **or** 2.5×10^{n} **or** 0.25×10^{-187} **or** $p\times10^{-188}$ where $1 \leq p < 10$		2	M1
			2.5×10^{-188}		A1
					Total 4 marks

9	(a)		x^9	1	B1 cao
	(b)		$64y^6$	2	B2 for $64y^6$ (B1 for ky^6 where $k \neq 64$ **or** $64y^m$ where $m \neq 6$)
	(c)	$(n \pm 3)(n \pm 4)$		2	M1 for $(n \pm 3)(n \pm 4)$ or $(n + a)(n + b)$ where $ab = 12$ or $a + b = -7$ Condone use of a different letter to n
			$(n - 3)(n - 4)$		A1
					Total 5 marks

10	3 × 2.5 (= 7.5) oe or 2 × 3 × 2.5 (= 15) oe or 12 × 3 (= 36) oe or 2 × 12 × 3 (= 72) oe or 12 × 2.5 (= 30)		6	M1 for area of rectangle
	(2 × 3 × 2.5) + (2 × 12 × 3) + (12 × 2.5) (= 117) or (2 × 7.5) + (2 × 36) + (12 × 2.5) (= 117) or 15 + 72 + 30 (= 117)			M1 for a complete method to find the surface area
	1 + 0.1 (= 1.1) **or** 100(%) + 10(%) (= 110(%)) **or** $\frac{26.95}{110}$ (= 0.245) oe			M1
	26.95 ÷ "1.1" (= 24.5(0)) **or** 26.95 ÷ "110" × 100 (= 24.5(0)) **or** 26.95 × 100 ÷ "110" (= 24.5(0)) oe **or** "0.245" × 100 (= 24.5(0)) oe			M1 dep on previous M1
	"117" ÷ 15 (= 7.8 or 8) **and** "8" × "24.50" (= 196) **or** "117" ÷ 15 (= 7.8 or 8) **and** 200 ÷ "24.5" (= 8.1...) **or** "117" ÷ 15 (= 7.8 or 8) **and** 200 ÷ "8" (= 25)			M1for working with a whole number of tins (rounded up) to reach figures where a decision can be made
		Correct figures to show that Jonty is correct		A1 e.g. 196 7.8 or 8 **and** 8.1... 24.5 **and** 25
				Total 6 marks

11	$\frac{110}{360}\times\pi\times7.1^2$ oe or $\frac{110}{360}\times3.14....\times7.1^2$ oe		2	M1 for a complete method to find the area
		48.4		A1 accept 48.3 – 49.2
				Total 2 marks

12	(a)	$n(3n^2+5n-12n-20)$ **or** $n(3n^2-7n-20)$ **or** $(3n^2+5n)(n-4)$ **or** $(n^2-4n)(3n+5)$ **or** $3n^3+5n^2-12n^2-20n$		2	M1 for a correct partial expansion (may be unsimplified) (allow one error in the expansion of $(n-4)(3n+5)$ e.g. for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for $3n^2-7n\ldots$ **or** for $\ldots-7n-20)$
			$3n^3-7n^2-20n$		A1 oe e.g. if correct answer seen allow further factorisation to $n(3n^2-7n-20)$
	(b)	$\frac{12}{4x}+\frac{2(x+2)}{4x}+\frac{x}{4x}$ oe **or** $\frac{12+2(x+2)+x}{4x}$ oe $\frac{3(8x)}{8x^2}+\frac{4x(x+2)}{8x^2}+\frac{2x^2}{8x^2}$ oe **or** $\frac{3(8x)+4x(x+2)+2x^2}{8x^2}$ oe		3	M1 for three correct fractions with a common denominator **or** a single correct fraction
		$\frac{12+2x+4+x}{4x}$ oe **or** $\frac{24x+4x^2+8x+2x^2}{8x^2}$ oe **or** $\frac{6x^2+32x}{8x^2}$ oe **or** $\frac{3x^2+16x}{4x^2}$ oe **or** $\frac{6x+32}{8x}$ oe			M1 for a correct single fraction with brackets expanded
			$\frac{3x+16}{4x}$		A1 oe $\frac{16+3x}{4x}$
					Total 5 marks

