1	(a)	(0.5 ×) 9.3 × 14.7 × sin106 **or** (9.3 × cos 16) × 14.7 **or** (9.3 × sin 74) × 14.7		2	M1 for applying the area of a triangle formula using correct values (to find half of the area of the parallelogram) **or** for a correct method to find the area of the parallelogram
			131		A1 awrt 131
	(b)	$(GE^2 =)\ 9.3^2 + 14.7^2 - 2 \times 9.3 \times 14.7 \times \cos 106$		3	M1 for the correct use of the cosine rule
		377(.9….) **or** 378 **or** 86.49 + 216.09 + 75.3… **or** 302.58 + 75.3….			M1 (dep on M1)for the correct order of operations
			19.4		A1 for 19.4 – 19.5
					Total 5 marks

2	$\sin 42 = \frac{6.5}{x}$ **or** $\frac{x}{\sin 90} = \frac{6.5}{\sin 42}$ or $\cos 48 = \frac{6.5}{x}$ [where 48 = 180 – 90 – 42]		3	M1	**or** use of tan to find the horizontal side **and** then a correct first step in Pythagoras' theorem ie [base =] $\frac{6.5}{\tan 42}$ (= 7.21...) and [x^2 =] 6.5^2 + "7.21…"^{2}
	[x =] $\frac{6.5}{\sin 42}$ **or** $\frac{6.5 \sin 90}{\sin 42}$ **or** [x =] $\frac{6.5}{\cos 48}$ [where 48 = 180 – 90 – 42]			M1	**or** complete method using Pythagoras [x =] $\sqrt{6.5^2 + "7.21..."^2}$ (If students give this statement with nothing before it they gain M2)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	9.7		A1	accept 9.7 – 9.72
					Total 3 marks

3	[ADC =] 180 – 98 (= 82)		6	M1	may be seen on diagram
	[AC^2 =] $8^2 + 7.5^2 - 2 \times 8 \times 7.5 \times \cos(98)$ (=136.95...)			M1	correct equation for AC or AC^2
	[AC =] $\sqrt{"136.95"}$ **or** $\sqrt{64 + 56.25 + 16.7....}$ (=11.7...) oe			M1	complete method to find AC showing correct order of operations
	eg [[AD =] $\frac{"11.7" \sin 35}{\sin "82"}$ (= 6.77..) **or** [DC =] $\frac{"11.7" \times \sin "63"}{\sin "82"}$ (=10.5..)oe (where **"82" = 180 – 98** , "63" = 180 – "82" – 35)			M1	correct calculation for AD **or** DC dep on 1st M1 and 2nd M1
	eg [AD =] $\frac{"11.7" \sin 35}{\sin "82"}$ **and** [DC =] $\frac{"11.7" \sin "63"}{\sin "82"}$ oe **or** [AD =] $\frac{"11.7" \sin 35}{\sin "82"}$ **and** [DC =] $\sqrt{"11.7"^2 + "6.77"^2 - 2 \times "11.7" \times "6.77" \times \cos "63"}$ [DC =] $\frac{"11.7" \sin "63"}{\sin "82"}$ **and** [AD =] $\sqrt{"11.7"^2 + "10.5"^2 - 2 \times "11.7" \times "10.5" \times \cos 35}$ Where "63" = 180 – "82" – 35			M1	correct calculations for AD **and** DC (AD = 6.77... DC = 10.5...) dep on 1st M1 and 2nd M1
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	32.8		A1	accept 32.7 – 32.9
					Total 6 marks

