education

Department of
Education
FREE STATE PROVINCE

GRADE 12

MATHEMATICS P1

EXAMINATION

JUNE 2026

MARKS: 150

TIME: 3 hours

This question paper consists of 9 pages and the information sheet

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions:

1. This question paper consists of 9 questions.
2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.
3. Clearly show ALL calculations, diagrams, graphs, etc. which you have used in determining your answers.
4. An approved calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
5. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
6. An INFORMATION SHEET with formulae is included at the end of the question paper.
7. Diagrams are NOT necessarily drawn to scale.
8. Write neatly and legibly.
9. Answers only will NOT necessarily be awarded full marks.

QUESTION 1

1.1 Solve for x:

1.1.1 $(3x-4)(7+2x)=0$ (2)

1.1.2 $x^2+4x+4=x(3x-6)$ (Correct to TWO decimal places) (4)

1.1.3 $2x-\sqrt{25x-1}=-3$ (5)

1.1.4 $3<x^2+2x$ (4)

1.1.5 $2^{2x}-6.2^x+8=0$ (3)

1.2 $x-3y=2$

$x^2+y^2+2x+2y=38$ (5)

1.3 Given: $f(x)=\cos 2\theta-\sin\theta$.

Determine the value(s) of k for which $f(x)=k$ has non - real roots. (4)

[27]

QUESTION 2

Consider the sequence: 16 ; 21 ; 32 ; 49 ; .....

2.1 Write down the next term of the sequence. (1)

2.2 Determine the n^{th} term. (4)

2.3 Which two consecutive terms of the first difference will have a sum of 304? (4)

2.4 Which term of the sequence will have the minimum value? (3)

[12]

QUESTION 3

3.1 Prove that the sum of n terms of an arithmetic series is given by

$$S_n = \frac{n}{2}\left[2a+(n-1)d\right] \quad (3)$$

3.2 The first 4 terms of an arithmetic sequence are: 3 ; w ; z ; 21. Determine:

3.2.1 the value of w and z. (5)

3.2.2 If $z=15$ and $w=9$, determine which term of the sequence is equal to 399. (2)

3.2.3 Calculate S_{67} (2)

[12]

QUESTION 4

4.1 Given the series: $\sum_{k=0}^{\infty} x^2(x-3)^k$

4.1.1 For which values of x will the series converge? (3)

4.1.2 If $\sum_{k=0}^{\infty} x^2(x-3)^k = \frac{49}{2}$, determine the value of x. (4)

4.2 A radio station has a competition where prize money is awarded over a period of 5 days. On the first day, R5 000 is given to the winner. On the second day, 80% of this amount is awarded to the winner and each of the next 3 days, 80% of the amount awarded on the previous day is given to the winner of the day.

4.2.1 How much money is given to the winner on the fourth day? (3)

4.2.2 How much money is given out by the radio station over the 5 days? (2)

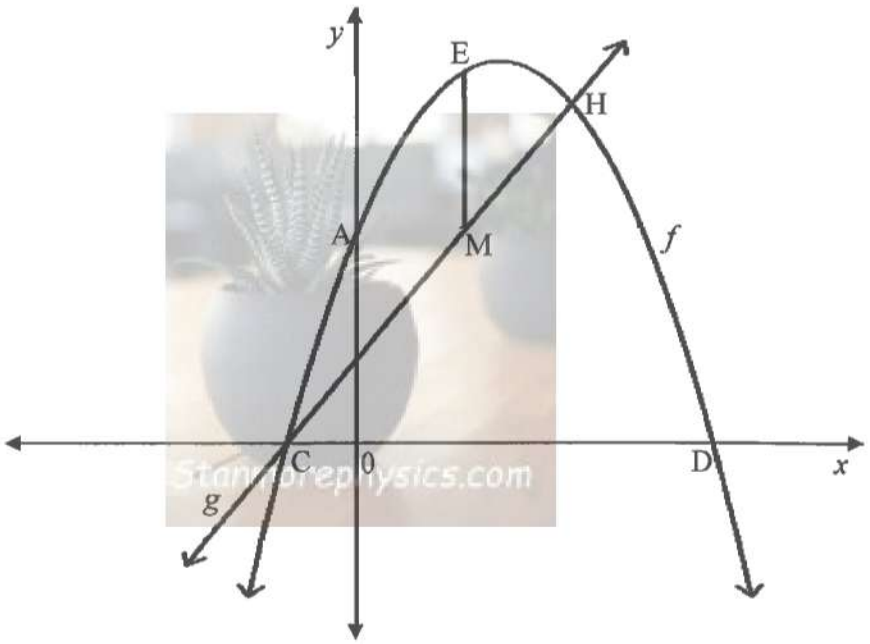
4.2.3 If the radio station has R22 000 to give out for this competition, over how many days could this competition last before there is no money to be awarded? (4)

[16]

QUESTION 5

The graphs of $f(x)=-(x-4)^2+36$ and $g(x)=4x+8$ are drawn below.

