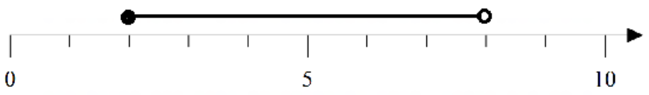
Question	Working	Answer	Mark	Notes
12	$\dfrac{4(x-6)-3(8x+2)}{12}$ oe			M1 Correct method to reduce to a single fraction. Condone invisible brackets if multiplied out correctly with one sign error only. Implied by next M1
	$\dfrac{4x-24-24x-6}{12}$ oe			M1 Multiplying out correctly (allow one sign error if 4 terms given - if incorrect answer this line must be seen) If M1 has already been awarded this can be implied by a correct answer
		$\dfrac{-10x-15}{6}$	3	A1 oe with denominator of 6 or – 6 Dependent on both M marks being awarded.
				Total 3 marks

13	$\angle BAE = \angle CDE$ **angles** in the **same segment** OR **angles** at the circumference **subtend** from the same **arc** of the circle			Allow *BAC* and *CDB* Do not accept other notations such as $\hat{A}$ and $\hat{D}$
	$\angle ABE = \angle DCE$ **angles** in the **same segment** OR **angles** at the circumference **subtend** from the same **arc** of the circle			Allow *ABD* and *DCA* Do not accept other notations such as $\hat{B}$ and $\hat{C}$
	$\angle BEA = \angle CED$ **vertically opposite** angle OR vertically **opposite angle**			M2 For two correct corresponding pairs of angles with at least one correct reason. Words in bold needed. Allow $\angle$ for angles (Allow M1 for 2 correct corresponding pair of angles)
		Two/Three angles are equal therefore *ABE* is similar to *DCE*	3	A1 A correct conclusion and 2 corresponding angles stated equal with correct reason for both angles. Ignore a third angle given even if incorrect. Allow Two/Three angles are equal therefore similar
				Total 3 marks

Question	Working	Answer	Mark	Notes
14	$[AX=]\sqrt{4^2+4^2}\ \left[=\sqrt{32} \text{ or } 5.656....\right]$ oe			M1 Allow $[AX=]\frac{1}{2}\sqrt{8^2+8^2}$
	$\tan(\angle EAX)=\frac{15}{\sqrt{4^2+4^2}}$			M1 dep on previous M mark being awarded. A correct method to find $\angle EAX$ eg using $\tan(\angle AEX)=\frac{\sqrt{4^2+4^2}}{15}$ **and** $\angle EAX=90-\angle AEX$
		69.3	3	A1 awrt 69.3 Working not required, so correct answer scores full marks (unless from obvious incorrect working)
Alternatives for the 2nd M1				
$[AE=]\sqrt{\left(\sqrt{4^2+4^2}\right)^2+15^2}\left[=\sqrt{257}\right]$ **and** $\sin EAX=\frac{15}{\sqrt{"257"}}$ or $\sin EAX=\frac{15\sin 90}{\sqrt{"257"}}$ or $\cos EAX=\frac{"\sqrt{32}"}{"\sqrt{257}"}$				
$[AE=]\sqrt{\left(\sqrt{4^2+4^2}\right)^2+15^2}\left[=\sqrt{257}\right]$ **and** $\angle EAX=90-\angle AEX$ **and** $\sin AEX=\frac{"\sqrt{32}"}{"\sqrt{257}"}$ or $\sin AEX=\frac{"\sqrt{32}"\sin 90}{"\sqrt{257}"}$ or $\cos AEX=\frac{15}{"\sqrt{257}"}$				
$[AE=]\sqrt{\left(\sqrt{4^2+4^2}\right)^2+15^2}\left[=\sqrt{257}\right]$ **and** $\cos(\angle EAX)=\left(\frac{"257"+"32"-15^2}{2\times"\sqrt{257}"\times"\sqrt{32}"}\right)$				
$[AE=]\sqrt{\left(\sqrt{4^2+4^2}\right)^2+15^2}\left[=\sqrt{257}\right]$ **and** $\cos(\angle AEX)=\frac{"257"+15^2-"32"}{2\times"\sqrt{257}"\times 15}$ **and** $\angle EAX=90-\angle AEX$				
Alternative for M1M1 -Finding *EA* from triangle *EAD*				
M1 $[AE=]\sqrt{\left(\sqrt{4^2+15^2}\right)^2+4^2}\left[=\sqrt{257}\right]$ M1dep $\sin EAX=\frac{15}{\sqrt{"257"}}$ or $\sin EAX=\frac{15\sin 90}{\sqrt{"257"}}$ or another correct method to find EAX				
				Total 3 marks