13	(a)		$\frac{5}{12}$	2	B1 for first choice correct 0.41(666…) to 2 dp truncated or rounded
			$\frac{7}{12}, \frac{5}{12}$		B1 for second choice correct 0.58(333…) to 2 dp truncated or rounded 0.41(666…) to 2 dp truncated or rounded
	(b)	$"\frac{5}{12}" \times \frac{5}{12}$ oe		2	M1 ft from their tree diagram 0.58(333…) to 2 dp truncated or rounded
			$\frac{25}{144}$		A1 oe 0.17(361111…) to 2 dp truncated or rounded or 17.(361111)% to 2 sf truncated or rounded
	(c)	$\frac{7}{12} \times \frac{5}{12} \times \frac{x}{15}$ oe **or** $\frac{7}{12} \times \frac{5}{12} \times y$ **or** $2 \times \frac{7}{12} \times \frac{5}{12}$ oe		3	M1 for *GRB* or *RGB* or 2 × *GR* or 2 × *RG*
		$2 \times \frac{7}{12} \times \frac{5}{12} \times \frac{x}{15} = \frac{7}{24}$ oe **or** $2 \times \frac{7}{12} \times \frac{5}{12} \times y = \frac{7}{24}$ oe **or** $\frac{\frac{7}{24}}{2 \times \frac{7}{12} \times \frac{5}{12}} \left(= \frac{3}{5}\right)$ oe			M1 (ft their tree diagram) for a complete method 0.29(166…) to 2 dp truncated or rounded
			9		A1
					Total 7 marks

14	*ABC* = 90° **and** *ACB* (= *ADB*) = 180 – 90 – 55 (= 35) **or** *ABO* = 55° **and** *AOB* = 180 – 2 × 55 (= 70) **or** *BDC* = 55°, *ADC* = 90° **and** *ADB* = 90 – 55 (= 35)		4	M1
		35		A1 for *ADB* = 35
	Angles in a semicircle are 90° Angles in a triangle add to 180° (Angles in a triangle add to 180°) Angles in the same segment (are equal) OR angles at the circumference subtend(ed) from the same arc/chord of the circle (are equal) **or** Angles in an isosceles triangle (are equal) Angles in a triangle sum to 180° (Angles in a triangle add to 180°) Angle at the centre is 2 × (double) angle at circumference / angle at circumference is ½ angle at centre **or** Angles in the same segment (are equal) OR angles at the circumference subtend(ed) from the same arc/chord of the circle Angles in a semicircle are 90°			B2 (dep on M1) for all 3 reasons appropriate to their method B1 (dep on M1) for one correct circle theorem appropriate to their method) NB For the third method only 2 reasons are required
				Total 4 marks

15	E.g. n, $n + 1$, $n + 2$ $(n^2 =)n^2$ $((n+1)^2 =)n^2+n+n+1=n^2+2n+1$ oe $((n+2)^2 =)n^2+2n+2n+4=n^2+4n+4$ oe or E.g. $n-1$, n, $n + 1$ $((n-1)^2 =)n^2-n-n+1=n^2-2n+1$ oe $(n^2 =)n^2$ $((n+1)^2 =)n^2+n+n+1=n^2+2n+1$ oe		3	M1 for 3 appropriate terms for their 3 numbers **and** for correctly finding the expansion of at least 2 squares (Allow 2 × middle number + 2)
	$n^2+n^2+2n+2n+4\ (=2n^2+4n+4)$ oe and $2(n+1)^2=2n^2+2n+2n+2(=2n^2+4n+2)$ oe or $n^2-2n+1+n^2+2n+1\ (=2n^2+2)$ oe			M1 for finding the sum of first and last square **and** double the square of the middle (Allow 2 × middle number + 2)
	E.g. $2n^2+4n+4=2n^2+4n+2+2$ oe or $2(x+1)^2+2=2(x+1)^2+2$ oe or $2n^2+2=2n^2+2$ oe	Complete proof		A1 for conclusion from two correct expressions e.g. $2n^2 + 4n + 4$ **and** $2n^2 + 4n + 2$
				Total 3 marks

