Question Number	Scheme	Marks
2	$(1+px)^{10}=1+10px+\frac{10\times 9}{2}p^2x^2+\frac{10\times 9\times 8}{6}p^3x^3+...$	
	Sets $10p=15 \Rightarrow p=1.5$ o.e.	M1 A1
	Finds the value of $45p^2 \Rightarrow q=101.25$ o.e.	M1 A1
	Finds the value of $120p^3 \Rightarrow r=405$	M1 A1
		(6) **(6 marks)**

Question Number	Scheme	Marks
9 (a)	Substitute $t=4$ in $3\log_2(t+4)-2\log_2(t-2) \Rightarrow 3\log_2 8-2\log_2 2$	M1
	$=3\times 3-2\times 1=7$ ✓	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)	$t^3-116t^2+560t-448=(t-4)(t^2+.....\pm 112)$	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
5(a)	$(2+ax)^6 = 2^6 + \binom{6}{1}2^5(ax) + \binom{6}{2}2^4(ax)^2 + \ldots$	M1
	$= 64 + 192ax + 240a^2x^2 + \ldots$	A1A1
		(3)
(b)	$\left(3+\frac{1}{x}\right)^2 = 9 + \frac{6}{x} + \frac{1}{x^2}$ or $9 + \frac{3}{x} + \frac{3}{x} + \frac{1}{x^2}$	B1
	$f(x) = \left(9 + \frac{6}{x} + \frac{1}{x^2}\right)\left(64 + 192ax + 240a^2x^2 + \ldots\right) = \ldots$ Constant term is $9 \times 64 + 6 \times 192a + 240a^2$	M1
	$576 + 1152a + 240a^2 = 576 \Rightarrow 1152a + 240a^2 = 0$ $\Rightarrow 1152 + 240a = 0 \Rightarrow a = \ldots$	**d**M1
	$a = -\frac{24}{5}$	A1
		(4)
		Total 7

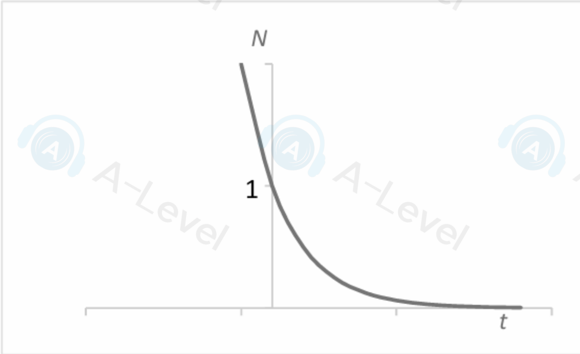
Question Number	Scheme	Marks
7 (a)	States either $kn = -24$ (1) or $\frac{n(n-1)}{2}k^2 = 270$ (2)	M1
	States both $kn = -24$ (1) and $\frac{n(n-1)}{2}k^2 = 270$ (2)	A1
	Substitutes $k = -\frac{24}{n}$ in equation (2) $\Rightarrow \frac{n(n-1)}{2}\left(-\frac{24}{n}\right)^2 = 270 \Rightarrow n = \ldots$	M1
	$n = 16$	A1
	Uses their $n = 16$ in $kn = -24 \Rightarrow k = -\frac{24}{16} = -\frac{3}{2}$	dM1, A1
		(6)
(b)	$p = \frac{n(n-1)(n-2)}{3!}k^3 = \frac{16 \times 15 \times 14}{6} \times \left(-\frac{3}{2}\right)^3 = \ldots$	M1
	$= -1890$	A1
		(2)
		(8 marks)

Question Number	Scheme	Marks
6 (a)	$2\log_4(x+3)=\log_4(x+3)^2$ or $\frac{1}{2}=\log_4 2$ o.e	B1
	Combines two terms e.g. $2\log_4(x+3)+\log_4 x=\log_4 x(x+3)^2$	M1
	e.g. $x(x+3)^2=2(4x+2)$	A1
	e.g. $x(x^2+6x+9)=8x+4\Rightarrow x^3+6x^2+x-4=0$ *	A1*
		(4)
(b) (i)	$x^3+6x^2+x-4=(x+1)(x^2+5x-4)$	M1
	$x=\frac{-5\pm\sqrt{25+16}}{2}\Rightarrow x=\frac{-5\pm\sqrt{41}}{2}$	dM1 A1
		(3)
(ii)	$x=\frac{-5+\sqrt{41}}{2}$	B1
		(1)
		(8 marks)