- C and D are the $x-$intercepts of the graph of f. A is the y intercept of f.
- A straight line, g, intersect f at C and H.
- E is a point of f and M is a point on g such that EM is parallel to the $y-$axis.



5.1 Write down the range of f. (1)

5.2 Write down the equation of axis of symmetry (1)

5.3 Calculate the length of CD. (4)

5.4 Determine the maximum length of EM. (3)

5.5 For which value(s) of k will $f(x)=-(x-4)^2+36$ and $h(x)=4x+k$ NOT intersect? (4)

[13]

QUESTION 6

Given: $g(x)=\frac{3}{x-2}+1$

6.1 Write down the equations of asymptotes of g. (2)

6.2 Determine the coodinates of x- and y-intercept of g. (3)

6.3 Sketch the graph of g. Clearly showing the asymptotes and the intercepts with axes. (3)

6.4 Determine the equation of the axis of symmetry of g that has a positive gradient. (2)

6.5 The graph of t, is obtained by $t(x)=g(x-1)$. Determine the values of x for which $t(x)\leq 0$ (3)

[13]

QUESTION 7

Given $h(x)=\log_3 x$

7.1 Write down the equation of $h^{-1}(x)$, the inverse of h in the form of $y=...$ (2)

7.2 Sketch the graphs of h and h^{-1} on the same system of axes. Clearly show intercepts with the axes and at least one other point on each graph. (4)

7.3 Determine the values of x for which $h(x)\leq 1$ (2)

7.4 Write down the range of g if $g(x)=-[h^{-1}(x)-4]$ (2)

[10]

QUESTION 8

8.1 Given: $f(x)=\frac{-2}{x}$

Determine $f'(x)$ from first principles. (5)

