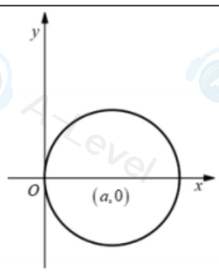
Question Number	Scheme	Marks
6	$2\log_4(x+1)=\log_4(x+1)^2$	B1
	e.g. $\log_4(12-2x)-\log_4(x+1)^2=\log_4\dfrac{12-2x}{(x+1)^2}$	M1
	$\dfrac{12-2x}{(x+1)^2}=16$	A1
	$\Rightarrow 8x^2+17x+2=0\Rightarrow x=...$	M1
	$x=-\dfrac{1}{8}$ oe e.g. -0.125	A1
		(5)
		Total 5

Question Number	Scheme	Marks
5(a)	$3^3+3^2(p+3)-3+q=0$	M1
	eg $\Rightarrow 27+9p+27-3+q=0\Rightarrow 9p+q=-51$*	A1*
		(2)
(b)	$(-p)^3+(p+3)(-p)^2-(-p)+q=9$	M1
	eg $-p^3+p^3+3p^2+p+q=9\Rightarrow 3p^2+p+q-9=0$*	A1*
		(2)
(c)	$3p^2+p+q-9=0$ $\Rightarrow 3p^2+p-51-9p-9=0$ $\Rightarrow 3p^2-8p-60=0$	M1
	$p=6$	A1
	$q=-51-9p=-105$	A1
		(3)
(d)	$\mathrm{f}(x)=x^3+9x^2-x-105$ $\mathrm{f}(x)=(x-3)(...x^2+...x+...)$	M1
	$\mathrm{g}(x)=x^2+12x+35$	A1
		(2)
		Total 9

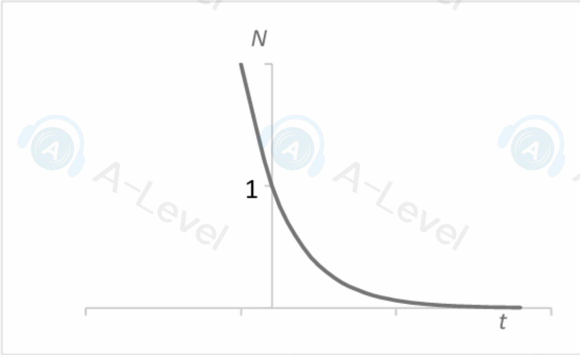
Question Number	Scheme	Marks
7. (i)	$\log_a\left(\frac{\sqrt{a}}{b}\right)=\frac{1}{2}\log_a a-\log_a b=\frac{1}{2}-k$	M1 A1
		(2)
(ii)	$\frac{\log_a a^2 b}{\log_a b^3}=\frac{2\log_a a+\log_a b}{3\log_a b}=\frac{2+k}{3k}$	M1 A1
		(2)
(iii)	$\sum_{n=1}^{50}\left(k+\log_a b^n\right)=50k+\left(1k+2k+3k+...+50k\right)$ or $\left(2k+3k+4k+...+51k\right)$	
	Uses the sum formula an AP with $n=50, d=k$	M1
	$S=50k+\frac{50}{2}\left(2k+49k\right)$ $\quad S=\frac{50}{2}\left(2k+51k\right)$	A1
	$=1325k$	A1
		(3)
		(7 marks)

Question Number	Scheme	Marks
4(i)	E.g. $2=\log_3 9$ Eg $\log_3(4x)-\log_3(5x+7)=\log_3\frac{4x}{5x+7}$	M1
	E.g. $36x=5x+7$ $\frac{4x}{5x+7}=\frac{1}{9}$	A1
	$x=\frac{7}{31}$	A1
		(3)
(ii)	$\left(\sum_{r=1}^{2}\log_a y^r=\right)\log_a y+\log_a y^2$ or $\left(\sum_{r=1}^{2}(\log_a y)^r=\right)\log_a y+(\log_a y)^2$	B1
	$\log_a y+\log_a y^2=\log_a y+(\log_a y)^2\Rightarrow 2\log_a y-(\log_a y)^2=0$ $\Rightarrow\log_a y(2-\log_a y)=0\Rightarrow\log_a y=2$	M1
	$y=a^2$	A1
		(3)
		Total 6

