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## **NATIONAL SENIOR CERTIFICATE**

**GRADE 12**

**MATHEMATICS P1**

**FEBRUARY/MARCH 2013**

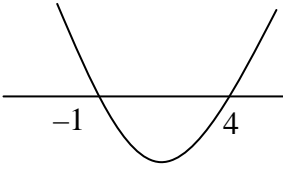
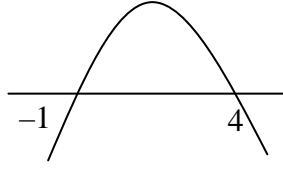
**MEMORANDUM**

**MARKS: 150**

**This memorandum consists of 19 pages.**

## QUESTION 1

1.1.1	$(x^2 - 9)(2x + 1) = 0$ $(x - 3)(x + 3)(2x + 1) = 0$ $x = \pm 3 \quad \text{or} \quad x = -\frac{1}{2}$ <p><b>OR</b></p> $(x^2 - 9)(2x + 1) = 0$ $x = \pm 3 \quad \text{or} \quad x = -\frac{1}{2}$	$\checkmark (x - 3)(x + 3)$ $\checkmark \pm 3$ $\checkmark -\frac{1}{2}$ <p>(3)</p> $\checkmark - 3$ $\checkmark 3$ $\checkmark -\frac{1}{2}$ <p>(3)</p>
1.1.2	$x^2 + x - 13 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-1 \pm \sqrt{1 - 4(1)(-13)}}{2}$ $= \frac{-1 \pm \sqrt{53}}{2}$ $x = 3,14 \quad \text{or} \quad x = -4,14$	$\checkmark \text{ subs into formula}$ $\checkmark \sqrt{53}$ $\checkmark \text{ answer}$ $\checkmark \text{ answer}$ <p>(4)</p>
1.1.3	$2 \cdot 3^x = 81 - 3^x$ $2 \cdot 3^x + 3^x = 81$ $3^x(2 + 1) = 81$ $3^x = 27$ $3^x = 3^3$ $x = 3$ <p><b>OR</b></p> $2 \cdot 3^x = 81 - 3^x$ $2 \cdot 3^x + 3^x = 81$ $3^x(2 + 1) = 81$ $3^{x+1} = 3^4$ $x + 1 = 4$ $x = 3$	$\checkmark 2 \cdot 3^x + 3^x = 81$ $\checkmark 3^x \text{ as common factor}$ $\checkmark \text{ simplification}$ $\checkmark \text{ answer}$ <p>(4)</p> $\checkmark 2 \cdot 3^x + 3^x = 81$ $\checkmark 3^x \text{ as common factor}$ $\checkmark 3^{x+1} = 3^4$ $\checkmark \text{ answer}$ <p>(4)</p>

<p>1.1.4</p>	$(x+1)(4-x) > 0$ $(x+1)(x-4) < 0$ $\begin{array}{cccccc} + & 0 & - & 0 & + & \\ \hline & -1 & & 4 & & \end{array}$ <p>or</p>  $-1 < x < 4$ <p><b>OR</b></p> $(x+1)(4-x) > 0$ $\begin{array}{cccccc} - & 0 & + & 0 & - & \\ \hline & -1 & & 4 & & \end{array}$  $-1 < x < 4$	<p>✓ change of sign ✓ both critical values ✓ correct inequality sign</p> <p>(3)</p> <p>✓ method ✓ both critical values ✓ correct inequality sign</p> <p>(3)</p>
<p>1.2.1</p>	$2^x + 2^{x+2} = -5y + 20$ $2^x(1 + 2^2) = -5y + 20$ $2^x = \frac{-5y+20}{5}$ <p><b>OR</b></p> $2^x = -y + 4$	<p>✓ <math>2^x</math> common factor</p> <p>✓ answer</p> <p>(2)</p>
<p>1.2.2</p>	<p>If <math>y = -4</math>,</p> $2^x + 2^{x+2} = -5y + 20$ $2^x + 2^{x+2} = 40$ $2^x(1 + 2^2) = 40$ $2^x = 8$ $2^x = 2^3$ $x = 3$	<p>✓ substitution</p> <p>✓ answer</p> <p>(2)</p>
<p>1.2.3</p>	$-y + 4 > 0$ $y < 4$ <p>Largest integer value of <math>y</math> is 3</p> $2^x = -3 + 4$ $2^x = 1$ $x = 0$	<p>✓ <math>-y + 4 &gt; 0</math></p> <p>✓ <math>y = 3</math></p> <p>✓ <math>x = 0</math></p> <p>(3)</p> <p><b>[21]</b></p>