8.2 Determine: $D_x\left[4\sqrt[3]{x}+\frac{1}{3x}+2\right]$ (4)

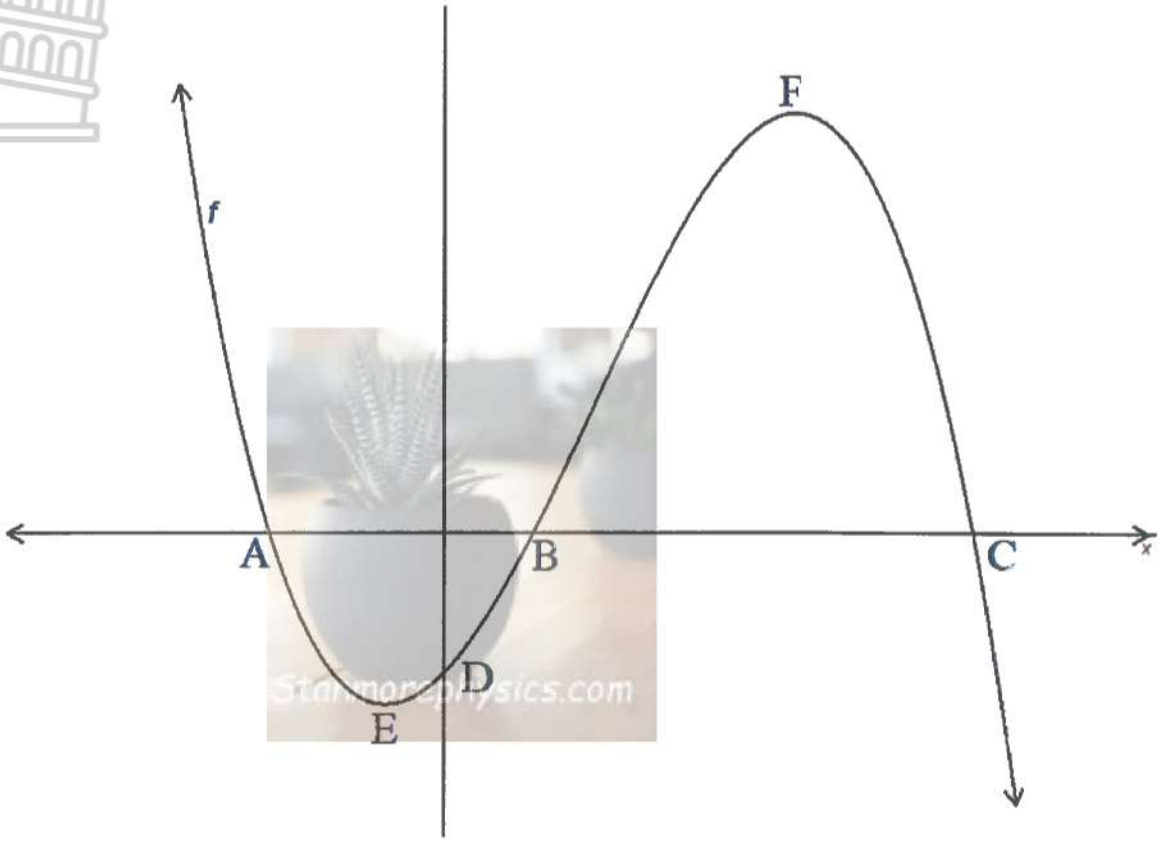
8.3 Given: $h(x)=ax^2$ where $x\geq 0$

Determine the value of a, for which $h^{-1}(8)=h'(4)$. (6)

[15]

QUESTION 9

The graph of a cubic function with the equation $f(x) = -x^3 + 5x^2 + 8x - 12$ is drawn below. A, B, C and D are the intercepts of f with axes. E and F are the turning points of f.



9.1 Write down the coordinates of D. (1)

9.2 Determine the coordinates of A, B and C. (5)

9.3 Calculate the coordinates of E, the turning point of f. (4)

9.4 If $g(x) = f''(x)$ sketch the graph of g clearly showing the intercepts with axes. (3)

9.5 For which values of x will:

9.5.1 the graph of f be concave up? (2)

9.5.2 $f'(x) > 0$ (2)

9.5.3 $f(x).f'(x) \geq 0$ (4)

9.6 Determine the value(s) of k for which $f(x)+k=0$ has 3 unequal roots. (3)

9.7 Determine the equation of the tangent to f at $x=5$. (4)

9.8 The graph of $h(x)=ax^3+bx^2+cx+d$ has two turning points.
The following information about h is also given:

- $h(2)=0$
- $h'(1)=0$
- $h''\left(\frac{1}{2}\right)>0$
- The x-axis is a tangent to the graph of h at $x=-1$.

Without calculating the equation of h, use the given information to draw a sketch of h, only indicating the x-coordinates of the x-intercepts and turning points. (4)

[32]

TOTAL 150

INFORMATION SHEET/INLIGTINGSBLAD

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$A = P(1+ni) \qquad A = P(1-ni) \qquad A = P(1-i)^n \qquad A = P(1+i)^n$$

$$T_n = a + (n-1)d \qquad S_n = \frac{n}{2}[2a + (n-1)d]$$

$$T_n = ar^{n-1} \qquad S_n = \frac{a(r^n - 1)}{r-1} \;; r \neq 1 \qquad S_\infty = \frac{a}{1-r} \;; -1 < r < 1$$

$$F = \frac{x[(1+i)^n - 1]}{i} \qquad P = \frac{x[1-(1+i)^{-n}]}{i}$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad M\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c \qquad y - y_1 = m(x - x_1) \qquad m = \frac{y_2 - y_1}{x_2 - x_1} \qquad m = \tan\theta$$

$$(x-a)^2 + (y-b)^2 = r^2$$

$$In\ \Delta ABC: \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc.\cos A$$

$$area\ \Delta ABC = \frac{1}{2}ab.\sin C$$

$$\sin(\alpha + \beta) = \sin\alpha.\cos\beta + \cos\alpha.\sin\beta \qquad \sin(\alpha - \beta) = \sin\alpha.\cos\beta - \cos\alpha.\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha.\cos\beta - \sin\alpha.\sin\beta \qquad \cos(\alpha - \beta) = \cos\alpha.\cos\beta + \sin\alpha.\sin\beta$$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases} \qquad \sin 2\alpha = 2\sin\alpha.\cos\alpha$$

$$\bar{x} = \frac{\sum x}{n} \qquad \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)} \qquad P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\hat{y} = a + bx \qquad b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$$

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ADDENDUM

GRADE 12

PAPER 1

9.8 The graph of $h(x) = ax^3 + bx^2 + cx + d$ has two turning points.
The following information about h is also given:

- $h(2) = 0$
- $h'(1) = 0$
- $h'\left(\frac{1}{2}\right) > 0$
- The x-axis is a tangent to the graph of h at $x = -1$.

