Apart from questions 6, 8, 13b and 24 (where the mark scheme states otherwise) the correct answer, unless clearly obtained from an incorrect method, should be taken to imply a correct method.					
Question	**Working**	**Answer**	**Mark**	**Notes**	
1	$\frac{5}{3}+\frac{11}{4}$		3	M1	converts to improper fractions
	$\frac{20}{12}+\frac{33}{12}$			M1	converts to fractions with the same common denominator
	$\frac{53}{12} = 4\frac{5}{12}$	Shown		A1	Dep on M2
	Alternative method				
	$\frac{2}{3}+\frac{3}{4}=\frac{8}{12}+\frac{9}{12}$			M1	correct method to add proper fractions
	$\frac{17}{12} = 1\frac{5}{12}$			M1	
	$1\frac{5}{12} + 1 + 2 = 4\frac{5}{12}$	Shown		A1	Dep on M2

Question	Working	Answer	Mark	Notes
2	$\frac{3}{4}\times 60$ (= 45) **or** $\frac{1}{4}\times 60 (=15)$ **OR** $\frac{3}{4}\times\frac{3}{5}\left(=\frac{9}{20}\right)$	$\frac{13}{20}$	4	M1
	$\frac{3}{5}\times$"45" (= 27) **or** $\frac{4}{5}\times$"15" (= 12) **OR** $\frac{1}{4}\times\frac{4}{5}\left(=\frac{4}{20}\right)$			M1
	$\frac{\text{"27"+"12"}}{60}$ **OR** $\text{"}\frac{9}{20}\text{"+"}\frac{4}{20}\text{"}$			M1 For a complete method
				A1 oe
3	$14^2 - 10^2$ (= 96)	11	4	M1
	"96"+ 5^2 (= 121)			M1
	$\sqrt{\text{"121"}}$			M1
				A1
4	(a =) 40 − 14 (=26)	26 34	3	M1 Method to find a
	e.g. $\frac{\text{"26"}+b}{2}=30$ **or** 30 + (30 – "26")			M1 Method to find b
				A1

Question	Working	Answer	Mark	Notes
5	30.5 ÷ 8 (= 3.8125) **OR** 60 ÷ 8 (= 7.5) "3.8125" × 60 **OR** 30.5 × "7.5"	228.75	3	M1 M2 for $30.5 \div \frac{8}{60}$ oe M1 A1 accept 229, 228.8
6	$3x + 10 = x + 52$ $3x - x = 52 - 10$ **or** $2x = 42$ **or** $x = 21$ $y = 180 - 2 \times ("21" + 52)$ **or** $y = 180 - 2 \times (3 \times "21" + 10)$ **or** $y = 180 - ("21" + 52) - (3 \times "21" + 10)$	34	4	M1 for equating the expressions for angle *P* and angle *Q* M1 for isolating the terms in *x* M1 for a complete method A1 dep on M2
7	eg $\frac{187}{147}$ **or** $\frac{147}{187}$ **or** $\frac{90}{187}$ **or** $\frac{187}{90}$ eg $90 \div \frac{187}{147}$ **or** $90 \times \frac{147}{187}$ **or** $147 \times \frac{90}{187}$ **or** $147 \div \frac{187}{90}$	71	3	M1 for an appropriate scale factor, candidates may work in either cm or m M1 for a complete method, candidates may work in either cm or m A1 70.7 – 71

Question	Working	Answer	Mark	Notes	
8	eg $8x + 4y = 18 +$ **or** $4x + 2y = 9 -$ $x - 4y = 9$ $4x - 16y = 36$ **or** $4(9 + 4y) + 2y = 9$	$x = 3$, $y = -1.5$	3	M1	correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate the selected variable (condone any one arithmetic error in multiplication) **or** writing x or y in terms of the other variable and correctly substituting
	eg $4 \times$ "3" $+ 2y = 9$ **or** $4x + 2 \times$ "-1.5" $= 9$ **or** $x = 9 + 4 \times$ "-1.5"			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
				A1	oe, dep first M1
9 (a)		4.8×10^{11}	1	B1	
(b)		$2^{14} \times 3 \times 5^{10}$	3	B3	for the correct answer
				B2	for an answer in the form $2^m \times 3 \times 5^n$, where m and n are positive integers
				B1	for at least 2 correct steps in repeated prime factorisation (including tree diagram)
(c)		29 296 875	1	B1	Accept 3×5^{10}, 2.9296875×10^7

Question	Working	Answer	Mark	Notes
10	$\pi\times\left(\frac{12}{2}\right)^2$ (=113….) or $\pi\times\left(\frac{12}{2}-2\right)^2$ (= 50.2…) or $\pi\times\left(\frac{12}{2}\right)^2\div 2$ (=56.5...) or $\pi\times\left(\frac{12}{2}-2\right)^2\div 2$ (= 25.1…)	10π	3	M1
	eg $(\pi\times 6^2-\pi\times 4^2)\div 2$ oe			M1 for a complete method
				A1

