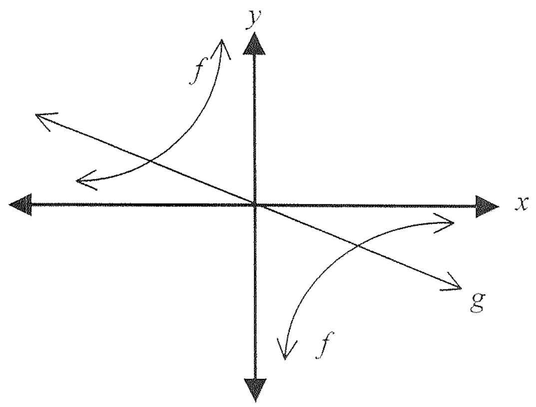
1.1	1.1.1	$2x^2 = 3x + 5$ $2x^2 - 3x - 5 = 0$ $(2x-5)(x+1) = 0$ $x = \frac{5}{2}$ or $x = -1$	(3)	(No penalty for omitting = 0) ✓ standard form ✓ factors (subs. in formula) ✓ both x-values (CA from factors)
	1.1.2	$x^2 - 4x + 2 = 0$ $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(2)}}{2(1)}$ $= \dfrac{4 \pm \sqrt{8}}{2}$ $= 3{,}41$ or $0{,}59$	(4)	✓ formula ✓ substitution into formula ✓✓ each value of x [**NOTE:**-1 mark for incorrect rounding off) Wrong formula: max ¼ for substitution)
	1.1.3	$2x - 1 = \sqrt{1-x}$ $4x^2 - 4x + 1 = 1 - x$ $4x^2 - 3x = 0$ $x(4x-3) = 0$ $x = 0$ or $x = \frac{3}{4}$ check: $2x - 1 \geq 0$ $\therefore x \geq \frac{1}{2}$ hence $x = \frac{3}{4}$ OR $-1 \neq \sqrt{1}$ $\therefore x \neq 0$ $\frac{1}{2} = \sqrt{\frac{1}{4}}$ $\therefore x = \frac{3}{4}$	(5)	✓ square both sides ✓ expansion ✓ factors ✓ both solutions ✓ rejecting $x = 0$ (checking)

1.2	$x - y = 1$ ……… .. (1) $x^2 + xy - 5x + 5y - y^2 = 0$ ………. (2) From (1): $x = y + 1$ ……. (3) Substitute (3) in (2): $(y+1)^2 + y(y+1) - 5(y+1) + 5y - y^2 = 0$ $y^2 + 2y + 1 + y^2 + y - 5y - 5 + 5y - y^2 = 0$ $y^2 + 3y - 4 = 0$ $(y+4)(y-1) = 0$ $y = -4$ or $y = 1$ $\therefore$ $x = -3$ or $x = 2$ **OR** From (1): $y = x - 1$ ……….. (4) Substitute (4) in (2): $x^2 + x(x-1) - 5x + 5(x-1) - (x-1)^2 = 0$ $x^2 + x^2 - x - 5x + 5x - 5 - x^2 + 2x - 1 = 0$ $x^2 + x - 6 = 0$ $(x+3)(x-2) = 0$ $x = -3$ or $x = 2$ $\therefore$ $y = -4$ or $y = 1$	(8)	✓ x-subject of formula ✓ substitution ✓ expansion ✓ simplification ✓ factors ✓ both values of y ✓✓ values of x ✓ y-subject of formula ✓ substitution ✓ expansion ✓ simplification ✓ factors ✓ both values of x ✓✓ values of y **(CA applies)**
		[20]	