Question Number	Scheme	Marks
7 (a)	States either $kn=-24$ (1) or $\frac{n(n-1)}{2}k^2=270$ (2)	M1
	States both $kn=-24$ (1) and $\frac{n(n-1)}{2}k^2=270$ (2)	A1
	Substitutes $k=-\frac{24}{n}$ in equation (2) $\Rightarrow \frac{n(n-1)}{2}\left(-\frac{24}{n}\right)^2=270 \Rightarrow n=...$	M1
	$n=16$	A1
	Uses their $n=16$ in $kn=-24 \Rightarrow k=-\frac{24}{16}=-\frac{3}{2}$	dM1, A1
		(6)
(b)	$p=\frac{n(n-1)(n-2)}{3!}k^3=\frac{16\times15\times14}{6}\times\left(-\frac{3}{2}\right)^3=...$	M1
	$=-1890$	A1
		(2)
		(8 marks)

Question Number	Scheme	Marks
9(a)		B1
		(1)
(b)	$(x\pm a)^2+y^2=...$	M1
	$(x\pm a)^2+y^2=a^2$	A1
	Uses $(5,6)$ in $(x\pm a)^2+y^2=a^2$ to form and solve an equation in a	dM1
	E.g. $(5-a)^2+36=a^2 \Rightarrow 10a=61 \Rightarrow a=6.1$	
	$(x-6.1)^2+y^2=6.1^2$	A1
		(4)
		(5 marks)

Question Number	Scheme	Marks
4.(a)	States -21	B1
		(1)
(b)	Attempts $f(3)=\left(3^2-2\right)(2\times3-3)-21$	M1
	Achieves $f(3)=0 \Rightarrow (x-3)$ is a factor of $f(x)$ *	A1*
		(2)
(c) (i)	$f(x)=2x^3-3x^2-4x-15=(x-3)\left(2x^2....\pm5\right)$	B1 M1
	$=(x-3)\left(2x^2+3x+5\right)$	A1
(ii)	Attempts b^2-4ac for their $2x^2+3x+5$	M1
	Achieves $b^2-4ac<0$ and states that only root is $x=3$ o.e. *	A1*
		(5)
		(8 marks)

Question	Scheme	Marks
9(a)		
	Correct shape from or passing through a point on positive vertical axis. May extend to the left of the vertical axis and allow to pass into quadrant 4. There must be no (obvious) turning points. Labels not required on axes and ignore any that are given.	M1
	Shape and position correct, accept 1 or k as intercept on the positive vertical axis and allow to extend to the left of the vertical axis as shown. Condone (1, 0) or (k, 0) as long as it is in the correct position. The curve should approach a horizontal asymptote that is half-way between the horizontal axis and the intercept or below. Be tolerant with "wobbles" as it approaches the asymptote. May just "touch" the horizontal axis but not go below it. Labels not required on axes and ignore any that are given.	A1
		(2)
(b)	$\frac{1}{2}k = k\lambda^{5700} \Rightarrow \lambda^{5700} = \frac{1}{2}$ (see notes for method via substitution)	M1
	$\Rightarrow \lambda = \left(\frac{1}{2}\right)^{\frac{1}{5700}} = 0.999878$ to 6 d.p.*	A1*
		(2)
(c)	When $t = 3250,\ N = 15 \times 0.999878^{3250} = \ldots$	M1
	$=$ awrt 10.1 (grams)	A1
		(2)
(d)	$18 = 25 \times 0.999878^{t}$	B1
	$\Rightarrow 0.999878^{t} = \frac{18}{25} \Rightarrow t = \frac{\log\frac{18}{25}}{\log 0.999878} = \ldots$	M1
	$t = 2692.49\ldots$ so item is 2700 years old	A1
		(3)
		(9 marks)