Question	Working	Answer	Mark	Notes
15	$\frac{4-\sqrt{12}}{4+\sqrt{12}}\times\frac{4-\sqrt{12}}{4-\sqrt{12}}$ oe			M1 multiplying by $\frac{4-\sqrt{12}}{4-\sqrt{12}}$ or $\frac{2-\sqrt{3}}{2+\sqrt{3}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}$ or $\frac{4-\sqrt{12}}{4-\sqrt{12}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}$ oe
	$\frac{16+12-8\sqrt{12}}{16-12}$ or $\frac{28-8\sqrt{12}}{4}$ oe			M1 multiplies out correctly but need not be simplified. Allow $\frac{4+3-4\sqrt{3}}{4-3}$ or $\frac{7-4\sqrt{3}}{1}$ or $7-4\sqrt{3}$ or $\frac{14-2\sqrt{12}-4\sqrt{3}}{2+2\sqrt{12}-4\sqrt{3}}$ oe
		$7-\sqrt{48}$	3	A1 dep on both the previous method marks being awarded. Correct answer with no working is no marks. Allow $a = 7$ and $b = 48$ ISW once $7-\sqrt{48}$ seen **NB** Do not allow for $7-4\sqrt{3}$ unless $7-\sqrt{48}$ seen in working
				Total 3 marks

16(a)	$25a^4b^6$			M1 Any 2 terms correct $25a^4\ldots$ or $\ldots a^4b^6$ or $25\ldots b^6$
		$25a^4b^6$	2	A1
(b)	$\frac{3x^2y^1}{3x^2y^{-4}}$ or $\frac{y^1}{y^{-4}}$			M1 Allow y for y^1
		y^5	2	A1 Working not required, so correct answer scores full marks (unless from obvious incorrect working)
				Total 4 marks

17(a)	$10 \leqslant 5x$ or $x < 8$ oe			M1 Condone $10 < 5x$ and $x \leqslant 8$
	$10 \leqslant 5x$ and $x < 8$ oe			M1 Correct inequality signs must be used.
		$2 \leqslant x < 8$	3	A1 oe ISW Working not required, so correct answer scores full marks (unless from obvious incorrect working) Allow [2,8) or other notation eg $\{x : 2 \leqslant x < 8\}$
(b)			1	B1 ft their inequality if answer to (a) is in the form $a \leqslant x < b$ or $a < x \leqslant b$ (one closed dot one open dot – do not accept alternative notation)
				Total 4 marks