2.1	$kx^2+3x-k=0$ and $x=-2$ is a root			
	2.1.1	$k(-2)^2+3(-2)-k=0$ $4k-6-k=0$ $3k=6$ $k=2$	(3)	✓ substitution ✓ remove brackets ✓ answer
	2.1.2	$2x^2+3x-2=0$ $(2x-1)(x+2)=0$ $x=\frac{1}{2}$ or $x=-2$ **Product** $=(-2)(\frac{1}{2})=-1$	(4)	✓substitution for $k=2$ (CA applies) ✓ factors ✓ both x-values/ only $x=½$ ✓ product [Answer only: ¼]
2.2	$f(x)=4x^2-6x+p$			
	2.2.1	$4x^2-6x+p=0$ $\Delta=b^2-4ac$ $=(-6)^2-4(4)(p)$ $=36-16p$ For non-real roots: $\Delta<0$ $\therefore\ 36-16p<0$ .... (1) $36<16p$ $\frac{36}{16}<p$ $2\frac{1}{4}<p$ **OR** From (1): $-16p<-36$ $p>2\frac{1}{4}$	(6)	✓ formula for Δ ✓ substitution ✓ value of delta ✓ $\Delta<0$ [$\Delta\le0$ max 5/6] [$\Delta=0$; $\Delta\ge0$: max 4/6] ✓ correct inequality ✓ $2\frac{1}{4}$ or 2,25 or $\frac{9}{4}$ or $\frac{36}{16}$ ✓ correct inequality ✓ $2\frac{1}{4}$
	2.2.2	$p=3$	(1)	✓ first integer greater than answer in 2.2.1 (CA)
2.3	$g(x)=ax^3+bx^2-4x+8$ $g(2)=0$ $\therefore\ a(2)^3+b(2)^2-4(2)+8=0$ $8a+4b=0$ i.e. $2a+b=0$ .... (1) $g(1)=1$ $\therefore a(1)^3+b(1)^2-4(1)+8=1$ $a+b=-3$ .... (2) (1) – (2): $a=3$ $\therefore\ b=-6$		(8)	✓ $g(2)=0$ ✓ substitution ✓ either equation in (1) ✓ $g(1)=1$ ✓ substitution ✓ simplification/ eq. (2) ✓ value of a ✓ value of b
			[22]	

3.1	$f(x) = ax^2 + bx + c \quad P(1;4)$ and $Q(0;3)$			
	3.1.1	$f(x) = a(x-p)^2 + q$ $y = a(x-1)^2 + 4$ $3 = a(0-1)^2 + 4$ $3 = a + 4$ $a = -1$ $\therefore f(x) = -(x-1)^2 + 4$ $= -x^2 + 2x - 1 + 4$ $= -x^2 + 2x + 3$ $\therefore b = 2, c = 3$ **OR** $c = 3$ Sust.$(1:4): a + b + 3 = 4$ $a + b = 1$ ....(1) $\frac{-b}{2a} = 1$ $-b = 2a$ ....(2) $(1) + (2): a = 2a + 1$ $a = -1$ $b = 2$	(6)	✓ formula ✓ substitute TP $P(1;4)$ ✓ substitute $Q(0;3)$ ✓ $a = -1$ ✓ multiplication / $b = 2$ ✓ $c = 3$ ✓ $c = 3$ ✓✓ substitute $P(1;4)$ & c ✓ axis of symmetry $\left(x = -\frac{b}{2a}\right)$ ✓ $a = -1$ ✓ $b = 2$ [**NOTE:** for $a = -1$ only✓✓, for $c = 3$ ✓, for $b = 2$ ✓]
	3.1.2	$-x^2 + 2x + 3 = 0$ $x^2 - 2x - 3 = 0$ $(x+1)(x-3) = 0$ $x = -1$ or $x = 3$ $\therefore R(-1;0)$ and $S(3;0)$	(5)	✓equating to 0 (CA applies) ✓ factors ✓ both values ✓✓ coordinates of R & S **Note:** No R & S **- 1 mark** If R = -1 & S = 3: - 1 mark [**Full answer only** : 4/5]
	3.1.3	$y \leq 4$	(1)	✓ answer
	3.1.4	$r^2 = x^2 + y^2$ $= 0^2 + 3^2 = 9$ $\therefore y = \sqrt{9 - x^2}$ **OR** $x^2 + y^2 = 9$ and $y \geq 0$	(3)	✓ circle equation ✓ substitution and r^2 value ✓ answer / equation $y = \pm\sqrt{9 - x^2}$ ✓✓ ✓✓ $x^2 + y^2 = 9$ ✓ $y \geq 0$ [Answer only 3/3]

