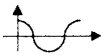
1	$15+19d=72$ Hence $d=3$ $S_n = \frac{100}{2}\{(2\times15)+(99\times3)\}$ $=16350$	M1 A1 M1 A1	**4**	Attempt to find d, from $a+(n-1)d$ or $a+nd$ Obtain $d=3$ Use correct formula for sum of n terms Obtain 16350
			4	
2	**(i)** $46\times\frac{\pi}{180}=0.802$ to 0.803	M1		Attempt to convert to radians using π and 180 (or 2π & 360)
		A1	**2**	Obtain 0.802 to 0.803, or better
	(ii) $8\times0.803=6.4$ cm	B1	**1**	State 6.4, or better
	(iii) $\frac{1}{2}\times8^2\times0.803=25.6$ to 25.7 cm^2	M1		Attempt area of sector using $\frac{1}{2}r^2\theta$ or $r^2\theta$, with θ in radians
		A1	**2**	Obtain 25.6 to 25.7, or better
			5	
3	**(i)** $\int(4x-5)\,dx=2x^2-5x+c$	M1		Obtain at least one correct term
		A1	**2**	Obtain at least $2x^2-5x$
	(ii) $y=2x^2-5x+c$ $7=2\times3^2-5\times3+c\Rightarrow c=4$ So equation is $y=2x^2-5x+4$	B1√ M1 A1	**3**	State or imply $y=$ their integral from **(i)** Use (3,7) to evaluate c Correct final equation
			5	
4	**(i)** area $=\frac{1}{2}\times5\sqrt{2}\times8\times\sin60°$ $=\frac{1}{2}\times5\sqrt{2}\times8\times\frac{\sqrt{3}}{2}$ $=10\sqrt{6}$	B1 M1 A1	**3**	State or imply that $\sin60°=\frac{\sqrt{3}}{2}$ or exact equiv Use $\frac{1}{2}ac\sin B$ Obtain $10\sqrt{6}$ only, from working in surds
	(ii) $AC^2=\left(5\sqrt{2}\right)^2+8^2-2\times5\sqrt{2}\times8\times\cos60°$	M1		Attempt to use the correct cosine formula
		A1		Correct unsimplified expression for AC^2
	$AC=7.58$ cm	A1	**3**	Obtain $AC=7.58$, or better
			6	
5	**(a)** **(i)** $\log_3\frac{4x+7}{x}$	B1	**1**	Correct single logarithm, as final answer, from correct working only
	(ii) $\log_3\frac{4x+7}{x}=2$			
	$\frac{4x+7}{x}=9$	B1		State or imply $2=\log_3 9$
	$4x+7=9x$	M1		Attempt to solve equation of form $f(x)=8$ or 9
	$x=1.4$	A1	**3**	Obtain $x=1.4$, or exact equiv
	(b) $\int_3^6\log_{10}x\,dx\approx\frac{1}{2}\times3\times(\log_{10}3+2\log_{10}6+\log_{10}9)$	B1		State, or imply, the 3 correct y-values only
	$=4.48$	M1		Attempt to use correct trapezium rule
		A1		Obtain correct unsimplified expression
		A1	**4**	Obtain 4.48, or better
			8	

6	(i)	$(1+4x)^7 = 1+28x+336x^2+2240x^3$	B1	Obtain $1 + 28x$
			M1	Attempt binomial expansion of at least 1 more term, with each term the product of binomial coeff and power of $4x$
			A1	Obtain $336x^2$
			A1 **4**	Obtain $2240x^3$
	(ii)	$28a + 1008 = 1001$ Hence $a = -\frac{1}{4}$	M1	Multiply together two relevant pairs of terms
			A1√	Obtain $28a + 1008 = 1001$
			A1 **3**	Obtain $a = -\frac{1}{4}$
			7	
7	(i)	(a) 	B1	Correct shape of $k\cos x$ graph
			B1 **2**	(90, 0), (270, 0) and (0, 2) stated or implied