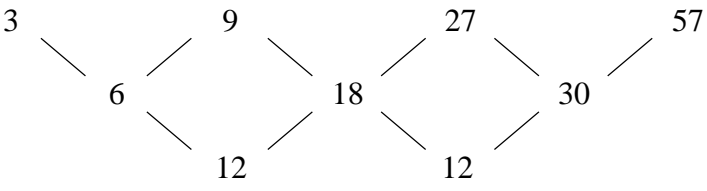
**QUESTION 2**

<p>2.1.1</p>	$r = -\frac{32}{64} = -\frac{1}{2}$ $p = 256\left(-\frac{1}{2}\right)$ $p = -128$ <p><b>OR</b></p> $\frac{p}{256} = \frac{64}{p}$ $p^2 = 16384$ $p = \pm 128$ $p = -128$ <p><b>OR</b></p> $\frac{p}{256} = \frac{-32}{64}$ $64p = 8192$ $p = -128$ <p><b>OR</b></p> $\frac{1}{r} = \frac{64}{-32} = -2$ $p = -2 \times 64$ $p = -128$	$\checkmark -\frac{1}{2}$ $\checkmark \text{ substitution}$ $\checkmark \text{ answer}$ <p style="text-align: right;">(3)</p> $\checkmark \frac{p}{256} = \frac{64}{p}$ $\checkmark p = \pm 128$ $\checkmark \text{ answer}$ <p style="text-align: right;">(3)</p> $\checkmark \frac{p}{256} = \frac{-32}{64}$ $\checkmark \text{ simplification}$ $\checkmark \text{ answer}$ <p style="text-align: right;">(3)</p> $\checkmark \frac{1}{r} = \frac{64}{-32} = -2$ $\checkmark \text{ simplification}$ $\checkmark \text{ answer}$ <p style="text-align: right;">(3)</p>
<p>2.1.2</p>	$S_n = \frac{a[1-r^n]}{1-r}$ $S_8 = \frac{256\left[1-\left(-\frac{1}{2}\right)^8\right]}{1+\frac{1}{2}}$ $= \frac{512}{3} \left(\frac{255}{256}\right)$ $= 170$ <p><b>OR</b></p>	$\checkmark \text{ formula}$ $\checkmark \text{ substitution}$ $\checkmark \text{ answer}$ <p style="text-align: right;">(3)</p>

	$S_n = \frac{a[1-r^n]}{1-r}$ $S_8 = \frac{2^8 \left[ 1 - \left( -\frac{1}{2} \right)^8 \right]}{1 + \frac{1}{2}}$ $= \frac{2^9 \left( \frac{255}{2^8} \right)}{3}$ $= 170$	<p>✓ formula</p> <p>✓ substitution</p> <p>✓ answer</p> <p>(3)</p>
2.1.3	<p><math>-1 &lt; r &lt; 1</math></p> <p><b>OR</b></p> <p>The common ratio is <math>-\frac{1}{2}</math> which is between <math>-1</math> and <math>1</math>.</p> <p><b>OR</b></p> <p><math>-1 &lt; -\frac{1}{2} &lt; 1</math></p>	<p>✓ answer</p> <p>(1)</p> <p>✓ answer</p> <p>(1)</p> <p>✓ answer</p> <p>(1)</p>
2.1.4	$S_\infty = \frac{a}{1-r}$ $= \frac{256}{1 - \left( -\frac{1}{2} \right)}$ $= \frac{512}{3}$ $= 170,67$	<p>✓ formula</p> <p>✓ substitution</p> <p>✓ answer</p> <p>(3)</p>