3.2	 $-\frac{2}{x} = -\frac{x}{2}$ $x^2 = 4$ $x = 2$ or $x = -2$ $y = -1$ or $y = 1$ $(-2;1)$ and $(2;-1)$	(8)	*f*: ✓ Hyperbola shape (should not cut axes) ✓ arms in quadrants 2 and 4 *g*: ✓ Straight line with negative gradient ✓ passing through the origin Points of intersection ✓ equating the two *y*-values ✓ $x^2 = 4$ ✓ values of x ✓ values of y [NOTES:1. 1/2 in each of the following cases: * 2 pieces in 1st & 3rd quadrants * only 1 piece in 2nd or 4th 2. 2/4 if 4 pieces, 1 in each quadrant, are drawn
		[23]	

4.1	4.1.1	$8^{-\frac{2}{3}} = \left(2^3\right)^{-\frac{2}{3}}$ $= 2^{-2}$ $= \frac{1}{4}$	(2)	✓ 2^3 or 2^{-2} ✓ $\frac{1}{2^2}$ or $\frac{1}{4}$
	4.1.2	$\left(\sqrt[3]{a}\,\sqrt{b}\right)^6 = \left(\sqrt[3]{a}\right)^6\left(\sqrt{b}\right)^6$ **OR** $(a^{\frac{1}{3}}b^{\frac{1}{2}})^6$ $= \left(a^{\frac{1}{3}}\right)^6\left(b^{\frac{1}{2}}\right)^6$ $= a^2b^3$ **OR** $\left(\sqrt[3]{a}\sqrt{b}\right)^6 = \sqrt[3]{a^6}\,\sqrt{b^6} = \left(a^6\right)^{\frac{1}{3}}\left(b^6\right)^{\frac{1}{2}}$ $= a^2b^3$	(3)	✓ $\left(\sqrt[3]{a}\right)^6\left(\sqrt{b}\right)^6$ ✓ $\left(a^{\frac{1}{3}}\right)^6\left(b^{\frac{1}{2}}\right)^6$ OR $(a^{\frac{1}{3}}b^{\frac{1}{2}})^6$ ✓answer

	4.1.3	$\frac{2\times 7^{2a-1}+7^{2a+1}}{49^a}=\frac{2\times 7^{-1}\times 7^{2a}+7\times 7^{2a}}{7^{2a}}$ $=\frac{7^{2a}\left(\frac{2}{7}+7\right)}{\left(7^{2a}\right)}$ $=7\frac{2}{7}$ **or** $\frac{51}{7}$ **OR** $\frac{2.7^{2a}.7^{-1}}{7^{2a}}+\frac{7.7^{2a}}{7^{2a}}=2.7^{-1}+7$ $=7\frac{2}{7}$ **or** $\frac{51}{7}$	(4)	✓ exp. law in numerator ✓exp. law in denominator ✓ common factor ✓ answer ✓✓ exp. law each term ✓ simplifying ✓ answer
4.2	4.2.1	$\log(2\times 3)=\log 2+\log 3$ $=a+b$ [Accept : $\log(2\times 3)=\log\left(10^a\times 10^b\right)$] ✓✓	(2)	✓ log law ✓ substitution/answer
	4.2.2	$\log(2+3)=\log 5$ $=\log\frac{10}{2}$ $=\log 10-\log 2$ $=1-a$ Accept $\log(2+3)=\log\left(10^a+10^b\right)$ ✓✓✓✓	(4)	✓ log 5 ✓ log 5 as log $\frac{10}{2}$ ✓ log law ✓ substitution/answer
4.3	4.3.1	$12^x\times 4=36\times 4^x$ $4^x\times 3^x\times 4=4\times 9\times 4^x$ $3^x=9=3^2$ $x=2$ **OR** $\left(\frac{12}{4}\right)^x=\left(\frac{36}{4}\right)$ **OR** $\left(\frac{4}{12}\right)^x=\left(\frac{4}{36}\right)$ $3^x=9=3^2$ | $\left(\frac{1}{3}\right)^x=\frac{1}{9}=\left(\frac{1}{3}\right)^2$ $\therefore\ x=2$ **OR** $\log\left(12^x\times 4\right)=\log\left(36\div 4^x\right)$ $\log 12^x+\log 4=\log 36+\log 4^x$ $x\log 12+\log 4=\log 36+x\log 4$ $x(\log 12-\log 4)=\log 36-\log 4$ $x\log 3=\log 9$ $x=\frac{\log 9}{\log 3}=\frac{2\log 3}{\log 3}=2$	(3)	✓ factors & exp. law ✓ same base ✓ answer ✓ transfer x & constants ✓ same base ✓ answer