		(b) $\cos x = 0.4$ $x = 66.4°, 294°$	M1	Divide by 2, and attempt to solve for x
			A1	Correct answer of 66.4° / 1.16 rads
			A1√ **3**	Second correct answer only, in degrees, following their x
	(ii)	$\tan x = 2$ $x = 63.4°, -117°$	M1	Use of $\tan x = \frac{\sin x}{\cos x}$ (or square and use $\sin^2 x + \cos^2 x \equiv 1$)
			A1	Correct answer of 63.4° / 1.56 rads
			A1√ **3**	Second correct answer only, in degrees, following their x
			8	
8	(i)	$-8 - 36 - 14 + 33 = -25$	M1	Substitute $x = -2$, or attempt complete division by $(x + 2)$
			A1 **2**	Obtain -25, as final answer
	(ii)	$27 - 81 + 21 + 33 = 0$ **A.G.**	B1 **1**	Confirm $f(3) = 0$, or equiv using division
	(iii)	$x = 3$	B1	State $x = 3$ as a root at any point
		$f(x) = (x - 3)(x^2 - 6x - 11)$	M1	Attempt complete division by $(x - 3)$ or equiv
			A1	Obtain $x^2 - 6x + k$
			A1	Obtain completely correct quotient
		$x = \frac{6 \pm \sqrt{36+44}}{2}$	M1	Attempt use of quadratic formula, or equiv, to find roots
		$= 3 \pm 2\sqrt{5}$ or $3 \pm \sqrt{20}$	A1 **6**	Obtain $3 \pm 2\sqrt{5}$ or $3 \pm \sqrt{20}$
			9	
9	(i)	$u_4 = 1.5 \times 1.02^4$	M1	Use $1.5r^4$, or find u_2, u_3, u_4
		$= 1.624$ tonnes **A.G.**	A1 **2**	Obtain 1.624 or better
	(ii)	$\frac{1.5(1.02^N - 1)}{1.02 - 1} \leq 39$	M1	Use correct formula for S_N
			A1	Correct unsimplified expressions for S_N
		$(1.02^N - 1) \leq (39 \times 0.02 \div 1.5)$	M1	Link S_N to 39 and attempt to rearrange
		$(1.02^N - 1) \leq 0.52$		
		Hence $1.02^N \leq 1.52$	A1 **4**	Obtain given inequality convincingly, with no sign errors
	(iii)	$\log 1.02^N \leq \log 1.52$	M1	Introduce logarithms on both sides and use $\log a^b = b \log$
		$N \log 1.02 \leq \log 1.52$	A1	Obtain $N \log 1.02 \leq \log 1.52$ (ignore linking sign)
		$N \leq 21.144$.	M1	Attempt to solve for N
		$N = 21$ trips	A1 **4**	Obtain $N = 21$ only
			10	

10	**(i)**	$0 = 1 - \frac{3}{\sqrt{9}}$	B1 **1**	Verification of (9, 0), with at least one step shown
	(ii)	$\int_9^a 1 - 3x^{-\frac{1}{2}}\,dx = \left[x - 6\sqrt{x}\right]_9^a$	M1	Attempt integration – increase in power for at least 1 term
			A1	For second term of form $kx^{\frac{1}{2}}$
			A1	For correct integral
		$= \left(a - 6\sqrt{a}\right) - \left(9 - 6\sqrt{9}\right)$	M1	Attempt F(a) – F(9)
		$= a - 6\sqrt{a} + 9$	A1	Obtain $a - 6\sqrt{a} + 9$
		$a - 6\sqrt{a} + 9 = 4$	M1	Equate expression for area to 4
		$a - 6\sqrt{a} + 5 = 0$	M1	Attempt to solve 'disguised' quadratic
		$\left(\sqrt{a} - 1\right)\left(\sqrt{a} - 5\right) = 0$		
		$\sqrt{a} = 1,\ \sqrt{a} = 5$	A1	Obtain at least $\sqrt{a} = 5$
		$a = 1,\ a = 25$		
		but $a \neq 9$, so $a = 25$	A1 **9**	Obtain $a = 25$ only
			10	