Without calculating the equation of h, use the given information to draw a sketch of h, only indicating the x-coordinates of the x-intercepts and turning points. (4)

VRAESTEL 1

9.8 Die vergelyking van $h(x) = ax^3 + bx^2 + cx + d$ het twee draaipunte.
Die volgende inligting oor h word ook gegee:

- $h(2) = 0$
- $h'(1) = 0$
- $h'\left(\frac{1}{2}\right) > 0$
- Die x-as is 'n raaklyn aan die grafiek van h by $x = -1$.

Sonder om die vergelyking van h te bereken, gebruik die gegewe inligting om die grafiek van h te skets, dui slegs die x-koördinate van die x-afsnitte en draaipunte aan. (4)

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MATHEMATICS

MARKING GUIDELINE

JUNE 2026

NOTE:

- If a candidate answers a question TWICE, only mark the FIRST attempt.
- If a candidate has crossed out an attempt of a question and not redone the question, mark the crossed-out version.
- Consistent accuracy applies in ALL aspects of the marking memorandum.
- Assuming answers/values to solve a problem is NOT acceptable.

NOTA:

- *As 'n kandidaat 'n vraag TWEE KEER beantwoord, merk slegs die EERSTE poging.*
- *As 'n kandidaat 'n antwoord van 'n vraag doodtrek en nie oordoen nie, merk die doodgetrekte poging.*
- *Volgehoue akkuraatheid word in ALLE aspekte van die nasienriglyne toegepas.*
- *Aanvaar van antwoorde/waardes om 'n probleem op te los, word NIE toegelaat nie.*

QUESTION 1

1.1.1	$x=\frac{4}{3}$ or $x=-\frac{7}{2}$	✓ $x=\frac{4}{3}$ ✓ $x=-\frac{7}{2}$ (2)
1.1.2	$x^2+4x+4=3x^2-6x$ $-2x^2+10x+4=0$ $x=\frac{-(10)\pm\sqrt{(10)^2-4(-2)(4)}}{2(-2)}$ $x=-0,37$ or $x=5,37$	✓ standard form ✓ correct substitution ✓ $x=-0,37$ ✓ $x=5,37$ (4)
1.1.3	$2x+3=\sqrt{25x-1}$ $(2x+3)^2=\left(\sqrt{25x-1}\right)^2$ $4x^2+12x+9=25x-1$ $4x^2-13x+10=0$ $(x-2)(4x-5)=0$ $x=2$ or $x=\frac{5}{4}$	✓ isolation ✓ squiring both sides ✓ standard form ✓ factors ✓ answers (5)
1.1.4	$x^2+2x-3>0$ $(x+3)(x-1)>0$ CV: -3 and 1 $x<-3$ or $x>1$	✓ standard form ✓ factors ✓ $x<-3$ ✓ $x>1$ (4)

1.1.5	$(2^x-4)(2^x-2)=0$ $2^x=4 \quad \text{or} \quad 2^x=2$ $2^x=2^2 \quad \text{or} \quad x=1$ $x=2$	✓ factors ✓ $2^x=2^2 \quad \text{or} \quad 2^x=2$ ✓ answers (3)
1.2	$x=3y+2$ $(3y+2)^2+y^2+2(3y+2)+2y=38$ $9y^2+12y+4+y^2+6y+4+2y-38=0$ $10y^2+20y-30=0$ $y^2+2y-3=0$ $(y-1)(y+3)=0$ $y=1 \quad \text{or} \quad y=-3$ $x=5 \quad \text{or} \quad x=-7$	✓ $x=3y+2$ ✓ substitution ✓ factors ✓ both y values ✓ both x values (5)
1.3	$1-2\sin^2\theta-\sin\theta-k=0$ $-2\sin^2\theta-\sin\theta-k+1=0$ $\Delta<0$ $(-1)^2-4(-2)(-k+1)<0$ $1-8k+8<0$ $k>\frac{9}{8}$	✓ double angle ✓ $\Delta<0$ ✓ substitution ✓ $k>\frac{9}{8}$ (4)
		[27]