16	$\frac{100}{2}[2\times1+(100-1)\times4](=19\,900)$ oe or $1+(41-1)\times4\,(=161)$ oe or $1+(100-1)\times4\,(=397)$ oe		4	M1 for method to find the sum of the first 100 terms or for finding the 41st term or for finding the 100th term
	$\frac{40}{2}(2\times1+(40-1)\times4)(=3160)$ oe or $\frac{41}{2}(2\times1+(41-1)\times4)(=3321)$ oe or $100 - 41 + 1\ (=60)$ oe			M1 for method to find the sum of the first 40 terms or 41 terms or for finding the number of terms from the 41st term to the 100th term
	"19 900" – "3160" or $\frac{"60"}{2}["161"+"397"]$ or $\frac{"60"}{2}[2\times"161"+("60"-1)\times4]$ oe			M1 for finding the difference or for finding the sum from the 41st term to the 100th term
		16 740		A1
				Total 4 marks

17	(i)		19	1	B1
	(ii)		0	1	B1
	(iii)		11	1	B1
	(iv)		28	1	B1
					Total 4 marks

18	$\sqrt{4} : \sqrt{9}\ (= 2:3)$ or $\frac{\sqrt{4}}{\sqrt{9}}\left(= \frac{2}{3}\right)$ oe or $\sqrt{9} : \sqrt{4}\ (= 3:2)$ or $\frac{\sqrt{9}}{\sqrt{4}}\left(= \frac{3}{2}\right)$ oe		4	M1 for finding the ratio or fraction for lengths for A : B or B : A
	$\sqrt[3]{125} : \sqrt[3]{343}\ (= 5:7)$ or $\frac{\sqrt[3]{125}}{\sqrt[3]{343}}\left(= \frac{5}{7}\right)$ oe or $\sqrt[3]{343} : \sqrt[3]{125}\ (= 7:5)$ or $\frac{\sqrt[3]{343}}{\sqrt[3]{125}}\left(= \frac{7}{5}\right)$ oe			M1 for finding the ratio or fraction for lengths for B : C or C : B
	A : B = 10 : 15 and B : C = 15 : 21 oe			M1 for mainpulating A : B and B : C so that both B values are equal
		10 : 21		A1 Allow 1 : 2.1 SC3 for 21 : 10 with all working shown
				Total 4 marks

19	(a)		$-\frac{4}{3}$	1	B1
	(b)	$3(x^2 + 4x) + 19$ **and** $3[(x + 2)^2 - 2^2] + 19$ **or** $3\left(x^2 + 4x + \frac{19}{3}\right)$ **and** $3\left((x+2)^2 - 2^2 + \frac{19}{3}\right)$ **or** a = 3 and $2ab$ = 12 oe and $b^2a + c$ = 19 oe **or** a = 3 and $b = \frac{12}{2\times 3}$ oe and $c = -\frac{12^2}{4\times 3} + 19$ oe			M1 for correctly taking out a factor of 3 and correctly completing the square **or** for equating coefficients by expanding $a(x+b)^2 + c = ax^2 + 2abx + b^2a + c$ **or** for equating coefficients by using $ax^2 + bx + c = a\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a} + c$
			$3(x + 2)^2 + 7$		A1 accept a = 3, b = 2, c = 7
					Total 3 marks

20	(a)(i)		(−6, 1)	2	B1
	(ii)		(−2, −4)		B1
	(b)	(−1, 6), (3, −2), (7, 6)	Fully correct graph	2	B2 for a fully correct graph (B1 for a V shape with least value at (3, −2))
	(c)		−3, 4	2	B2 for 2 correct values in any order (B1 for 1 correct value)
					Total 6 marks

21	16 ÷ 0.5 (= 32) or a correct value on the FD scale or 10 small squares =1 watermelon oe 25 small squares (1 large square) =16 ÷ 6.4 = 2.5 watermelon oe			M1 for use of area to represent frequency or one correct frequency from the 4 remaining bars
	15 × 1 + 16 + 23 × 1 + 30 × 1 + 12 × 1.5 **or** 15 + 16 + 23 + 30 + 18 **or** 16 + 0.1 × (15 × 10 + 23 × 10 + 30 × 10 + 12 × 15) oe **or** (150 + 160 + 230 +300 +180) × 0.1 oe **or** (6 + 6.4 + 9.2 + 12 + 7.2) × 2.5 oe			M1 (dep on M1) for a fully correct method, allow one error in products or number of squares but must be the sum of 5 parts
		102		A1
				Total 3 marks