4	$(BC^2 =)\ 150^2 + 275^2 - (2 \times 150 \times 275 \times \cos 120)\ (= 139\ 375)$		5	M1	for correct substitution into the cosine rule
	$(BC =)\ \sqrt{150^2 + 275^2 + 41250}$ oe or $\sqrt{139375}$ or $25\sqrt{223}$ or 373.…			M1	for correct order of operations and square root
	e.g. $\frac{\sin ABC}{275} = \frac{\sin 120}{"373..."}$ **or** $275^2 = 150^2 + "373..."^2 - (2 \times 150 \times "373..." \times \cos ABC)$ **or** $\cos ABC = \frac{150^2 + "373..."^2 - 275^2}{2 \times 150 \times "373..."}$ **or** $\frac{\sin ACB}{150} = \frac{\sin 120}{"373..."}$ **or** $150^2 = 275^2 + "373..."^2 - (2 \times 275 \times "373..." \times \cos ACB)$ **or** $\cos ACB = \frac{275^2 + "373..."^2 - 150^2}{2 \times 275 \times "373..."}$			M1	(dep on 1st M1) ft 373… for a correct trig statement involving angle ABC **or** angle ACB
	$(ABC =) \sin^{-1}\left(\frac{\sin 120}{"373..."} \times 275\right) (= 39.6…)$ **or** $(ABC =) \cos^{-1}\left(\frac{150^2 + "373..."^2 - 275^2}{2 \times 150 \times "373..."}\right) (= 39.6…)$ **or** $(ACB =) \sin^{-1}\left(\frac{\sin 120}{"373..."} \times 150\right) (= 20.3…)$ **or** $(ACB =) \cos^{-1}\left(\frac{275^2 + "373..."^2 - 150^2}{2 \times 275 \times "373..."}\right) (= 20.3…)$			M1	for a complete method to find angle ABC **or** angle ACB
		140		A1	accept 140 – 140.4
					Total 5 marks

5	eg $(AD =) \sqrt{6^2 + 6^2 - 2 \times 6 \times 6 \times \cos(50)}$ $(= 5.07…)$**or** $2 \times 6\sin 25\ (=5.07...)$ **or** $\frac{6 \sin 50}{\sin 65} (= 5.07...)$ oe		6	M1	Correct expression for AD ie $AD = …$ or $x =$ oe
	eg $6 + 6 + \sqrt{6^2 + 6^2 - 2 \times 6 \times 6 \times \cos(50)}$ or $12 +$"5.07…" (=17.0)7... or 17.1)			M1	A **correct** statement of perimeter of triangle OAD
	eg (arc BC=) $\frac{50}{360} \times \pi \times 2 \times (6 + x)$ oe			M1	A correct statement for arc BC (condone missing brackets around $(6 + x)$ for this mark only)
	eg $2 \times "17.1" = 12 + 2x + \frac{50}{360} \times \pi \times 2 \times (6 + x)$ oe			M1	dep on M3 for a correct equation for x
	eg $2 \times 17.1 - 12 - \frac{30}{18}\pi = 2x + \frac{5x}{18}\pi$			M1	isolating terms in x in a correct equation
		5.89		A1	5.88 – 5.89
					Total 6 marks

6	$(AC^2 =)\ 9.7^2 + 12.3^2 - 2 \times 9.7 \times 12.3 \times \cos 115$		5	M1 for the correct use of cosine rule
	$(AC^2 =)\ 346(.2…)$ **or** $(AC =)\ \sqrt{346(.2....)}$ or 18.6…			A1 for 346 or $\sqrt{346(.2....)}$ or 18.6…
	$\frac{\sin x}{9.7} = \frac{\sin 115}{"\sqrt{346}"}$ oe or $9.7^2 = "\sqrt{346}"^2 + 12.3^2 - 2 \times "\sqrt{346}" \times 12.3 \times \cos x$ or $\frac{1}{2} \times 9.7 \times 12.3 \times \sin 115 = \frac{1}{2} \times 12.3 \times "\sqrt{346}" \times \sin x$ oe			M1 use of their AC dep on first M1 for correct use of sine rule **or** cosine rule **or** for setting up an equation using the area of a triangle formula to find $\sin x$
	$\sin x = 9.7 \times \frac{\sin 115}{"\sqrt{346}"}$ oe or $\sin x = 0.47...$ or $\cos x = \frac{"\sqrt{346}"^2 + 12.3^2 - 9.7^2}{2 \times "\sqrt{346}" \times 12.3}$ or $\cos x = 0.88...$			M1 use of their AC dep on first M1 Allow $(x =) \sin^{-1}(....)$ or $(x =) \cos^{-1}(....)$
		28.2		A1 awrt
				Total 5 marks