QUESTION 2

2.1	72	✓ answer (1)
2.2	$2a=6$ $\quad 3a+b=5$ $\quad a+b+c=16$ $a=3$ $\quad 3(3)+b=5$ $\quad 3+(-4)+c=16$ $b=-4$ $\quad c=17$ $T_n=3n^2-4n+17$	✓ $a=3$ ✓ $b=-4$ ✓ $c=17$ ✓ T_n (4)
2.3	$T_n=6n-1$ $T_n+T_{n+1}=304$ $6n-1+6(n+1)-1=304$ $6n-1+6n+6-1=304$ $12n=300$ $n=25$ $\therefore T_{25}$ and T_{26}	✓ $T_n=6n-1$ ✓ substitution ✓ $n=25$ ✓ answers (4)
2.4	$n=-\dfrac{-4}{2(3)}$ $=\dfrac{2}{3}$ Since the position of n in a sequence must be a positive integer. The sequence increases steadily from the first term. The **first term** will have the minimum value.	✓ Subst. ✓ $n\neq\dfrac{2}{3}$ ✓ answer (3)
		[12]

QUESTION 3

3.1	$S_n = a + a + d + a + 2d + ... + [a + (n-2)d] + [a + (n-1)d]$ $S_n = [a + (n-1)d] + [+(n-2)d + ...a + 2d + a + d + a$ $\therefore 2S_n = [2a + (n-1)d] + ... + [2a + (n-1)d]$ $2S_n = n[2a + (n-1)d]$ $\therefore S_n = \frac{n}{2}[2a + (n-1)d]$	✓ setting up of S ✓ addition ✓ multiply by n terms (3)
3.2	$w - 3 = z - w$ $z = 2w - 3$ $z - w = 21 - z$ $2z = 21 + w$ $2(2w - 3) = 21 + w$ $4w - 6 = 21 + w$ $3w = 27$ $w = 9$ $z = 15$	✓ equating 1st diff ✓ 2nd equation ✓ subst. ✓ value of w ✓ Value of z (5)
3.2.2	$399 = 6n - 3$ $402 = 6n$ $n = 67$	✓ subst. ✓ answer (2)
3.3.1	$S_{67} = \frac{67}{2}[2(3) + (67-1) \times 6]$ $= 13\,467$	✓ subst. ✓ answer (2)
		[12]

QUESTION 4

4.1.1	$r = x-3$ $-1 < x-3 < 1$ $2 < x < 4$	✓ r ✓ subst. ✓ answer (3)
4.1.2	$\frac{x^2}{1-(x-3)} = \frac{49}{2}$ $\frac{x^2}{4-x} = \frac{49}{2}$ $2x^2 = 196 - 49x$ $2x^2 + 49x - 196 = 0$ $(2x-7)(x+28) = 0$ $x = \frac{7}{2}$ or $x \neq -28$	✓ correct subst. ✓ simplification ✓ standard form ✓ answer with rejection (4)
4.2.1	$T_4 = 5\,000(0.8)^{4-1}$ $= R2\,560$	✓ r ✓ subst. in the formula ✓ answer (3)
4.2.2	$S_5 = \frac{5\,000(0,8^5 - 1)}{0,8-1}$ $= R16\,808$	✓ subst. ✓ answer (2)

4.2.3	$\frac{5\,000\left(0.8^{n}-1\right)}{0.8-1}=22\,000$ $0.8^{n}-1=\frac{4400}{5000}$ $0,8^{n}=0,12$ $n=\log_{0,8}(0,12)$ $n\approx 9,51$ $n=9$	✓ subst. ✓ simplification ✓ correct application of log ✓ answer (4)
		[16]