22	11.45 or 11.55 or 79.5 or 80.5 or 74.5 or 75.5		4	B1 Accept $11.54\dot{9}$ for 11.55 $80.4\dot{9}$ for 80.5 $75.4\dot{9}$ for 75.5
	180 – (74.5 + 79.5) (= 26)			M1 for a correct calculation to find the upper bound of angle *B* NB 180° – (*LB* of 75° + *LB* of 80°)
	$\frac{(AC)}{\sin(26)} = \frac{11.55}{\sin(74.5)}$ oe or $\frac{(AC)}{\sin(180-74.5-79.5)} = \frac{11.55}{\sin(74.5)}$			M1 for substituting the correct bounds into the sine rule $\frac{(YZ)}{\sin("26")} = \frac{UB_1}{\sin(LB_2)}$ oe where $11.5 < UB_1 \leq 11.55$ **and** $74.5 \leq LB_2 < 75$
		5.25		A1 awrt 5.25 from correct working
				Total 4 marks

23	$3t^2 - 2\times 4t + 5$ or $3t^2 - 8t + 5$		6	M1 for differentiation of *s* with 2 out of 3 terms correct (can be implied by subsequent working)
	$3t^2 - 2\times 4t + 5 = 0$ or $3t^2 - 8t + 5 = 0$			M1 (dep on previous M1) for equating at least a 2TQ to zero (allow inequality signs), E.g. $3t^2 - 8t = 0$ or $3t^2 + 5 = 0$ (can be implied by subsequent working)
	$(t =)\frac{5}{3}$ oe $(\text{and } t = 1)$			A1 for $\frac{5}{3}$ (and *t* = 1 may be crossed out or absent) (allow $\frac{5}{3}$ = 1.6(66666) to 2 sf truncated or rounded)
	$2t - 4 = 0$			M1 for differentiation of *x* to find $at + b = 0$ (allow inequality signs) where a = 2 and b = −4
	$(t =)2$			A1 for a correct value of *t*
		$(1<)t < \frac{5}{3}$ **and** $t > 2$		A1 oe $(t > 1)$ $t < \frac{5}{3}$ and $t > 2$
				Total 6 marks

24	$(\overrightarrow{ON} =)\lambda(\mathbf{a}+\mathbf{b})(=\lambda\mathbf{a}+\lambda\mathbf{b})$ **or** $(\overrightarrow{NY} =)(1-\lambda)(\mathbf{a}+\mathbf{b})(=(1-\lambda)\mathbf{a}+(1-\lambda)\mathbf{b})$		5	M1 for finding a vector for $\overrightarrow{ON}$ **or** $\overrightarrow{NY}$ **or** $\overrightarrow{NO}$ **or** $\overrightarrow{YN}$ in terms **a** and **b** and using λ oe (can be embedded)
	$(\overrightarrow{MN}=\overrightarrow{MO}+\overrightarrow{ON}=)-0.5\mathbf{a}+\lambda\mathbf{a}+\lambda\mathbf{b}(=(\lambda-0.5)\mathbf{a}+\lambda\mathbf{b})$ **or** $(\overrightarrow{MZ}=\overrightarrow{MO}+\overrightarrow{OZ}=)-0.5\mathbf{a}+3\mathbf{b}$ **or** $(\overrightarrow{MN}=\overrightarrow{MX}+\overrightarrow{XY}+\overrightarrow{YN}=)0.5\mathbf{a}+\mathbf{b}+(\lambda-1)(\mathbf{a}+\mathbf{b})(=(\lambda-0.5)\mathbf{a}+\lambda\mathbf{b})$			M1 for finding a vector for $\overrightarrow{MN}$ **or** $\overrightarrow{NM}$ **or** $\overrightarrow{MZ}$ **or** $\overrightarrow{ZM}$
	$(\overrightarrow{MN}=\mu\overrightarrow{MZ}=)\mu(-0.5\mathbf{a}+3\mathbf{b})(=-0.5\mu\mathbf{a}+3\mu\mathbf{b})$ **or** $(\overrightarrow{ON}=\overrightarrow{OM}+\overrightarrow{MN}=)0.5\mathbf{a}+\mu(-0.5\mathbf{a}+3\mathbf{b})(=(0.5-0.5\mu)\mathbf{a}+3\mu\mathbf{b})$ **or** $(\overrightarrow{NY}=\overrightarrow{NM}+\overrightarrow{MX}+\overrightarrow{XY}=)-\mu(-0.5\mathbf{a}+3\mathbf{b})+0.5\mathbf{a}+\mathbf{b}(=(0.5+0.5\mu)\mathbf{a}+(1-3\mu)\mathbf{b})$			M1 for finding a vector for $\overrightarrow{MN}$ or $\overrightarrow{ON}$ or $\overrightarrow{NY}$ or $\overrightarrow{NM}$ or $\overrightarrow{NO}$ or $\overrightarrow{YN}$ using another variable e.g. μ oe
	$-0.5\mu=-0.5+\lambda$ oe $3\mu=\lambda$ oe	$1-\lambda=0.5\mu+0.5$ oe $1-\lambda=1-3\mu$ oe		M1 for setting up **two** simultaneous equations using the components of **a** and **b** for $\overrightarrow{MN}$ or $\overrightarrow{ON}$ or $\overrightarrow{NY}$ oe
		$\frac{3}{7}$		A1 (allow $\frac{3}{7}$ = 0.42(8571…) to 2 sf truncated or rounded)
				Total 5 marks