2.2.1	16	✓ answer (1)
2.2.2	$T_n = -8 + 6(n - 1)$ $148 = 6n - 14$ $6n = 162$ $n = 27$	✓ substitution into equation ✓ $T_n = 148$ ✓ answer (3)
2.2.3	$S_n = \frac{n}{2}[2a + (n - 1)d]$ $\frac{n}{2}[2(-8) + (n - 1)(6)] > 10\,140$ $3n^2 - 11n > 10\,140$ $3n^2 - 11n - 10\,140 > 0$ $(3n + 169)(n - 60) > 0$ When $n = 60$ , $S_n = 10\,140$  Smallest $n = 61$	✓ $\frac{n}{2}[2(-8) + (n - 1)(6)]$ ✓ $3n^2 - 11n > 10\,140$  ✓ factors ✓ $n = 60$  ✓ answer (5)
2.3	$\sum_{k=1}^{30} (3k + 5)$ $a = 8 \quad n = 30 \quad d = 3$ $\sum_{k=1}^{30} (3k + 5) = \frac{30}{2}[2(8) + 29(3)]$ $= 15(103)$ $= 1545$	✓ $n = 30$  ✓ substitution into correct formula ✓ answer (3) <b>[22]</b>

**QUESTION 3**

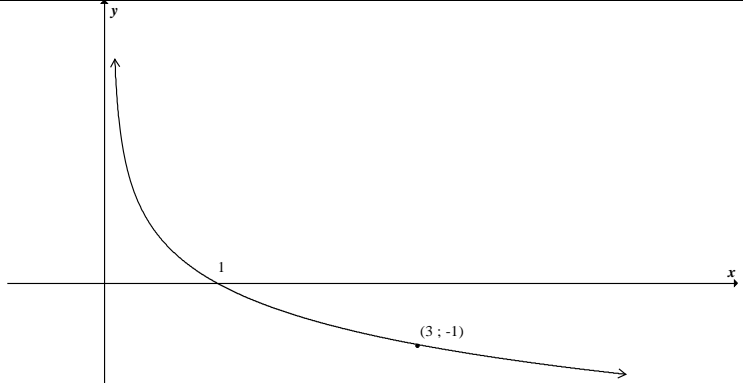
<p>3.1</p>	<p>Jacob calculated that the sequence is geometric or exponential. Vusi calculated that the sequence is quadratic.</p> <p><b>OR</b></p> <p>Jacob has multiplied each term by 3 to get the next term. Vusi sees it as a sequence with a constant second difference.</p> <p><b>OR</b></p> <p>Jacob calculated that the sequence is geometric or exponential. Vusi calculated that the sequence can be seen as a combination of exponential and cubic sequences.</p>	<p>✓ Jacob (geometric/exponential) ✓ Vusi (quadratic) (2)</p> <p>✓ Jacob (multiplied each term by 3) ✓ Vusi (constant second difference) (2)</p> <p>✓ Jacob (geometric/exponential) ✓ Vusi (exponential and cubic combined) (2)</p>
<p>3.2.1</p>	<p><math>T_n = 3^n</math></p> <p><b>OR</b></p> <p><math>T_n = 3 \cdot 3^{n-1}</math></p>	<p>✓ answer (1)</p> <p>✓ answer (1)</p>
<p>3.2.2</p>	 <p><math>2a = 12</math>    <math>3a + b = 6</math>    <math>a + b + c = 3</math>  <math>a = 6</math>    <math>18 + b = 6</math>    <math>6 - 12 + c = 3</math>                    <math>b = -12</math>                            <math>c = 9</math></p> <p><math>T_n = 6n^2 - 12n + 9</math></p> <p><b>OR</b></p> <p><math>2a = 12</math>  <math>a = 6</math>  <math>T_0 = c = 9</math>  <math>T_n = an^2 + bn + 9</math>  <math>3 = 6(1)^2 + b(1) + 9</math>  <math>b = -12</math>  <math>T_n = 6n^2 - 12n + 9</math></p> <p><b>OR</b></p>	<p>✓ <math>a = 6</math>  ✓ method  ✓ <math>b = -12</math>  ✓ <math>c = 9</math> (4)</p> <p>✓ <math>a = 6</math>  ✓ <math>c = 9</math>  ✓ method  ✓ <math>b = -12</math> (4)</p>