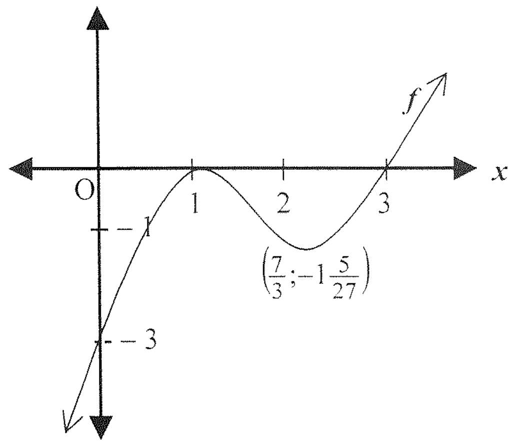
	4.3.2	$\log_7(5x+2) - 2\log_7 x = \log_7 3$ $\log_7(5x+2) = \log_7 x^2 + \log_7 3$ $\log_7(5x+2) = \log_7 3x^2$ $\left.\begin{array}{r}5x+2 = 3x^2\\3x^2 - 5x - 2 = 0\end{array}\right\}$ $(3x+1)(x-2) = 0$ $x = -\frac{1}{3}$ or $x = 2$ but $x > 0$ by definition $\therefore x = 2$	(5)	✓ transposing & log law ✓ single log at RHS ✓ standard form ✓ factors ✓ both values ✓ $x = 2$ (bonus mark) [NOTE: For $\frac{\log_7(5x+2)}{\log_7 x^2} = \log_7 3$ $\frac{5x+2}{x^2} = 3$ etc. max 4/5]
4.4		$8^x = 160$ $\log 8^x = \log 160$ $x \log 8 = \log 160$ $x = \frac{\log 160}{\log 8}$ $= 2{,}44$ **OR** $x = \log_8 160$ $\therefore x = \frac{\log 160}{\log 8}$ $= 2{,}44$	(4)	✓ apply logs both sides ✓ $\log 8^x = x \log 8$ ✓ x-subject of formula ✓ answer **OR** ✓ ✓ log-form ✓ change of base ✓ answer **[Answer only : 4/4]**
			[27]	

5.1		$T_1 = a = -1$ and $T_7 = 35$		
	5.1.1	$T_n = a + (n-1)d$ $-1 + 6d = 35$ $6d = 36$ $d = 6$ **OR** -1 , 5 , 11 , 17 , 23 , 29 , 35 $\therefore d = 6$ **OR** $d = \frac{T_7 - T_1}{7-1} = \frac{36}{6} = 6$	(3)	✓ formula ✓ substitution ✓ answer [NOTE: Wrong formula 0/3]