Question	Working	Answer	Mark	Notes
11	12×5.5 (= 66) $\frac{"66"+18}{20}$	4.2	3	M1 M1 for a complete method A1
12 (a)		$\frac{n}{2n-1}$	2	M1 for $2n \pm k$ oe as the denominator A1 oe
(b)	$(2n-1)^2 = 4n^2 - 4n + 1$ $4(n^2 - n) + 1$ **or** $\frac{4n^2-4n+1}{4} = n^2 - n + \frac{1}{4}$	Proved	3	M1 or $(2n + 1)^2 = 4n^2 + 4n + 1$ ft on $2n \pm k$ (k non zero) M1 or $4(n^2 + n) + 1$ **or** $\frac{4n^2+4n+1}{4} = n^2 + n + \frac{1}{4}$ A1 Conclusion

Question		Working	Answer	Mark	Notes	
13	(a)		$3x^2 - 2x - 8$	2	B2	(B1 for at least 1 correct non zero term)
	(b)	"$3x^2 - 2x - 8$" = 0	$-\frac{4}{3}, 2$	3	M1	Dep on at least B1, ft on M marks only dep on $\frac{dy}{dx}$ being a 3 term quadratic
		$(3x + 4)(x - 2)$ (=0)			M1	
		or				
		$x = \frac{2 \pm \sqrt{100}}{2 \times 3}$ or $x = \frac{2 \pm \sqrt{(-2)^2 - 4 \times 3 \times (-8)}}{2 \times 3}$				
					A1	(dep 2nd M1)
	(c)	At $x = 2$, $y = 2^3 - 2^2 - 8 \times 2 + 12$ (= 0)	Shown	2	M1	Substitutes at least one of $-\frac{4}{3}$ **or** 2 **or** their answer from (b) into $(y =)x^3 - x^2 - 8x + 12$
		or at $x = -\frac{4}{3}$, $y = \left(-\frac{4}{3}\right)^3 - \left(-\frac{4}{3}\right)^2 - 8 \times \left(-\frac{4}{3}\right) + 12$ $\left(= \frac{500}{27}\right)$				
					A1	must show that (2,0) is a turning point on the curve and give concluding statement

Question	Working	Answer	Mark	Notes	
14 (a)		97	1	B1	96 - 98
(b)		Correct graph	2	M1	for at least 4 points plotted correctly at end of interval **or** for all 6 points plotted consistently within each interval at the correct height
				A1	accept curve or line segments accept curve that is not joined to (0, 0)
(c)		14	2	M1	A line drawn at CF = 60 to meet at least one curve or sight of "55" or "69"
				A1	13 - 15 ft candidate's CFD

Question		Working	Answer	Mark	Notes	
15	(a)		$81x^8y^{20}$	2	B2	(B1 two terms correct in a product of 3 terms)
	(b)	$4n(n^2+2n-15)$ **or** $(4n^2-12n)(n+5)$ **or** $(4n^2+20n)(n-3)$	$4n^3+8n^2-60n$	2	M1	For a correct partial expansion (may be unsimplified e.g $4n(n^2+5n-3n-15)$)
					A1	
	(c)		$(2c-3d)(2c+3d)$	1	B1	
	(d)	$\frac{(4-x)(3-x)}{x(4-x)}$ or $\frac{(x-4)(x-3)}{x(4-x)}$	$\frac{3-x}{x}$	3	M1	for either numerator or denominator factorised correctly
					M1	for both numerator and denominator factorised correctly
					A1	oe

Question	Working	Answer	Mark	Notes
16 (a)	$\frac{2}{12}\times\frac{1}{11}$	$\frac{1}{66}$	2	M1 A1
(b)	Any two of $\frac{7}{12}\times\frac{3}{11}\left(=\frac{21}{132}\right)$ **or** $\frac{7}{12}\times\frac{2}{11}\left(=\frac{14}{132}\right)$ **or** $\frac{3}{12}\times\frac{2}{11}\left(=\frac{6}{132}\right)$	$\frac{41}{66}$	3	M1 for any two correct
	$2\times\frac{7}{12}\times\frac{3}{11}+2\times\frac{7}{12}\times\frac{2}{11}+2\times\frac{3}{12}\times\frac{2}{11}$			M1 for a complete method A1 oe
	Alternative method $\frac{7}{12}\times\frac{6}{11}\left(=\frac{42}{132}\right)$ **and** $\frac{3}{12}\times\frac{2}{11}\left(=\frac{6}{132}\right)$	$\frac{41}{66}$		M1 both correct
	$1-"\frac{2}{12}\times\frac{1}{11}"-\frac{7}{12}\times\frac{6}{11}-\frac{3}{12}\times\frac{2}{11}$			M1 for a complete method A1 **SC** B2 for an answer of $\frac{41}{72}$ oe

Question		Working	Answer	Mark	Notes
17	(a)	$2\pi r^2 + 2\pi r \times 2r$	$6r^2$	2	M1 A1
	(b)	S.A. $6\pi r^2 : 4\pi r^2 = 3 : 2$	Shown	3	M1 ft their answer from (a), must be in terms of r. Ratios could be seen as fractions throughout eg $\frac{3}{2}$
		$V_c : V_s = 2\pi r^3 : \frac{4}{3}\pi r^3$			M1
		$= 3 \times 2 : 4 = 3 : 2$			A1 oe eg ratios could be $\frac{3}{2}:1$

