SEKOLAH BUKIT SION

IGCSE Mock Examination 2021

STUDENT NAME

EXAM NUMBER

CLASS

0606 ADDITIONAL MATHEMATICS (PAPER 1)

Year 10

10 April 2021

1 hour 30 minutes

Additional Materials:

- Scientific Calculator
- Ruler
- Graphing Paper

READ THESE INSTRUCTIONS FIRST

Write your name, exam number and grade on all the work you hand in.
Write in dark blue or black pen.
Use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

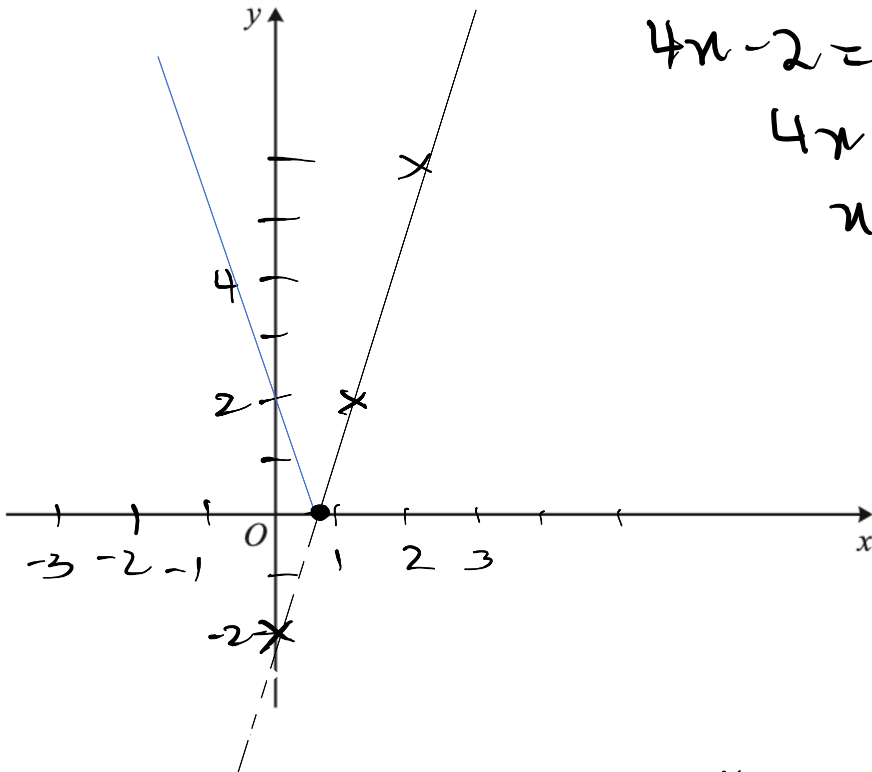
Answer **all** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 60.

Score :

This document consists of **11** printed pages including this page.

1 **(a)** Sketch the graph of $y = |4x - 2|$ on the axes below, showing the coordinates of the points where the graph meets the axes. [3]



$4x - 2 = 0$

$4x = 2$

$x = \frac{1}{2}$

(b) Solve the equation $|4x - 2| = x$. [3]

$4x - 2 = x$

$3x = 2$

$x = \frac{2}{3}$

$4x - 2 = -x$

$5x = 2$

$x = \frac{2}{5}$

Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	Idea of modulus correct	**B1**		Two straight lines above and touching x-axis	
	$\frac{1}{2}$ indicated on x-axis	**B1**		Must be a sketch	
	2 indicated on y-axis	**B1**		Must be a sketch	
1(b)	$\frac{2}{3}$ (0.667)	**B1**		0.67 is **B0**	
	Solve $4x - 2 = -x$ or $(4x-2)^2 = x^2$	**M1**		As far as x = numerical value	
	$\frac{2}{5}$	**A1**		SC: If drawn then **B1**, **B2** for exact answers only	
					[Total: 6]

2 Find the equation of the normal to the curve $y = \sqrt{8x+5}$ at the point where $x = \frac{1}{2}$, giving your answer in the form of $ax + by + c = 0$, where a, b and c are integers.