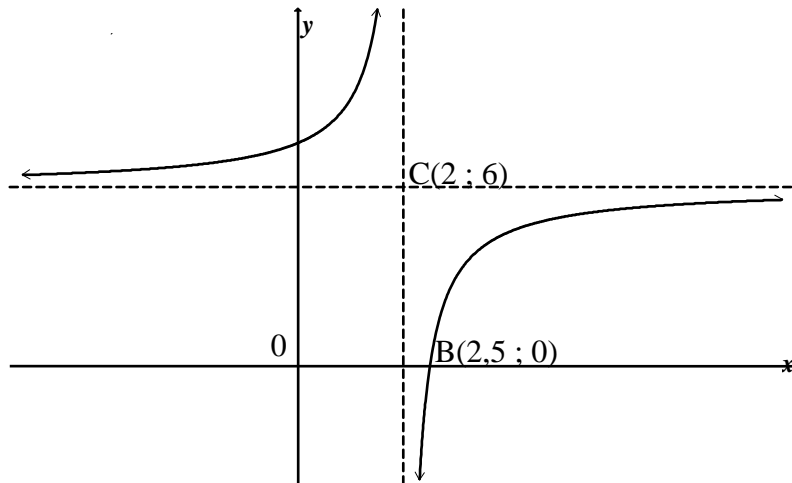
## NSC – Memorandum

	$2a = 12$ $a = 6$ $T_n = 6n^2 + bn + c$ $T_1 = 3 = 6(1)^2 + b(1) + c \quad \text{i.e.} \quad 3 = 6 + b + c$ $T_2 = 9 = 6(2)^2 + b(2) + c \quad \text{i.e.} \quad \frac{9 = 24 + 2b + c}{6 = 18 + b}$ $b = -12$ $c = 9$ $T_n = 6n^2 - 12n + 9$ <p><b>OR</b></p> $T_n = 3^n + k(n-1)(n-2)(n-3)$ $57 = 3^4 + k(3)(2)(1)$ $6k = -24$ $k = -4$ $T_n = 3^n - 4(n-1)(n-2)(n-3)$	$\checkmark a = 6$ $\checkmark$ method  $\checkmark b = -12$ $\checkmark c = 9$ <p style="text-align: right;">(4)</p> $\checkmark\checkmark$ $T_n = 3^n + k(n-1)(n-2)(n-3)$ $\checkmark$ substitution $\checkmark$ answer <p style="text-align: right;">(4) [7]</p>
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**QUESTION 4**

4.1	<b>R OR</b> $(-\infty; \infty)$	✓ answer (1)
4.2	$y = 0$	✓ $y = 0$ (1)
4.3	$x = \left(\frac{1}{3}\right)^y$ $y = \log_{\frac{1}{3}} x$ <b>OR</b> $x = \left(\frac{1}{3}\right)^y$ $x = 3^{-y}$ $-y = \log_3 x$ $y = -\log_3 x$	✓ $x = \left(\frac{1}{3}\right)^y$ ✓ $y = \log_{\frac{1}{3}} x$ ✓ $x = \left(\frac{1}{3}\right)^y$ ✓ $y = -\log_3 x$ (2)
4.4		✓ shape ✓ intercept at $(1 ; 0)$ ✓ any other correct point (3)
4.5	$x = -2$	✓✓ $x = -2$ (2)
4.6	$\text{LHS} = [f(x)]^2 - [f(-x)]^2$ $= \left[\left(\frac{1}{3}\right)^x\right]^2 - \left[\left(\frac{1}{3}\right)^{-x}\right]^2$ $= 3^{-2x} - 3^{2x}$ $\text{RHS} = f(2x) - f(-2x)$ $= \left(\frac{1}{3}\right)^{2x} - \left(\frac{1}{3}\right)^{-2x}$ $= 3^{-2x} - 3^{2x}$ $\therefore \text{LHS} = \text{RHS}$ $[f(x)]^2 - [f(-x)]^2 = f(2x) - f(-2x)$	✓ $\left[\left(\frac{1}{3}\right)^x\right]^2 - \left[\left(\frac{1}{3}\right)^{-x}\right]^2$ ✓ $3^{-2x} - 3^{2x}$ ✓ $\left(\frac{1}{3}\right)^{2x} - \left(\frac{1}{3}\right)^{-2x}$ (3) <b>[12]</b>