Question	Working	Answer	Mark	Notes
18	$\frac{\sqrt{8}}{\sqrt{8}-2}\times\frac{\sqrt{8}+2}{\sqrt{8}+2}$ $\frac{\sqrt{8}\left(\sqrt{8}+2\right)}{8-4}=\frac{8+2\sqrt{8}}{4}=\frac{8+4\sqrt{2}}{4}$ $=2+\sqrt{2}$	Shown	3	M1 or $\frac{2\sqrt{2}}{2\sqrt{2}-2}$ or $\frac{\sqrt{2}}{\sqrt{2}-1}$ M1 or $\frac{\sqrt{2}}{\sqrt{2}-1}\times\frac{\sqrt{2}+1}{\sqrt{2}+1}$ A1 (dep on M2) Conclusion - need not state the value of *n*
19	Angle *BCE* = 73° Angle *BDE* = 73° Angle *DEB* = 73° **and** Angle *DCB* = 180−73 (=107°) Angle *DEB* = 73° **and** Angle *DBE* = 180−73×2 (=34°) Angle *DCE* = 34° eg Alternate segment theorem Opposite angles of a cyclic quadrilateral sum to 180° Alternate angles are equal Angles in the Same segment are equal Angles in a triangle sum to 180	34	5	M1 angles may be written on the diagram M1 A1 B2 for a full set of reasons relevant to their method (B1 for at least one relevant circle theorem)

Question	Working	Answer	Mark	Notes
20	Let N be the midpoint of BC Let sides of cube have length $2a$ cm $AN^2 = 4a^2 + a^2 (= 5a^2)$ or $AM^2 = 4a^2 + a^2 + 4a^2 (= 9a^2)$ eg $\tan MAN = \frac{2a}{\sqrt{"5a^2"}}$ or $\sin MAN = \frac{2a}{\sqrt{"9a^2"}}$	41.8	4	B1 for recognising that required angle is MAN (could be marked on a diagram) M1 any $a > 0$ (a could be a number or a letter) M1 correct trig statement for angle MAN, any $a > 0$ (a could be a number or a letter) A1 41.8 - 41.82
21	$x^2 = 5^2 + y^2 - 2 \times 5 \times y \cos 60^o$ $(y-1)^2 = 5^2 + y^2 - 5y$ **or** $x^2 = 5^2 + (x+1)^2 - 5x - 5$ $y^2 - 2y + 1 = 25 + y^2 - 5y$ **or** $x^2 = 5^2 + x^2 + 2x + 1 - 5x - 5$ $5y - 2y = 25 - 1$ **or** $y = 8$ **or** $3x = 21$ **or** $x = 7$	20	5	M1 recognising need for the cosine rule M1 M1 for expansion of $(y-1)^2$ or $(x+1)^2$ in a correct equation M1 for correct linear equation with correct isolation of terms A1

Question	Working	Answer	Mark	Notes
22	eg $\overrightarrow{EX} = \overrightarrow{ED} + \overrightarrow{DC} + \overrightarrow{CX}$ or $\overrightarrow{EX} = \overrightarrow{EF} + \overrightarrow{FA} + \overrightarrow{AX}$		4	M1 a correct statement for $\overrightarrow{EX}$
	$\overrightarrow{DC} = -\mathbf{b} + \mathbf{a}$ or $\overrightarrow{CX} = -\mathbf{b} + \mathbf{a}$ or $\overrightarrow{FA} = -\mathbf{b} + \mathbf{a}$			M1
	$\overrightarrow{EX} = \mathbf{a} + 2(-\mathbf{b} + \mathbf{a})$			M1 for a complete method which gives a correct but unsimplified expression for $\overrightarrow{EX}$
		$3\mathbf{a} - 2\mathbf{b}$		A1

Question	Working	Answer	Mark	Notes
23 (a)	$y = \frac{\sqrt{x^2+k^2}}{x}, x^2y^2 = x^2+k^2 \quad x^2(y^2-1) = k^2$		3	M1 for squaring and rearranging correctly to the form $x^2(y^2-1) = k^2$
	$\frac{k}{\sqrt{p^2-1}} = k$			M1 (dep) for "$f^{-1}(p)$" = k
		$\sqrt{2}$		A1
	Alternative method			
	$p = f(k)$			M1
	$p = \frac{\sqrt{k^2+k^2}}{k}$			M1
		$\sqrt{2}$		A1
(b)	$(gf(a) =)\left(\frac{\sqrt{a^2+k^2}}{a}\right)^2$ or $(gf(x) =)\left(\frac{\sqrt{x^2+k^2}}{x}\right)^2$		3	M1
	$ka^2 - a^2 = k^2$			M1 (dep) for rearranging gf = k and isolating correctly the terms in a^2
		$\frac{k}{\sqrt{k-1}}$		A1 oe eg $\sqrt{\frac{k^2}{k-1}}$