7	$\frac{1}{2}\times 45\times 36\times \sin 'C'$ (= 405) $\sin 'C' = \left(\frac{405\times 2}{45\times 36}\right)$ ('C' = 30) oe $(BD =)\sqrt{45^2+36^2-2\times 45\times 36\times \cos '30'}$ $\left(=\sqrt{3321-3240\times\cos '30'}\right)$ $\left(=\sqrt{515.077...}=22.695...\right)$ $\cos 'ABD' = \left(\frac{'22.695...'^2+19^2-28^2}{2\times '22.695...'\times 19}\right)$ leading to '*ABD*' = **or** $(BAD =)\ \cos^{-1}\left(\frac{28^2+19^2-'22.695...'^2}{2\times 28\times 19}\right)$ (= 53.7…) **and** $\sin 'ABD' = \frac{\sin '53.7'}{'22.695...'}\times 28$ leading to '*ABD*' =	**alternative** $\frac{2\times 405}{36}(=22.5)$ **or** $\frac{2\times 405}{45}(=18)$ $\sqrt{45^2-22.5^2}\left(=\sqrt{1518.75}=38.97\right)$ or $\sqrt{36^2-18^2}\left(=\sqrt{972}=31.17\right)$ $\sqrt{('38.97'-36)^2+22.5^2}\left(=\sqrt{515.077...}\right)$ or $\sqrt{('45'-31.17)^2+18^2}\left(=\sqrt{515.077...}\right)$		5	M1 correct substitution into the sine area formula, with their choice of symbol to represent *C*. **or** work out the perpendicular height with *BC* or *CD* as the base. M1 correct rearrangement to make sin *C* the subject **or** use Pythagoras with their found perpendicular height. M1 (dep on 1st M1, ft 30) correct expression for *BD* ft their *C* (must be less than 90°). **or** use Pythagoras to find an expression for *BD*. M1 for a complete method to find angle *ABD*
			83.9		A1 accept 83.85 – 83.9
					Total 5 marks

8	eg $\sin 65 = \frac{AB}{8.4}$ **or** $\frac{AB}{\sin 65} = \frac{8.4}{\sin 90}$		3	M1	for setting up a trig equation in *AB*
	eg $(AB =)\ 8.4\sin 65$ **or** $(AB =)\frac{8.4\sin 65}{\sin 90}$			M1	for a complete method
		7.61		A1	accept 7.61 – 7.613
					Total 3 marks

9	$\frac{\sin Q}{4.2} = \frac{\sin 18}{1.6}$ oe or $1.6^2 = 4.2^2 + RQ^2 - 2\times 4.2\times RQ\times\cos 18$ oe		6	M1	correct sine ratio - could be rearranged or correct substitution into the cosine rule using angle *R*
	$\sin^{-1}\left(4.2\times\frac{\sin 18}{1.6}\right)$ (= 54.2) **or** $\sin^{-1}(0.811...)$ $\frac{2\times 4.2\times\cos 18 \pm \sqrt{(2\times 4.2\times\cos 18)^2 - 4\times 1\times 15.08}}{2}$			M1	
	180 – "54.2" (=125.8) or *RQ* = 3.0585.. and 4.933…			M1	This can be implied by the correct value(s) (125.8 or 3.0585…) used later
	(*P* =) 180 –"125.8" – 18 (=36.2) **or** $RQ = \sqrt{4.2^2+1.6^2-2\times 4.2\times 1.6\times\cos"36.2"}$ (= 3.0585…) or 3.0585 chosen as value from cosine rule above **or** perpendicular height = 4.2sin"36.2" (= 2.4805…) (where "36.2" comes from correct working)			M1	
	(Area =) $\frac{1}{2}\times 4.2\times 1.6\times\sin("36.2")$ **or** (Area =) $\frac{1}{2}\times 4.2\times"3.0585..."\times\sin 18$ **or** (Area =) $\frac{1}{2}\times 1.6\times"2.4805..."$			M1	
		1.98		A1	awrt 1.98
					Total 6 marks