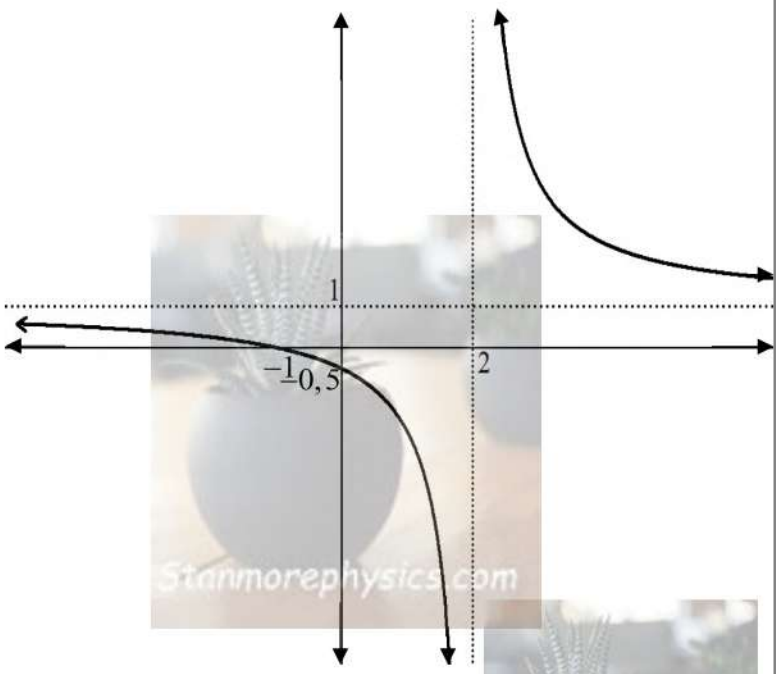
QUESTION 5

5.1	$y\varepsilon\left(-\infty;36\right]$ or $y\leq 36$	✓ $y\varepsilon\left(-\infty;36\right]$ (1)
5.2	$x=4$	✓ $x=4$ (1)
5.3	$0=-\left(x-4\right)^{2}+36$ $\left(x-4\right)^{2}=36$ $\left(x-4\right)=\pm 6$ $x=10$ or $x=-2$ $\therefore$ Length of CD $=12$ units	✓ $y=0$ ✓ factors ✓ both x values ✓ answer (4)

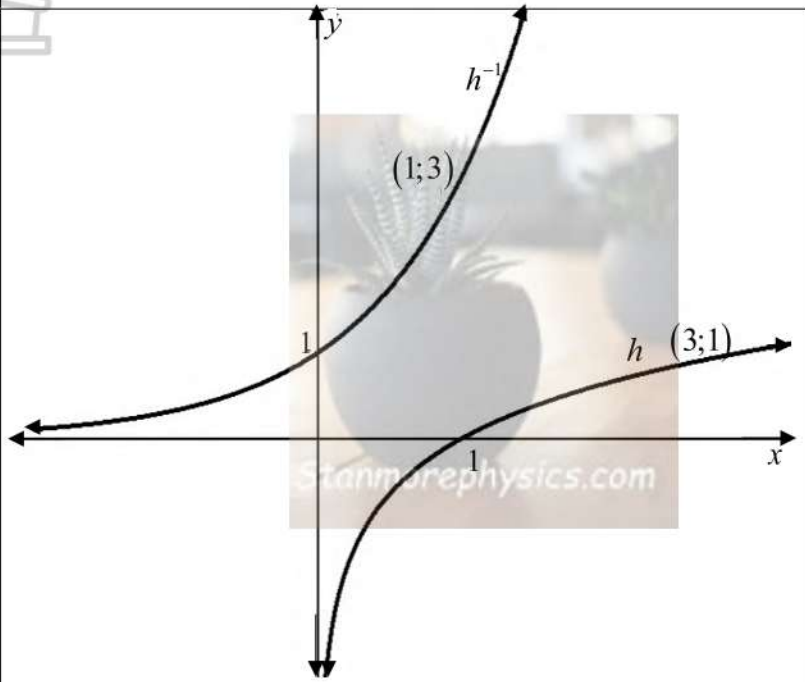
5.4	$\text{EM} = -(x-4)^2 + 36 - (4x+8)$ $= -x^2 + 8x + 20 - 4x - 8$ $= -x^2 + 4x + 12$ $= -(x-2)^2 + 16$ Maximum length $= 16$	✓ $\text{EM} = y_f - y_g$ ✓ Method (completing the square/derivative/ $x = \frac{-b}{2a}$) ✓ answer (3)
5.5	$-x^2 + 8x - 16 + 36 = 4x + k$ $-x^2 + 4x + 20 - k = 0$ $\Delta = (4)^2 - 4(-1)(20-k)$ $16 + 80 - 4k < 0$ $-4k < -96$ $k > 24$	✓ equating ✓ correct subst. ✓ $\Delta < 0$ ✓ answer (4)
		[13]

QUESTION 6

6.1	$x = 2$ $y = 1$	✓ $x = 2$ ✓ $y = 1$ (2)