Question	Working	Answer	Mark	Notes

18	$\left[AD=\right]\dfrac{25}{\tan 33}-20\left[=18.496...\right]$			M1 A correct method to find *AD* eg 25tan57 – 20 Must use correct angle.
	$\tan(\angle DBA)=\dfrac{\text{"18.496..."}}{25}\left[\angle DBA=36.496\right]$			M1 dep on previous M mark awarded Allow use of their *AD* (maybe marked on the diagram) M2 for $\tan(\angle BDA)=\left(\dfrac{25}{\text{"18.496"}}\right)$
	Angle of depression = 90 – "36.49…"			M1 dep on previous M mark awarded.
		53.5	4	A1 awrt 53.5 Working not required, so correct answer scores full marks (unless from obvious incorrect working) Allow marked on diagram if clearly the angle of depression.
Alt 1	$\left[AD=\right]\dfrac{25}{\tan 33}-20\left[=18.496...\right]$			M1 A correct method to find *AD* eg 25tan57 – 20 Must use correct angle
	$\left[BD=\right]\sqrt{25^2+\text{"18.496..."}^2}\left[=31.098...\right]$ **and** $\cos\angle DBA=\dfrac{25}{\text{"31.098..."}}$ **or** $\sin\angle DBA=\dfrac{\text{"18.496..."}}{\text{"31.098..."}}$			M1 dep on previous M mark awarded Allow use of their *AD* if clearly labelled or marked on the diagram for *AD*. Also allow use of their "31.098…" M2 for $BD=\sqrt{25^2+\text{"18.496..."}^2}\left[=31.098...\right]$ **and** $\cos\angle BDA=\dfrac{\text{"18.496..."}}{\text{"31.098..."}}$ or $\sin\angle BDA=\dfrac{25}{\text{"31.098..."}}$ oe
	Angle of depression = 90 – 36.49…			M1 dep on previous M mark awarded
		53.5	4	A1 awrt 53.5 Allow marked on diagram if clearly the angle of depression.
Alt 2	$\left[AD=\right]\dfrac{25}{\tan 33}-20\left[=18.496...\right]$			M1 A correct method to find *AD* eg 25tan57 – 20 Must use correct angle
	$\cos\angle CBD=\dfrac{\left(25^2+\left(20+\text{"18.496..."}\right)^2\right)+\left(25^2+18.496...^2\right)-20^2}{2\times\sqrt{25^2+\left(20+\text{"18.496..."}\right)^2}\times\sqrt{\left(25^2+18.496...^2\right)}}$			M1 dep on previous M mark awarded. Allow use of their *AD* if their value of *AD* is labelled or marked on the diagram for *AD*
	Angle of depression = $33+\text{"20.51…"}$			M1 dep on previous M mark awarded
		53.5	4	A1 awrt 53.5 Allow marked on diagram if clearly the angle of depression.
				Total 4 marks
NB: Allow use of sine or cosine rule for calculations on triangle *ABD* or *ACB* but need to rearrange to get $\cos\angle BDA$ etc				
Question	**Working**	**Answer**	**Mark**	**Notes**

19	$\frac{1}{2}y\sqrt{y^2-\left(\frac{1}{2}y\right)^2}\left[=\frac{\sqrt{3}}{4}y^2\right]$			M1 Correct method for finding the area of the triangle eg $\frac{1}{2}y^2\sin 60$ or $\frac{1}{2}y^2\cos 30$ or $\frac{y^2}{4}\tan 60$ or $\frac{y^2}{4\tan 30}$ oe or Heron's formula
	$\sqrt{3}x^2=\frac{1}{2}y\sqrt{y^2-\left(\frac{1}{2}y\right)^2}$ $[\Rightarrow 2x=y]$ oe			M1 dep on previous M being awarded. Equating the area of the rectangle to the area of the triangle eg $\sqrt{3}x^2=\frac{1}{2}y^2\sin 60$
	$2x+2\sqrt{3}x:3\times\text{"}2x\text{"}$ **or** $\text{"}y\text{"}+\text{"}y\text{"}\sqrt{3}:3y$			M1 A correct ratio un-simplified. Allow multiples. Allow $2x+2\sqrt{3}x:3\times y$ where y is a function of x based on their equation or $2x(1+\sqrt{3}):3y$ where x is a function of y based on their equation.
		$(1+\sqrt{3}):3$	4	A1 cao Working not required, so correct answer scores full marks (unless from obvious incorrect working) Allow a = 1 and b = 3
				Total 4 marks