[5]

Question	Answer	Marks	AO Element	Notes	Guidance
1	**M1** $\frac{dy}{dx} = k(8x+5)^{-\frac{1}{2}}$	5		For attempt to differentiate, must be in the form $k(8x+5)^{-\frac{1}{2}}$	
	A1 $\frac{dy}{dx} = 4(8x+5)^{-\frac{1}{2}}$				
	B1 When $x = \frac{1}{2}$, $y = 3$				
	M1 Normal: $y - 3 = -\frac{3}{4}\left(x - \frac{1}{2}\right)$			For attempt at the normal when $x = \frac{1}{2}$, using correct process for *their* $\frac{dy}{dx}$ and *their* y.	
	A1 $6x + 8y - 27 = 0$				
					[Total: 5]

3 Find the values of k for which the line $y = kx - 3$ and the curve $y = 2x^2 + 3x + k$ do not intersect. [5]

Question	Answer	Marks	AO Element	Notes	Guidance
1	**M1** $2x^2 + 3x + k = kx - 3$	5		For an attempt to equate and simplify to a 3 term quadratic equation, allow an error in one term	
	A1 $2x^2 + (3-k)x + (k+3) = 0$				
	M1 $(3-k)^2 - 4 \times 2 \times (k+3)$			For attempt to use the discriminant, allow previous error, leading to a quadratic equation in terms of k	
	A1 $k^2 - 14k - 15 = 0$ giving critical values of -1 and 15			For critical values	
	A1 $-1 < k < 15$				
					[Total: 5]

4 Find the values of x for which $x\,(6x + 7) \geq 20$. [3]

Question	Answer	Marks	AO Element	Notes	Guidance
1	**M1** $6x^2 + 7x - 20$ [*0] **A1** Critical values $\frac{4}{3}$, $-\frac{5}{2}$ **A1** $x \leqslant -\frac{5}{2}$ or $x \geqslant \frac{4}{3}$ final answer	**3**		where * may be any inequality sign or = **FT** *their* critical values using outside regions	
					[Total: 3]

5 The functions f and g are defined for real values of x by

$f(x) = \sqrt{x-1} - 3$ for $x > 1$,

$g(x) = \frac{x-2}{2x-3}$ for $x > 2$.

(a) Find gf(37). [2]

(b) Find an expression for $f^{-1}(x)$. [2]

(c) Find an expression for $g^{-1}(x)$. [2]

Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	$f(37) = 3$ or $gf(x) = \frac{\sqrt{x-1} - 3 - 2}{2\left(\sqrt{x-1} - 3\right) - 3}$	**B1**			
	$gf(37) = \frac{3-2}{6-3} = \frac{1}{3}$	**B1**			
1(b)	$y = \sqrt{x-1} - 3 \rightarrow (y+3)^2 = x - 1$	**M1**		Rearrange and square in any order	
	$(x+3)^2 + 1 = f^{-1}(x)$ oe isw	**A1**		Interchange x and y and complete	
1(c)	$y = \frac{x-2}{2x-3}$ $2xy - 3y = x - 2 \rightarrow 2xy - x = 3y - 2$	**M1**		Multiply and collect like terms	
	$\frac{3x-2}{2x-1} = g^{-1}(x)$ oe	**A1**		Interchange and complete Mark final answer	
					[Total: 6]

6 Solve.

(a) $2(5)^{2z} + 5^z - 1 = 0.$ [4]

Question	Answer	Marks	AO Element	Notes	Guidance
1	$(2(5^z) - 1)(5^z + 1) = 0$	**M1**		**M1** for solution of quadratic	
	leading to $2.5^z = 1$ $(5^z = -1)$	**A1**		**A1** for correct solution	
	$5^z = 0.5$	**M1**		**DM1** for correct attempt to solve $2.5^z = k$, where k is positive	
	$z = \dfrac{\log 0.5}{\log 5}$ or $z = -0.431$ or better	**A1**		**A1** must have one solution only	
					[Total: 4]

(b) $1 + 2\log_5 x = \log_5(18x - 9)$ [4]

Question	Answer	Marks	AO Element	Notes	Guidance
1	$1 + 2\log_5 x = \log_5(18x - 9)$ $\log_5 5 + \log_5 x^2 = \log_5(18x - 9)$	**B2**		**B1** for dealing with '1', **B1** for dealing with '2'	
	$\log_5 5x^2 = \log_5(18x - 9)$	**M1**		for a correct use of addition or subtraction of logarithms	
	$5x^2 = 18x - 9$ $(5x - 3)(x - 3) = 0$	**M1**		**DM1** for elimination of logarithms to form a 3 term quadratic and for solution of quadratic	
	$x = \dfrac{3}{5}, 3$	**A1**		for both x values	
					[Total: 5]