10	eg $(x + 5)(5x - 12) = x(x + 12)$		5	M1	for setting up a correct equation
	eg $4x^2 + x - 60\ (= 0)$ oe allow $4x^2 + x = 60$			A1	for writing the correct quadratic expression in the form $ax^2 + bx + c\ (= 0)$ allow $ax^2 + bx = c$
	eg $(4x-15)(x+4)(=0)$ **or** $\frac{-1 \pm \sqrt{1^2 - 4\times4\times-60}}{2\times4}$ **or** $4\left[\left(x+\frac{1}{8}\right)^2 - \left(\frac{1}{8}\right)^2\right] = 60$ oe			M1	(dep on M1) for a complete method to solve **their** 3-term quadratic (allow one sign error and some simplification – allow as far as $\frac{-1 \pm \sqrt{1+960}}{8}$) Allow + instead of ± in quadratic formula
	eg $(ADE =)\sin^{-1}\left(\frac{("3.75"+5)\sin(48)}{"3.75"+12}\right)$			M1	for a complete method for *ADE*. Allow use of $x = -4$ for this mark
	Correct answer scores full marks (unless from obvious incorrect working)	24.4		A1	accept 24.3 – 24.4
					Total 5 marks

11	$\frac{\sin ABC}{24} = \frac{\sin 64}{31}$ oe		5	M1	
	$(ABC =)\sin^{-1}\left(\frac{24\times\sin 64}{31}\right)(= 44.\ldots)$			M1	
	$180 - "44.\ldots" - 64\ (= 71.9\ldots)$			M1	accept 72
	$(DE^2 =)16^2 + 19^2 - 2\times16\times19\times\cos"71.9..."$ or $(DE =)\sqrt{16^2 + 19^2 - 2\times16\times19\times\cos"71.9..."}$ or $(DE =)\sqrt{617 - 181.8...}$ or $\sqrt{428.166...}$			M1	for DE^2 or DE
	Correct answer scores full marks (unless from obvious incorrect working)	20.7		A1	awrt 20.7
					Total 5 marks

12	eg $\frac{1}{2}(2x-1)(2x+1)\sin 30 = x^2 + x - 3.75$ oe		6	M1	for equating area of triangle with the given area
		3.5		A1	for the value of x
	$(BC^2 =)"6"^2 + "8"^2 - (2\times"6"\times"8"\times\cos 30)(=16.8(615...))$ oe or $(BC =)\ \sqrt{"16.8..."}\ (= 4.10(628\ldots))$			M1	ft dep on M1 for a correct method to find BC^2 or BC ($AB = 6$ and $AC = 8$)
	$\frac{\sin(ABC)}{"8"} = \frac{\sin 30}{\sqrt{"16.8"}}$ oe or $\frac{\sin(BCA)}{"6"} = \frac{\sin 30}{\sqrt{"16.8"}}$ oe or $"6"^2 = "8"^2 + \left(\sqrt{"16.8"}\right)^2 - \left(2\times"8"\times\sqrt{"16.8"}\times\cos(BCA)\right)$ oe or $"8"^2 = "6"^2 + \left(\sqrt{"16.8"}\right)^2 - \left(2\times"6"\times\sqrt{"16.8"}\times\cos(ABC)\right)$ oe			M1	ft dep on previous M1 for a correct method to find angle *ABC* or angle *BCA*
	$(\sin ABC =)\frac{\sin 30\times"8"}{\sqrt{"16.8"}}(= 0.974...)$ oe or $ABC = 76.9\ldots$ or $(\sin BCA =)\frac{\sin 30\times"6"}{\sqrt{"16.8"}}(= 0.730...)$ oe or $BCA = 46.9\ldots$ or $(\cos BCA =)\frac{"8"^2 + \left(\sqrt{"16.8"}\right)^2 - "6"^2}{2\times"8"\times\left(\sqrt{"16.8"}\right)}(= 0.682...)$ oe or $BCA = 46.9\ldots$ or $(\cos ABC =)\frac{"6"^2 + \left(\sqrt{"16.8"}\right)^2 - "8"^2}{2\times"6"\times\left(\sqrt{"16.8"}\right)}(= -0.226...)$ oe or $ABC = 103.0\ldots$			M1	ft dep on previous M1 for a correct rearrangement for sin *ABC* or sin *BCA* or cos *BCA* or cos *ABC*
	Correct answer scores full marks (unless from obvious incorrect working)	103		A1	accept awrt 103
					Total 6 marks