6.2	$y=\frac{3}{0-2}+1$ $y=-\frac{1}{2}$ $\left(0;-\frac{1}{2}\right)$ $0=\frac{3}{x-2}+1$ $-1=\frac{3}{x-2}$ $3=-x+2$ $x=-1$ $(-1;0)$	✓ $y=-\frac{1}{2}$ ✓ sub $y=0$ ✓ $x=-1$ (3)
6.3		✓ intercepts ✓ asymptotes ✓ shape (no c/a) (3)
6.4	$y=(x-2)+1$ $y=x-1$	✓ sub m and point ✓ answer (2)
6.5	$0\le x<3$	✓ 0 & ✓3 ✓ notation (3)
		[13]

QUESTION 7

7.1	$y = \log_3 x$ $x = \log_3 y$ $y = 3^x$	✓swapping x and y ✓ answer (2)
7.2		✓ shape & x-int of h ✓ any point on h ✓ shape & y-int of h^{-1} ✓ point on the inverse (4)
7.3	$0 < x \leq 3$	✓ 0 & 3 ✓ Notation (2)
7.4	$g(x) = -[h^{-1}(x) - 4]$ $g(x) = -3^x + 4$ $Range: y < 4$	✓ $g(x) = -3^x + 4$ ✓ $y < 4$ (2)
		[10]

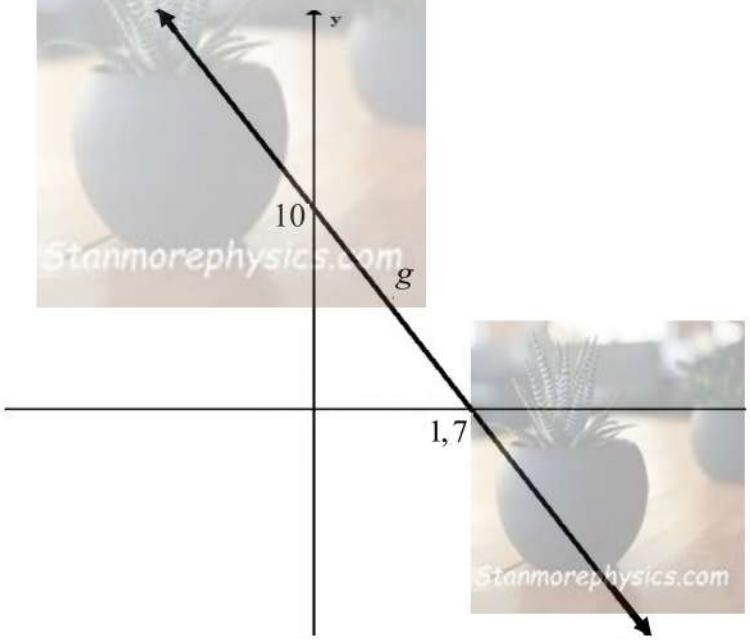
QUESTION 8

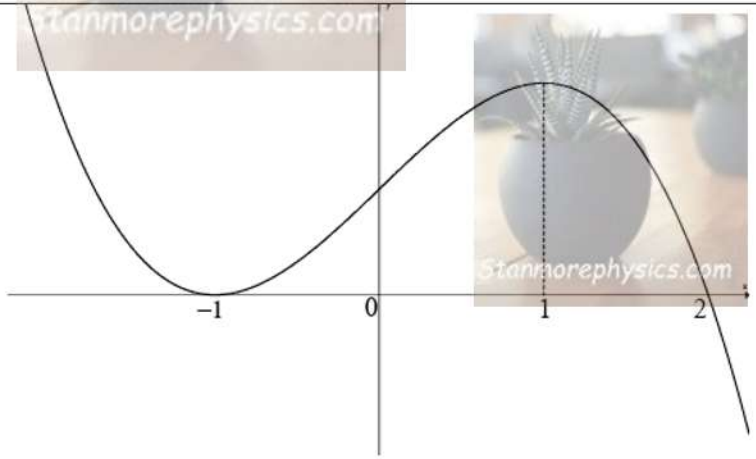
8.1	$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $f(x)=\frac{-2}{x}$ $\therefore f(x+h)=\frac{-2}{x+h}$ $f'(x)=\lim_{h\to 0}\frac{\frac{-2}{x+h}+\frac{2}{x}}{h}$ $=\lim_{h\to 0}\frac{-2x+2x+2h}{x(x+h)}\div h$ $=\lim_{h\to 0}\frac{2h}{x(x+h)}\times\frac{1}{h}$ $=\lim_{h\to 0}\frac{2}{x(x+h)}$ $=\frac{2}{x^2}$	✓ $f(x+h)$ ✓ subst. ✓ simplification ✓ $\frac{2}{x(x+h)}$ ✓Answer (5)
8.2	$D_x\left[4x^{\frac{1}{3}}+\frac{1}{3}x^{-1}+2\right]$ $=\frac{4}{3}x^{-\frac{2}{3}}-\frac{1}{3}x^{-2}$	✓ $4x^{\frac{1}{3}}$ ✓ $\frac{1}{3}x^{-1}$ ✓ $\frac{4}{3}x^{-\frac{2}{3}}$ ✓ $-\frac{1}{3}x^{-2}$ (4)