20	$[m_{\text{LB}}=]5075$, $[m_{\text{UB}}=]5085$ $[d_{\text{LB}}=]8.725$, $[d_{\text{UB}}=]8.735$ $[r_{\text{LB}}=]8.45$, $[r_{\text{UB}}=]8.55$			B1 For one correct LB or UB stated or used.
	Volume = $\frac{1}{3}\times 3.142\times(r)^2 h$ where $8.45\le r\le 8.55$ **or** Volume = $\frac{m}{d}$ where $5075\le m\le 5085$ and $8.725\le d\le 8.735$			M1 Correct method to find Volume. Allow π instead of 3.142
	$[h=]\dfrac{5085}{\frac{1}{3}\times 3.142\times 8.45^2\times 8.725}$			M1 dep on previous M being awarded. Correct formula used for the height of cone, using m_{UB} where $5080<m_{\text{UB}}\le 5085$, r_{LB} where $8.45\le r_{\text{LB}}<8.5$, and d_{LB} where $8.725\le d_{\text{LB}}<8.73$ Allow if use π instead of 3.142
		7.8	4	A1 awrt 7.8 from correct working. Must be seen to use 5085, (Allow 5084.99…), 8.45, 8.725
				Total 4 marks

Question	Working	Answer	Mark	Notes
21	$\left(\sqrt{\dfrac{10478}{1550}}\right)^3$ $\left[=\dfrac{2197}{125}\right]$ oe			M2 The correct scale factor (17.576) Allow (M1) for $\left(\dfrac{10478}{1550}\right)^3$ or $\sqrt{\dfrac{10478}{1550}}\left[=\dfrac{13}{5}\right]$ or $5\sqrt{62}$ **and** $13\sqrt{62}$ identified as the linear SF (Accept 5 and 13)
	$V_A \times "\dfrac{2197}{125}" - V_A = 62160$ oe			M1 dep on at least one of the previous M being awarded. For equation with their SF. May be implied.
	$[V_A =]\dfrac{62160}{"\dfrac{2197}{125}"-1}$			M1 dep on previous M mark being awarded. For making V_A the subject. Allow equivalent methods
		3750		A1 cao Working not required, so correct answer scores full marks (unless from obvious incorrect working)
			5	
Alternative				
	$\left(\sqrt{\dfrac{1550}{10478}}\right)^3$ $\left[=\dfrac{125}{2197}\right]$ oe			M2 The correct scale factor (0.0568957…) Allow (M1) for $\left(\dfrac{1550}{10478}\right)^3$ or $\sqrt{\dfrac{1550}{10478}}$ or $5\sqrt{62}$ **and** $13\sqrt{62}$ identified as the linear SF (Accept 5 and 13)
	$V_B - V_B \times "\dfrac{125}{1297}" = 62160$ oe			M1 dep on at least one of the previous M being awarded. For equation with their SF. May be implied
	$[V_B =]\dfrac{62160}{1-"\dfrac{125}{2197}"} - 62160$			M1 dep for making V_B the subject and subtracting 62160. Allow equivalent methods
		3750		A1 cao Working not required, so correct answer scores full marks (unless from obvious incorrect working)
				Total 5 marks