Question Number	Scheme	Marks
2. (a)	For correct term ${}^6C_4 3^2 (ax)^4$ Sets $15 \times 3^2 a^4 = 540$ $a^4 = 4 \Rightarrow a = \pm\sqrt{2}$	M1 A1 dM1 A1 **(4)**
(b)	$\frac{1}{81} \times 3^6 + a^6$ $=17$	M1 A1 A1 **(3)** **(7 marks)**

Question Number	Scheme	Marks
6(a)(i)	Centre is $(-4, 2)$	B1
(ii)	$x^2+y^2+8x-4y=0$ $\Rightarrow (x+4)^2+(y-2)^2-16-4=0 \Rightarrow r=...$	M1
	$r=2\sqrt{5}$ oe	A1
		(3)
(b)	$x^2+y^2+8x-4y=0,\ x+2y+10=0$ $\Rightarrow (-2y-10)^2+y^2+8(-2y-10)-4y=0$ or $x^2+\left(\frac{-x-10}{2}\right)^2+8x-4\left(\frac{-x-10}{2}\right)=0$	M1
	$y^2+4y+4=0$ or e.g. $x^2+12x+36=0$	A1
	$(y+2)^2=0 \Rightarrow y=...$ or e.g. $(x+6)^2=0 \Rightarrow x=...$	dM1
	$(-6, -2)$	A1
		(4)
(c)	$x+2y+10=0 \Rightarrow m_T=-\frac{1}{2} \Rightarrow m_N=2$ or $m_N=\frac{"2"-("-2")}{"-4"-("-6")}$	M1
	Usually either $y-2=2(x+4)$ or $y+2=2(x+6)$	dM1
	$y=2x+10$	A1
		(3)
		Total 10

Question Number	Scheme	Marks
9 (a)	Substitute $t=4$ in $3\log_2(t+4)-2\log_2(t-2) \Rightarrow 3\log_2 8-2\log_2 2$ $=3\times3-2\times1=7$ ✓	M1 A1
		(2)
(b)	One correct log law applied. E.g $3\log_2(t+4)=\log_2(t+4)^3$	M1
	Correctly removes logs $\frac{(t+4)^3}{(t-2)^2}=2^7$	A1
	$t^3+12t^2+48t+64=128(t^2-4t+4) \Rightarrow t^3-116t^2+560t-448=0$	A1*
		(3)
(c)	$t^3-116t^2+560t-448=(t-4)(t^2+.....\pm112)$	M1
	$t^3-116t^2+560t-448=(t-4)(t^2-112t+112)$	A1
	Solves their $t^2-112t+112$ and finds at least the value of t greater than 2	dM1
	$t=4,\ 56+12\sqrt{21}$	A1
		(4)
		Total 9

Question Number	Scheme	Marks
3	$\int_1^4 3x+\frac{16}{x^2}-8\,dx=\frac{3}{2}x^2-\frac{16}{x}-8x\quad(+c)$	M1, A1, A1
	e.g. Area $=\frac{3}{2}(5+11)-\left[\frac{3}{2}x^2-\frac{16}{x}-8x\right]_1^4=24-\left(-12+\frac{45}{2}\right)=\frac{27}{2}$	dM1, A1
		(5) **(5 marks)**

Question Number	Scheme	Marks
2 (a)	Strip width = 1.5	B1
	$\frac{3}{4}\{4.16+2.28+2\times(2.91+a+1.73+1.37+1.43)\}=19.3\Rightarrow a=...$	M1
	$a=$ awrt 2.21	A1
		(3)
(b)	$\int_{-4}^{5}(2\,f(x)-3)\,dx=2\times19.3-[3x]_{-4}^{5}$	M1
	$=11.6$	A1
		(2)
		Total 5