**QUESTION 5**

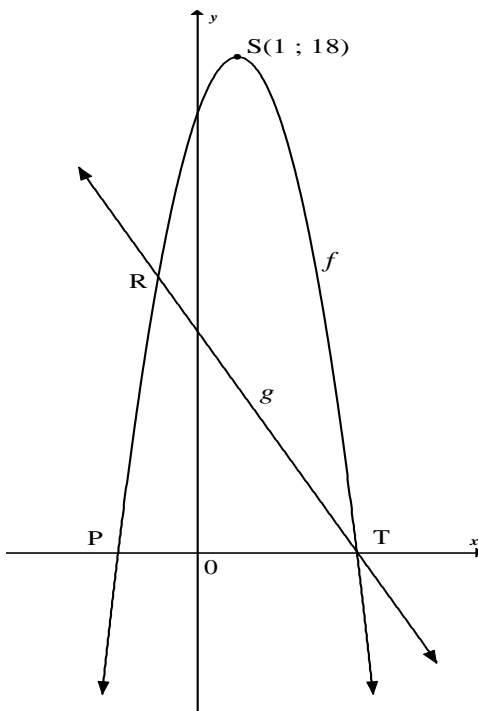


<p>5.1</p>	$g(x) = \frac{a}{x-2} + 6$ $0 = \frac{a}{2,5-2} + 6$ $0 = 2a + 6$ $a = -3$ $g(x) = \frac{-3}{x-2} + 6$	<p>✓ <math>p = 2</math>                  ✓ <math>q = 6</math>                  ✓ substitute <math>B(2,5 ; 0)</math>                  ✓ <math>a = -3</math></p> <p style="text-align: right;">(4)</p>
<p>5.2</p>	$x_f = 2 - \frac{1}{2}$ $x_f = \frac{3}{2}$ $y_f = 6 + 6$ $y_f = 12$ $F\left(\frac{3}{2} ; 12\right)$	<p>✓ x-coordinate                  ✓ y-coordinate</p> <p style="text-align: right;">(2)  <b>[6]</b></p>

**QUESTION 6**

$$f(x) = ax^2 + bx + c$$

$$g(x) = -2x + 8$$



<p>6.1</p>	$0 = -2x + 8$ $2x = 8$ $x = 4$ <p>T (4 ; 0)</p>	<p>✓ <math>y = 0</math></p> <p>✓ <math>x = 4</math></p> <p>(2)</p>
<p>6.2</p>	<p>By symmetry, P(-2 ; 0)</p> $f(x) = a(x + 2)(x - 4)$ $18 = a(1 + 2)(1 - 4)$ $a = -2$ $f(x) = -2(x + 2)(x - 4)$ $= -2(x^2 - 2x - 8)$ $= -2x^2 + 4x + 16$ <p><b>OR</b></p> $f(x) = a(x - 1)^2 + 18$ $0 = a(4 - 1)^2 + 18$ $a = -2$ $f(x) = -2(x - 1)^2 + 18$ $= -2(x^2 - 2x + 1) + 18$ $= -2x^2 + 4x + 16$	<p>✓ <math>f(x) = a(x + 2)(x - 4)</math></p> <p>✓ substitutes S(1 ; 18)</p> <p>✓ <math>a = -2</math></p> <p>✓ multiplies out correctly to get <math>-2x^2 + 4x + 16</math></p> <p>(4)</p> <p>✓ <math>f(x) = a(x - 1)^2 + 18</math></p> <p>✓ substitutes T(4 ; 0)</p> <p>✓ <math>a = -2</math></p> <p>✓ multiplies out correctly to get <math>-2x^2 + 4x + 16</math></p> <p>(4)</p>

## NSC – Memorandum

6.3	$-2x + 8 = -2x^2 + 4x + 16$ $2x^2 - 6x - 8 = 0$ $x^2 - 3x - 4 = 0$ $(x - 4)(x + 1) = 0$ $x = 4 \text{ or } x = -1$ at R, $y = -2(-1) + 8 = 10$ i.e. R(-1; 10)	$\checkmark -2x + 8 = -2x^2 + 4x + 16$ $\checkmark 2x^2 - 6x - 8 = 0$ $\checkmark x = -1$ $\checkmark y = 10$ (4)
6.4.1	$-1 \leq x \leq 4$	$\checkmark -1 \leq x$ $\checkmark x \leq 4$ (2)
6.4.2	$-2x^2 + 4x - 2 < 0$ $-2x^2 + 4x - 2 + 18 < 18$ $-2x^2 + 4x + 16 < 18$ $f(x) < 18$ $(-\infty; 1) \cup (1; \infty)$ <b>OR</b> $-2x^2 + 4x - 2 < 0$ $-2x^2 + 4x - 2 + 18 < 18$ $-2x^2 + 4x + 16 < 18$ $f(x) < 18$ $x \in \mathbf{R}; x \neq 1$	$\checkmark -2x^2 + 4x - 2 + 18 < 18$ $\checkmark -2x^2 + 4x + 16 < 18$ $\checkmark f(x) < 18$ $\checkmark (-\infty; 1) \cup (1; \infty)$ (4) $\checkmark -2x^2 + 4x - 2 + 18 < 18$ $\checkmark -2x^2 + 4x + 16 < 18$ $\checkmark f(x) < 18$ $\checkmark x \in \mathbf{R}; x \neq 1$ (4) <b>[16]</b>