Question Number	Scheme	Marks
2	$(1+px)^{10}=1+10px+\frac{10\times9}{2}p^2x^2+\frac{10\times9\times8}{6}p^3x^3+\ldots$	
	Sets $10p=15\Rightarrow p=1.5$ o.e.	M1 A1
	Finds the value of $45p^2\Rightarrow q=101.25$ o.e.	M1 A1
	Finds the value of $120p^3\Rightarrow r=405$	M1 A1
		(6) **(6 marks)**

Question Number	Scheme	Marks
5	$\log_2 16x + \log_2(x+1) = 3 + \log_2(x+6)$	
	$\log_2 a = b \Rightarrow 2^b = a$	B1
	$\log_2 16x(x+1) = \log_2 8(x+6)$	M1
	$2x^2 + x - 6 = 0$	A1
	$(2x-3)(x+2) = 0$	dM1
	$x = \dfrac{3}{2}$ only	A1cso
		(5 marks)

Question	Answer	Marks	Guidance
1	Use correct logarithm property to simplify left-hand side	**M1**	Or equivalent method
	Use correct process to obtain equation without logarithms	**M1**	
	Obtain $\dfrac{2x+1}{x-3} = e^2$	**A1**	OE
	Obtain $x = \dfrac{3e^2+1}{e^2-2}$	**A1**	OE
		4	

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
	$= \text{awrt } 10.1\ (\text{grams})$	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
4(a)	$(2+px)^6=(2^6+)\ 6\times 2^5(px)+\frac{6\times 5}{2}\times 2^4(px)^2+\ldots$ or $\left(1+\frac{"p"}{2}x\right)^6=1+6\times\left(\frac{"p"}{2}x\right)+\frac{6\times 5}{2}\times\left(\frac{"p"}{2}x\right)^2+\ldots$	M1
	2^6 or 64	B1
	$+192px$ or $+240p^2x^2$	A1
	$(64+)192px+240p^2x^2$	A1
		(4)
(b)	$\left(3-\frac{1}{2}x\right)(2+px)^6\Rightarrow\left(3-\frac{1}{2}x\right)(64+192px+240p^2x^2)$	
	Attempts $3\times"240p^2"$ and $\left(-\frac{1}{2}\right)\times"192p"$	M1
	$3\times"240p^2"+\left(-\frac{1}{2}\right)\times"192p"=-\frac{3}{4}$	dM1
	$2880p^2-384p+3=0\Rightarrow p=\ldots$	ddM1
	$(p=)\ \frac{1}{8},\frac{1}{120}$	A1
		(4)
		(8 marks)

Question Number	Scheme	Marks
3(i)	$7^{x+2}=3\Rightarrow 7^2\times 7^x=3$	M1
	$\Rightarrow x=\log_7\frac{3}{7^2}$	A1
	$x=\log_7\frac{3}{49}$	A1
		(3)
Alt(i)	$7^{x+2}=3$	
	$(x+2)\log_7 7=\log_7 3$	M1
	$\Rightarrow x=\log_7 3-2$	A1
	$x=\log_7\frac{3}{49}$	A1
		(3)
(ii)	$1+\log_2 y+\log_2(y+4)=\log_2(5-y)$	
	E.g. $1+\log_2 y(y+4)=\log_2(5-y)$ or $1\rightarrow\log_2 2$	M1
	$\log_2\left(\frac{y(y+4)}{5-y}\right)=-1\Rightarrow\frac{y(y+4)}{5-y}=\frac{1}{2}$ or $\log_2(2y(y+4))=\log_2(5-y)\Rightarrow 2y(y+4)=5-y$	dM1
	$2y^2+9y-5=0$	A1
	$(2y-1)(y+5)=0\Rightarrow y=...$	ddM1
	$y=\frac{1}{2}$	A1
		(5)
		(8 marks)

Question Number	Scheme	Marks
4a	3^5 or 243	B1
		(1)
bi	$(B=)5\times 3^4p\ (=405p)\qquad(D=)10\times 3^2p^3\ (=90p^3)$	M1A1
	$B=18D\Rightarrow=405p=18\times 90p^3\Rightarrow p^2=\frac{1}{4}\Rightarrow p=-\frac{1}{2}$	M1A1
ii	$(C=)\,{}^5C_2\times 3^3\times\left(-\frac{1}{2}\right)^2=\frac{135}{2}$	M1A1
		(6)
		(7 marks)

Question Number	Scheme	Marks
2	$\left(\frac{3}{8}+4x\right)^{12}$	
	Term in x^7 is ${}^{12}C_7\left(\frac{3}{8}\right)^5(4x)^7$ or coefficient of x^7 is ${}^{12}C_7\left(\frac{3}{8}\right)^5 4^7$	M1 A1
	Coefficient is 96228	A1
		(3)
		(3 marks)