	5.1.2	$T_n = a + (n-1)d$ $473 = -1 + (n-1)6$ $474 = 6n - 6$ $6n = 480$ $n = 80$	(3)	✓ formula for T_n ✓ substitution (CA applies) ✓ answer
5.2	$\sum_{r=1}^{100}(3r-1) = 2 + 5 + 8 + \cdots$ $\therefore\ a = 2\ ;\ d = 3\ \ \&\ \ n = 100$ $S_n = \frac{n}{2}\left[2a + (n-1)d\right]$ $S_{100} = \frac{100}{2}\left[2(2) + (100-1)3\right]$ $= 50(4 + 297)$ $= 15\ 050$ **OR** $S_n = \frac{n}{2}(a + T_n)$ $S_{100} = \frac{100}{2}(2 + 299)$ $= 15\ 050$		(5)	✓ $a = 2$; ✓ $d = 3$ ✓ $n = 100$ ✓ formula & substitution ✓ answer ✓ $a = 2$ ✓ $n = 100$ ✓ $T_{100} = 299$ ✓ formula & substitution ✓ answer [NOTE: For 2 + 4 + 8. . . leading to $2^{101} - 2$ max 4/5]

5.3	$\frac{1}{27};\frac{1}{9};\frac{1}{3};\ldots$		
	$r=\frac{\frac{1}{9}}{\frac{1}{27}}=3$ $S_n=\frac{a(r^n-1)}{r-1}$ $S_{10}=\frac{\frac{1}{27}(3^{10}-1)}{3-1}$ $=1\,093{,}48$ **OR** $\frac{29524}{27}$ **OR** $1093\frac{13}{27}$ **OR** $S_n=\frac{a(1-r^n)}{1-r}$ $S_{10}=\frac{\frac{1}{27}(1-3^{10})}{1-3}$ $=1\,093{,}48$ **OR** $\frac{29524}{27}$ **OR** $1093\frac{13}{27}$	(4)	✓ value of r ✓ formula ✓ substitution ✓ answer ✓ formula ✓ substitution ✓ answer [Determine all 10 terms and find the sum: 4/4] Wrong formula: $T_{10}=\frac{1}{27}(3)^{10-1}$ max 2/4
5.4.1	$\frac{T_2}{T_1}=\frac{350}{250}=1{,}4$ $\frac{T_3}{T_2}=\frac{490}{350}=1{,}4$ $\therefore r=1{,}4$ or $\frac{7}{5}$ sequence thus geometric	(2)	✓ $\frac{T_2}{T_1}$ ✓ $\frac{T_3}{T_2}$
5.4.2	$a=250$, $r=1{,}4$ for 1 000 minutes $T_5=ar^4$ $=250(1{,}4)^4$ $=$ R960,40 **OR** $T_4=1{,}4(490)=686$ $T_5=1{,}4(686)=960{,}4$ $\therefore$ R960,40	(3)	(CA applies) ✓ formula for T_n ✓ substitution ✓ answer ✓ T_4 ✓✓ T_5
5.5	$A=P\left(1-\frac{r}{100}\right)^n$ $=70\,000\left(1-\frac{9}{100}\right)^7$ $=70\,000(0{,}91)^7$ $=36\,173{,}27$ $\therefore A=R36\,173$ [Interchange A & P : answer R135 459 max of 3/5]	(5)	✓ formula [Given formula: max 4/5] ✓ substitution ✓ simplification [Formula with +: max 3/5] ✓ answer ✓ rounding off [R36 400 / R36 190/ R36173,27 4/5 marks]
		[25]	