**QUESTION 7**

<p>7.1</p>	$F = P(1 + i)^n$ $= 4\,000\,000(1 + 0,06)^3$ $= R4\,764\,064$	<p>✓ formula ✓ substitution ✓ answer</p> <p style="text-align: right;">(3)</p>
<p>7.2.1</p>	$4\,000\,000 = \frac{30\,000 \left[ 1 - \left( 1 + \frac{0,06}{12} \right)^{-n} \right]}{\frac{0,06}{12}}$ $\frac{4\,000\,000 \times \left( \frac{0,06}{12} \right)}{30\,000} = 1 - \left( 1 + \frac{0,06}{12} \right)^{-n}$ $\frac{1}{3} = \left( 1 + \frac{0,06}{12} \right)^{-n}$ $\log_{\left( 1 + \frac{0,06}{12} \right)} \frac{1}{3} = -n$ $n = 220,27$ <p>Therefore she will make 220 withdrawals of R30 000.</p> <p><b>OR</b></p> $4\,000\,000 = \frac{30\,000 \left[ 1 - \left( 1 + \frac{0,06}{12} \right)^{-n} \right]}{\frac{0,06}{12}}$ $\frac{4\,000\,000 \times \left( \frac{0,06}{12} \right)}{30\,000} = 1 - \left( 1 + \frac{0,06}{12} \right)^{-n}$ $\frac{1}{3} = \left( 1 + \frac{0,06}{12} \right)^{-n}$ $\log \frac{1}{3} = -n \log \left( 1 + \frac{0,06}{12} \right)$ $n = 220,27$ <p>Therefore she will make 220 withdrawals of R30 000.</p>	<p>✓ formula ✓ <math>i = \frac{0,06}{12}</math> ✓ substitution into correct formula ✓ <math>\frac{1}{3} = \left( 1 + \frac{0,06}{12} \right)^{-n}</math> ✓ correct use of logs ✓ answer of 220 withdrawals</p> <p style="text-align: right;">(6)</p> <p>✓ formula ✓ <math>i = \frac{0,06}{12}</math> ✓ substitution into correct formula ✓ <math>\frac{1}{3} = \left( 1 + \frac{0,06}{12} \right)^{-n}</math> ✓ correct use of logs ✓ answer of 220 withdrawals</p> <p style="text-align: right;">(6)</p>

7.2.2	$4\,000\,000 = \frac{20\,000 \left[ 1 - \left( 1 + \frac{0,06}{12} \right)^{-n} \right]}{\frac{0,06}{12}}$ $0 = \left( 1 + \frac{0,06}{12} \right)^{-n}$ <p>She can make as many withdrawals as she pleases.</p>	<p>✓</p> $4\,000\,000 = \frac{20\,000 \left[ 1 - \left( 1 + \frac{0,06}{12} \right)^{-n} \right]}{\frac{0,06}{12}}$ <p>✓ <math>0 = \left( 1 + \frac{0,06}{12} \right)^{-n}</math></p> <p>✓ conclusion</p> <p>(3) [12]</p>
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## QUESTION 8

	$\left( 1 + \frac{0,08}{12} \right)^{12} = \left( 1 + \frac{r}{2} \right)^2$ $\frac{r}{2} = 0,040672622$ $r = 8,13452446\%$ $r = 8,13\%$	<p>✓ <math>\left( 1 + \frac{0,08}{12} \right)^{12}</math></p> <p>✓ <math>\left( 1 + \frac{i}{2} \right)^2</math></p> <p>✓ answer</p> <p>[3]</p>
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**QUESTION 9**