24 **ALT**	$(\overrightarrow{ON} =)\lambda(\mathbf{a}+\mathbf{b})(=\lambda\mathbf{a}+\lambda\mathbf{b})$ **or** $(\overrightarrow{NY} =)(1-\lambda)(\mathbf{a}+\mathbf{b})(=(1-\lambda)\mathbf{a}+(1-\lambda)\mathbf{b})$		5	M1 for finding a vector for $\overrightarrow{ON}$ **or** $\overrightarrow{NY}$ **or** $\overrightarrow{NO}$ **or** $\overrightarrow{YN}$ in terms **a** and **b** and using λ oe
	$(\overrightarrow{MN}=\overrightarrow{MO}+\overrightarrow{ON}=)-0.5\mathbf{a}+\lambda\mathbf{a}+\lambda\mathbf{b}(=(\lambda-0.5)\mathbf{a}+\lambda\mathbf{b})$ **or** $(\overrightarrow{MN}=\overrightarrow{MX}+\overrightarrow{XY}+\overrightarrow{YN}=)0.5\mathbf{a}+\mathbf{b}+(\lambda-1)(\mathbf{a}+\mathbf{b})(=(\lambda-0.5)\mathbf{a}+\lambda\mathbf{b})$			M1 for finding a vector for $\overrightarrow{MN}$ **or** $\overrightarrow{NM}$ in terms **a** and **b** and using λ oe
	$(\overrightarrow{NZ}=\overrightarrow{NO}+\overrightarrow{OZ}=)-\lambda(\mathbf{a}+\mathbf{b})+3\mathbf{b}(=-\lambda\mathbf{a}+(3-\lambda)\mathbf{b})$ **or** $(\overrightarrow{NZ}=\overrightarrow{NY}+\overrightarrow{YZ}=)(1-\lambda)(\mathbf{a}+\mathbf{b})-\mathbf{b}-\mathbf{a}+3\mathbf{b}(=-\lambda\mathbf{a}+(3-\lambda)\mathbf{b})$			M1 for finding a vector for $\overrightarrow{NZ}$ or $\overrightarrow{ZN}$ in terms **a** and **b** and using λ oe
	$\frac{\lambda-0.5}{-\lambda}=\frac{\lambda}{3-\lambda}$ oe			M1 for setting up an equation using the components of $\overrightarrow{MN}$ and $\overrightarrow{NZ}$ oe
		$\frac{3}{7}$		A1 (allow $\frac{3}{7}$ = 0.42(8571…) to 2 sf truncated or rounded)
				Total 5 marks