6.1	$f(x) = -x^2$ $f(x+h) = -(x+h)^2 = -x^2 - 2xh - h^2$ $f(x+h) - f(x) = -2xh - h^2$ $f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0} \frac{h(-2x-h)}{h}$ $= \lim_{h\to 0} (-2x-h)$ $= -2x$ **OR** $\frac{f(x+h)-f(x)}{h} = \frac{-2xh-h^2}{h}$ $= -2x - h$ $f'(x) = \lim_{h\to 0} (-2x-h)$ $= -2x$	(5)	✓ multiplication ✓ simplification ✓ formula ✓ common factor h ✓ dividing by h ✓ substitution ✓ dividing by h ✓ $f'(x) = \lim_{h\to 0} (-2x-h)$ **[- 1 mark for incorrect notation]** [For $f(x) = -2x$, etc max 3/5]
6.2	6.2.1 $y = 3x^{\frac{4}{3}} - 2x$ $\frac{dy}{dx} = 4x^{\frac{1}{3}} - 2$	(2)	✓ $4x^{\frac{1}{3}}$ **or** $3\left(\frac{4}{3}\right)x^{\frac{4}{3}-1}$ ✓ -2
	6.2.2 $y = \frac{9x^4 - 6}{3x}$ $= 3x^3 - 2x^{-1}$ $\frac{dy}{dx} = 9x^2 + 2x^{-2}$ 1. $\left(\frac{dy}{dx} = \frac{36x^3}{3}\right)$ max of 2/4 marks 2. $y = 9x^4 - 6 - 3x$ $\therefore \frac{dy}{dx} = 36x^3 - 3$ max of 2/4 marks	(4)	✓ ✓ exponential form ✓ $9x^2$ **or** $3(3)x^{3-1}$ ✓ $2x^{-2}$ **or** $-2(-1)x^{-2}$ **or** $\frac{2}{x^2}$
6.3	$f(x) = x^3 - 5x^2 + 7x - 3$		
	6.3.1 $f(0) = -3$; $\therefore (0;-3)$ $x^3 - 5x^2 + 7x - 3 = 0$ $(x-1)(x^2 - 4x + 3) = 0$ $(x-1)(x-1)(x-3) = 0$ $\therefore x = 1$ or $x = 3$ $\therefore (1;0)$; $(3;0)$	(5)	✓ y-intercept (or if shown on the graph) quadratic factor: ✓ $-4x$ and ✓ 3 ✓ linear factors ✓ both values

	6.3.2	At turning points $f'(x) = 0$ $3x^2 - 10x + 7 = 0$ $(3x-7)(x-1) = 0$ $x = \frac{7}{3}$ or $x = 1$ $f\left(\frac{7}{3}\right) = \left(\frac{7}{3}\right)^3 - 5\left(\frac{7}{3}\right)^2 + 7\left(\frac{7}{3}\right) - 3 = -1\frac{5}{27}$ $\therefore \left(\frac{7}{3};-1\frac{5}{27}\right)$ is a turning point	(5)	✓ know T pts. @ $f'(x) = 0$ ✓ derivative ✓ factors ✓ both values ✓ substitution [Mark 6.3.1 to 6.3.3 as one]
6.3	6.3.3		(4)	✓ shape ✓ turning points ✓ y-intercept ✓ x-intercepts
			[25]	

7	$m(t) = 0{,}02t^3 - 0{,}2t^2 + 3200;\ 0 \le t \le 30$		
7.1	$m(0) = 3{,}2$ kg or 3 200 g.	(1)	✓ answer
7.2	$\frac{dm}{dt} = 0$ $0{,}06t^2 - 0{,}4t = 0$ $t(0{,}06t - 0{,}4) = 0$ $t = 0$ or $t = \frac{40}{6} = 6\frac{2}{3}$ A minimum on $6\frac{2}{3}$ days. [or during the 7th day]	(5)	✓ derivative = 0 ✓ finding derivative ✓ factors ✓ both values ✓ answer
7.3	$m(30) = 0{,}02(30)^3 - 0{,}2(30)^2 + 3200$ =3560 g or 3,56 kg which is $> m(0)$	(2)	✓ substituting $t = 30$ ✓ answer [subst. $t = 30$ in $m'(t)$ ✓]
		[8]	

TOTAL MARKS :	**150**	