8.3	$h(x) = ax^2 \quad ; x \geq 0$ $h^{-1}(8) = h'(4)$ $h^{-1}(x) = \sqrt{\frac{1}{a}x} \qquad h'(x) = 2ax$ $h^{-1}(8) = \sqrt{\frac{1}{a}(8)} \qquad h'(4) = 2a(4)$ $\therefore \sqrt{\frac{8}{a}} = 8a$ $\frac{8}{a} = 64a^2$ $64a^3 = 8$ $a^3 = \frac{1}{8}$ $a = \frac{1}{2}$	✓ $h^{-1}(x) = \sqrt{\frac{1}{a}x}$ ✓ $h'(x) = 2ax$ ✓ sub of 8 ✓ sub of 4 ✓ simplification ✓ answer (6)
		[15]

QUESTION 9

9.1	$D(0;-12)$	✓ answer (1)
9.2	$y = -x^3 + 5x^2 + 8x - 12$ $0 = -x^3 + 5x^2 + 8x - 12$ $0 = x^3 - 5x^2 - 8x + 12$ $0 = (x+2)(x-1)(x-6)$ $x = -2 \quad or \quad x = 1 \quad or \quad x = 6$ $A(-2;0) \; B(1;0) \; C(6;0)$	✓ $y = 0$ ✓ factors ✓ $x = -2$ ✓ $x = 1$ ✓ $x = 6$ (5)

9.3	$f(x)=-x^3+5x^2+8x-12$ $At\ TP: f'(x)=0$ $\therefore\ -3x^2+10x+8=0$ $3x^2-10x-8=0$ $(3x+2)(x-4)=0$ $x=-\frac{2}{3}\quad or\quad x=4$ $y\ at\quad E:$ $y=-\left(-\frac{2}{3}\right)^3+5\left(-\frac{2}{3}\right)^2+8\left(-\frac{2}{3}\right)-12$ $y=-\frac{400}{27}/-14,81$ $E\left(-\frac{2}{3};-\frac{400}{27}\right)$	✓ $f'(x)=0$ ✓ factors ✓ x values ✓ coordinates of E (4)
9.4	$f''(x)=-6x+10$ $\therefore g(x)=-6x+10$ 	✓ $g(x)=-6x+10$ ✓ shape ✓ intercepts (3)
9.5.1	$f''(x)>0$ $-6x+10>0$ $-6x>-10$ $x<\frac{5}{3}$	✓ $\frac{5}{3}$ ✓ $x<\frac{5}{3}$ (2)

9.5.2	$-\frac{2}{3} < x < 4$	✓✓ $-\frac{2}{3} < x < 4$ (2)
9.5.3	$-2 \le x \le -\frac{2}{3}$ $1 \le x \le 4$ $x \ge 6$	✓✓ $-2 \le x \le -\frac{2}{3}$ ✓ $1 \le x \le 4$ ✓ $x \ge 6$ (4)
9.6	$-f'(x) = k$ $-\frac{400}{27} < -k < 36$ $\therefore -36 < k < \frac{400}{27}$	✓ 36 ✓✓ $-36 < k < \frac{400}{27}$ (3)
9.7	$f(x) = -x^3 + 5x^2 + 8x - 12$ $y = -(5)^3 + 5(5)^2 + 8(5) - 12$ $y = 28$ $f'(5) = -3(5)^2 + 10(5) + 8$ $f'(5) = -17$ $y - 28 = -17(x - 5)$ $y = -17x + 113$	✓ $y = 28$ ✓ $f'(5) = -17$ ✓ subst. ✓ answer (4)
9.8		✓ $x = -1$ and $x = 2$ ✓ *TP at* $x = -1$ ✓ *TP at* $x = 1$ ✓ shape (4)