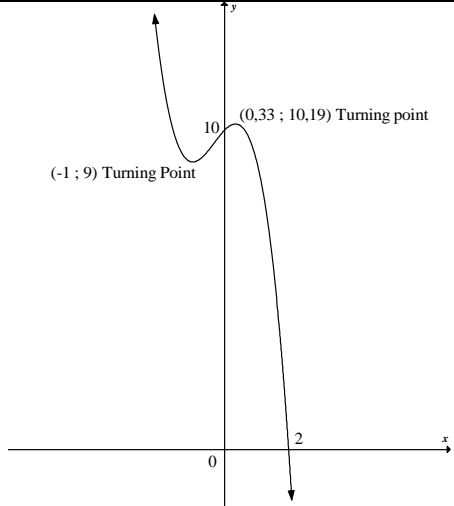
<p>9.1</p>	$f(x) = 2x^3$ $f(x+h) = 2(x+h)^3$ $= 2(x^3 + 3x^2h + 3xh^2 + h^3)$ $= 2x^3 + 6x^2h + 6xh^2 + 2h^3$ $f(x+h) - f(x) = 2x^3 + 6x^2h + 6xh^2 + 2h^3 - 2x^3$ $= 6x^2h + 6xh^2 + 2h^3$ $f'(x) = \lim_{h \rightarrow 0} \frac{6x^2h + 6xh^2 + 2h^3}{h}$ $= \lim_{h \rightarrow 0} \frac{h(6x^2 + 6xh + 2h^2)}{h}$ $= \lim_{h \rightarrow 0} (6x^2 + 6xh + 2h^2)$ $f'(x) = 6x^2$ <p><b>OR</b></p> $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{2(x+h)^3 - 2x^3}{h}$ $= \lim_{h \rightarrow 0} \frac{2(x^3 + 3x^2h + 3xh^2 + h^3) - 2x^3}{h}$ $= \lim_{h \rightarrow 0} \frac{6x^2h + 6xh^2 + 2h^3}{h}$ $= \lim_{h \rightarrow 0} \frac{h(6x^2 + 6xh + 2h^2)}{h}$ $= \lim_{h \rightarrow 0} (6x^2 + 6xh + 2h^2)$ $f'(x) = 6x^2$	<p>✓ substitution</p> <p>✓ expansion</p> <p>✓ formula</p> <p>✓ <math>6x^2 + 6xh + 2h^2</math></p> <p>✓ answer</p> <p>(5)</p> <p>✓ formula</p> <p>✓ substitution</p> <p>✓ expansion</p> <p>✓ <math>6x^2 + 6xh + 2h^2</math></p> <p>✓ answer</p> <p>(5)</p>
<p>9.2</p>	$y = \frac{2\sqrt{x} + 1}{x^2}$ $= 2x^{-\frac{3}{2}} + x^{-2}$ $\frac{dy}{dx} = -3x^{-\frac{5}{2}} - 2x^{-3}$	<p>✓ <math>2x^{-\frac{3}{2}}</math></p> <p>✓ <math>x^{-2}</math></p> <p>✓ <math>-3x^{-\frac{5}{2}}</math></p> <p>✓ <math>-2x^{-3}</math></p> <p>(4)</p>



9.3	$f'(-1) = -7$ $f'(x) = 2ax + b$ $-7 = -2a + b$ $f(-1) = -7(-1) + 3$ $= 10$ $\therefore a - b + 5 = 10$ $a - b = 5 \dots \dots \dots [1]$ $-2a + b = -7 \dots \dots \dots [2]$ $-a = -2 \dots \dots \dots [1] + [2]$ $a = 2$ $b = -3$	$\checkmark f'(x) = 2ax + b$ $\checkmark \text{substitution of } x = -1$ $\checkmark -7 = -2a + b$ $\checkmark f(-1) = 10$  $\checkmark a = 2$ $\checkmark b = -3$ <p style="text-align: right;">(6) <b>[15]</b></p>
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**QUESTION 10**