Question	Working	Answer	Mark	Notes
22	$x+7x=180[\Rightarrow x=22.5]$			M1 Correct method to find the value of x or $7x$ Allow if 22.5 or 157.5 seen
	[Sum of angles of *BCDEFGP* =] $180(7-2)[=900]$			M1 Calculating the sum of interior angles of a relevant polygon eg For *GFEDCBA* $180(6-2)[=720]$ For *GFEDCBAH* $180(8-2)[=1080]$
	Internal angle eg *BCD* 180 + "22.5" [=202.5] oe			M1 Correct method to calculate a second relevant angle(sum of angles) eg $360-"157.5"$[=202.5] or for *GFEDCBA* $720-4\times"157.5"$ [=90] or for *GFEDCBAH* $1080-6\times"157.5"$[=135]
	$[\angle GPB=]"900"-2\times"22.5"-4\times"202.5"$			M1 Dep on all 3 previous method marks being awarded. Complete correct method to find $\angle BPG$ eg for *PGB* $180-90-22.5\times 2$ or for *PAH* $180-135$
		45	5	A1 Previous method mark must be awarded
				Total 5 marks
Alternative – using kite *BPGO* or *OAPH* (where *O* is the centre of the *n*-sided polygon)				
	$x+7x=180[\Rightarrow x=22.5]$			M1 Correct method to find the value of x or $7x$ Allow if 22.5 or 157.5 seen
	$[n=]\frac{360}{"22.5"}[=16]$			M1 finding the number of sides of the *n*-sided polygon
	$OGP=4.5x$ and $OBP=4.5x$ $BOG=5x$ or $OHP=3.5x$ and $OAP=3.5x$ $AOH=7x$			M1 Correct method to find the 3 angles of a kite
	$360-14\times"22.5"$			M1 dep on all 3 previous method marks being awarded. Complete correct method to find $\angle BPG$
		45		A1

Question	Working	Answer	Mark	Notes
23	$2x+16$ and $5x-107$			M1 or $X+16$ and $Y-107$ and $5X=2Y$
	$\frac{2x+16}{4}=\frac{5x-107}{3}$ oe			M1 dep Allow one sign error or $\frac{X+16}{Y-107}=\frac{4}{3}$ or Allow $2x+16=4y$ and $5x-107=3y$
	$[x=]34$			M1 dep on both previous Method marks. Using a correct method to solve equation(s) leading to $x=\dots$ or $y=\dots$ or $5x=\dots$ or $X=\dots$ or $Y=\dots$
	$5\times"34"-107$			M1 dep on previous mark. or $3\times"21"$
		63	5	A1 Working not required, so correct answer scores full marks (unless from obvious incorrect working)
				Total 5 marks
Alternative				
	T is the total number of eagles in 2003 t is the total number of eagles in 2015			
	$\frac{2}{7}T+16$ and $\frac{5}{7}T-107$ **or** $\frac{4}{7}t-16$ and $\frac{3}{7}t+107$			M1 May be seen as part of a correct equation.
	$\frac{2}{7}T+16=\frac{4}{7}t$ and $\frac{5}{7}T-107=\frac{3}{7}t$ oe			M1 dep for 2 correct equations
	$t=147$ **or** $T=238$			M1 dep on both previous Method marks. Using a correct method to solve equation(s) leading to $T=\dots$ or $t=$ or $5T=\dots$ or $3t=$
	$\frac{3}{7}\times"147"$ **or** $\frac{5}{7}\times"238"-107$			M1 dep on previous mark. Allow their 147 or their 238
		63		A1 Working not required, so correct answer scores full marks (unless from obvious incorrect working)

Question	Working		Answer	Mark	Notes
24	Method 1	Method 2			
	$(2x+1)$	$\left(x+\frac{1}{2}\right)$			B1 Using the factor theorem to find a factor. Implied by the 1st M1
	$3x^2 \pm nx - 6$	$6x^2 \pm mx - 12$			M1 Finding the quadratic factor. Accept synthetic division
	$\left(3x^2+7x-6\right)$	$\left(6x^2+14x-12\right)$			A1 A correct quadratic for their method
	$(3x-2)(x+3)$	$2(3x-2)(x+3)$			M1 dep on previous M mark being awarded. Correct method for solving their 3 term quadratic = 0 by formula, completing the square or factorising. Method must be seen if the quadratic is incorrect. By factorisation brackets must expand to give 2 out of 3 terms correct or correct substitution into fully correct formula (Allow 1 sign error). Allow $(6x-4)(x+3)$ or $(3x-2)(2x+6)$ Allow $(3x-2)(x+3)[=0]$ If the 1st M1A1 is awarded this may be implied by both solutions being correct.
			$\frac{2}{3}, -3$	5	A1 dep on 1st M1A1 Correct answers with no working scores no marks.
					Total 5 marks