13	$9^2 = 11^2 + 16^2 - 2 \times 11 \times 16 \times \cos BCA$ oe or $11^2 = 9^2 + 16^2 - 2 \times 9 \times 16 \times \cos BAC$ or $16^2 = 9^2 + 11^2 - 2 \times 9 \times 11 \times \cos ABC$ or (area of $\triangle ABC =) \sqrt{18 \times 2 \times 7 \times 9} (= 47.6235...)$ oe		5	M1	For a start to the correct method to find angle *BCA* or angle *BAC* or angle *ABC* or a fully correct method to find the area of the triangle
	$(\cos BCA =) \left(\frac{11^2 + 16^2 - 9^2}{2 \times 11 \times 16} \right) (BCA = 32.763...)$ or $(\cos BAC =) \left(\frac{9^2 + 16^2 - 11^2}{2 \times 9 \times 16} \right) (BAC = 41.409...)$ or $(\cos ABC =) \left(\frac{9^2 + 11^2 - 16^2}{2 \times 9 \times 11} \right) (ABC = 105.826...)$ or $\frac{1}{2} \times 16 \times BD = "47.6235..."$			M1	For a correct rearrangement for cos*BCA* or cos*BAC* or cos*ABC* or a correct equation to find *BD* (accept angles to the nearest whole number rounded or truncated as long as not from incorrect working)
	(*BD* =) 11 sin"32.763..."(= 5.95...) oe eg 11 sin(180 – "41.4…" – 105.8…") (= 5.95…) or 9 sin"41.4…." (= 5.95…) oe or $\frac{"47.6235..." \times 2}{16} (= 5.95...)$ oe or $\sqrt{11^2 - "9.25"^2}$ or $\sqrt{9^2 - "6.75"^2}$ $11 \sin\left(\sin^{-1}\left(\frac{9 \sin "105.826..."}{16} \right) \right) (= 5.95…)$ oe			M1	For a correct calculation that will lead to the value of *BD* "47.6235…" may also come from 0.5 × 9 × 11 × sin"105.8…" or 0.5 × 9 × 16 × sin"41.4…" or 0.5 × 16 × 11 × sin"32.7…" [Students may find an angle by sine rule after already finding an angle and use this]
	$\tan FDB = \frac{10}{"5.95..."}$ oe			M1	For a correct expression for the required angle (in form tan*x* =… or cos*x* =… or sin*x* =…) oe
	Correct answer scores full marks (unless from obvious incorrect working)	59.2		A1	awrt 59.2
	SEE OVER FOR ALTERNATIVE SCHEME				**Total 5 marks**

Angle *DBC* = 57.237…Angle *ABD* = 48.591…*AD* = 6.75 m *CD* = 9.25 m					
13	$BD^2 = 11^2 - (16 - y)^2$ and $BD^2 = 9^2 - y^2$ oe		5	M1	For 2 different expressions in the same single variable for *BD* or BD^2
	$11^2 - (16 - y)^2 = 9^2 - y^2$ ($y = 6.75$ or $x = 9.25$)			M1	Equating the 2 expressions
	$BD = \sqrt{9^2 - (16 - "9.25")^2}$ or $\sqrt{11^2 - "9.25"^2}$ (= 5.95)			M1	A correct calculation to find BD ("9.25" or "6.75" must come from a correct method)
	$\tan FDB = \frac{10}{"5.95..."}$ oe			M1	For a correct expression for the required angle (in form tan*x* =… or cos*x* =… of sin*x* =…) oe
	Correct answer scores full marks (unless from obvious incorrect working)	59.2		A1	awrt 59.2
					Total 5 marks