$$f(x) = -x^3 - x^2 + x + 10$$

10.1	(0;10)	✓ (0;10)  (1)
10.2	$0 = -x^3 - x^2 + x + 10$ $0 = -(x-2)(x^2 + 3x + 5)$ $x-2 = 0 \quad \text{or} \quad x^2 + 3x + 5 = 0$ $x = 2$ $x = \frac{-3 \pm \sqrt{3^2 - 4(1)(5)}}{2(1)}$ $= \frac{-3 \pm \sqrt{-11}}{2}$ which has no solution Therefore the only x-intercept of f is (2;0)	✓ (x-2) ✓ (x <sup>2</sup> + 3x + 5)  ✓ $x = \frac{-3 \pm \sqrt{-11}}{2}$  ✓ no solution  (4)
10.3	$f'(x) = -3x^2 - 2x + 1$ $0 = -3x^2 - 2x + 1$ $0 = (3x-1)(x+1)$ $x = \frac{1}{3} \quad \text{or} \quad x = -1$ $y = -\left(\frac{1}{3}\right)^3 - \left(\frac{1}{3}\right)^2 + \left(\frac{1}{3}\right) + 10 \quad \text{or} \quad y = -(-1)^3 - (-1)^2 + (-1) + 10$ $= \frac{275}{27} \quad \quad \quad = 9$ $\left(\frac{1}{3}; 10\frac{5}{27}\right) \quad \quad \quad (-1; 9)$	✓ $f'(x) = -3x^2 - 2x + 1$ ✓ $f'(x) = 0$ ✓ factors  ✓ x-values  ✓ $\left(\frac{1}{3}; 10\frac{5}{27}\right)$ ✓ (-1; 9)  (6)
10.4		✓ shape ✓ intercepts ✓ turning points  (3) <b>[14]</b>

## QUESTION 11

11.1	Length of box = $3x$ Volume = $l \times b \times h$ $9 = 3x \cdot x \cdot h$ $9 = 3x^2h$ $h = \frac{3}{x^2}$	$\checkmark$ length of box = $3x$ $\checkmark 9 = 3x \cdot x \cdot h$ $\checkmark h = \frac{3}{x^2}$ (3)
11.2	$C = (2(3xh) + 2xh) \times 50 + (2 \times 3x^2) \times 100$ $= 8x \left( \frac{3}{x^2} \right) \times 50 + 600x^2$ $= \frac{1200}{x} + 600x^2$ <b>OR</b> $C = (h \times 8x) \times 50 + (2 \times 3x^2) \times 100$ $= 8x \left( \frac{3}{x^2} \right) \times 50 + 600x^2$ $= \frac{1200}{x} + 600x^2$	$\checkmark (2(3xh) + 2xh) \times 50$ $\checkmark (2 \times 3x^2) \times 100$ $\checkmark$ substitution of $h = \frac{3}{x^2}$ (3) $\checkmark (h \times 8x) \times 50$ $\checkmark (2 \times 3x^2) \times 100$ $\checkmark$ substitution of $h = \frac{3}{x^2}$ (3)
11.3	$C = 1200x^{-1} + 600x^2$ $\frac{dC}{dx} = -1200x^{-2} + 1200x$ $0 = -1200x^{-2} + 1200x$ $1200x^3 = 1200$ $x^3 = 1$ $x = 1$ Therefore the width of the box is 1 metre.	$\checkmark \frac{dC}{dx} = -1200x^{-2} + 1200x$ $\frac{dC}{dx} = 0$ $\checkmark \frac{dC}{dx} = 0$ $\checkmark x^3 = 1$ $\checkmark x = 1$ (4) <b>[10]</b>

**QUESTION 12**

<p>12.1</p>		<p>✓✓ region ABIJ shaded (2)</p> <p><b>NOTE:</b> If region BCEFGI is shaded: award ONE mark</p> <p>If any other region is shaded: award 0 marks</p>
<p>12.2</p>	<p><math>x \leq 40</math> <math>x + y \leq 60</math> <math>y \geq 0</math></p>	<p>✓ <math>x \leq 40</math> ✓ <math>x + y \leq 60</math> ✓ <math>y \geq 0</math> (3)</p>
<p>12.3</p>	<p><math>x = 25</math></p>	<p>✓ answer (1)</p>
<p>12.4</p>	<p>At <math>I(25 ; 10)</math>, <math>P = 4(25) + 10 = 110</math> Maximum value of <math>P</math> is 110 when <math>x = 25</math> and <math>y = 10</math></p>	<p>✓ <math>x = 25</math> ✓ <math>y = 10</math> ✓ substitution ✓ maximum value of <math>P</math> is 110 (4)</p>
<p>12.5</p>	<p><math>C = kx + y</math> <math>y = -kx + C</math> <math>-k &lt; -1</math> <math>k &gt; 1</math></p>	<p>✓ <math>y = -kx + C</math> ✓ <math>k &gt; 1</math> (2)</p> <p><b>NOTE:</b> Answer only: award TWO marks [12]</p>

**TOTAL: 150**