7 A curve has equation $y = (3x - 5)^3 - 2x$.

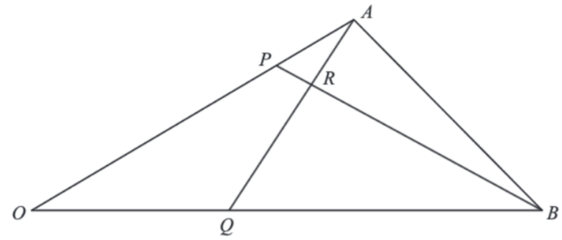
(a) Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$. [4]

(b) Find the exact value of the x-coordinate of each of the stationary points of the curve. [2]

(c) Use the second derivative test to determine the nature of each of the stationary points. [2]

Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	**B2** $9(3x-5)^2 - 2$ isw **B2** $54(3x-5)^{[1]}$ isw	**4**		**B1** for $k(3x-5)^2$ $k \neq 9$ seen **B1** for $k(3x-5)^{[1]}$ $k \neq 54$ seen	
1(b)	**M1** Solves *their* $9(3x-5)^2 - 2 = 0$ **A1** $[x =]\ \frac{5}{3} \pm \frac{\sqrt{2}}{9}$ or exact equivalent	**2**			
1(c)	**M1** Substitutes *their* $\frac{5}{3} + \frac{\sqrt{2}}{9}$ or *their* $\frac{5}{3} - \frac{\sqrt{2}}{9}$ into *their* $54(3x-5)^{[1]}$ and considers sign of result **A1** When $x = \frac{5}{3} + \frac{\sqrt{2}}{9}$ $\frac{d^2y}{dx^2} > 0$ so minimum and when $x = \frac{5}{3} - \frac{\sqrt{2}}{9}$ $\frac{d^2y}{dx^2} < 0$ so maximum	**2**			

8



The position vectors of points A and B relative to an origin O are **a** and **b** respectively.
The point P is such that $\overrightarrow{OP} = \mu\overrightarrow{OA}$. The point Q is such that $\overrightarrow{OQ} = \lambda\overrightarrow{OB}$.
The lines AQ and BP intersect at the point R.

(a) Express $\overrightarrow{AQ}$ in terms of λ, **a** and **b**. [1]

(b) Express $\overrightarrow{BP}$ in terms of μ, **a** and **b**. [1]

It is given that $3\overrightarrow{AR} = \overrightarrow{AQ}$ and $8\overrightarrow{BR} = 7\overrightarrow{BP}$.

(c) Express $\overrightarrow{OR}$ in terms of λ, **a** and **b**. [2]

(d) Express $\overrightarrow{OR}$ in terms of μ, **a** and **b**. [2]

(e) Hence find the value of μ and λ. [3]

Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	$\overrightarrow{AQ} = \lambda\mathbf{b} - \mathbf{a}$	B1			
1(b)	$\overrightarrow{BP} = \mu\mathbf{a} - \mathbf{b}$	B1			
1(c)	$\overrightarrow{OR} = \mathbf{a} + \frac{1}{3}(\lambda\mathbf{b} - \mathbf{a})$ or $\lambda\mathbf{b} - \frac{2}{3}(\lambda\mathbf{b} - \mathbf{a})$	M1		for $\mathbf{a} + \frac{1}{3}$ *their* **(a)**	
	$= \frac{2}{3}\mathbf{a} + \frac{1}{3}\lambda\mathbf{b}$	A1		Allow unsimplified	
1(d)	$\overrightarrow{OR} = \mathbf{b} + \frac{7}{8}(\mu\mathbf{a} - \mathbf{b})$ or $\mu\mathbf{a} - \frac{1}{8}(\mu\mathbf{a} - \mathbf{b})$	M1		for $\mathbf{b} + \frac{7}{8}$ *their* **(b)**	
	$= \frac{1}{8}\mathbf{b} + \frac{7}{8}\mu\mathbf{a}$	A1		Allow unsimplified	
1(e)	$\frac{2}{3}\mathbf{a} + \frac{1}{3}\lambda\mathbf{b} = \frac{1}{8}\mathbf{b} + \frac{7}{8}\mu\mathbf{a}$	M1		for equating **(c)** and **(d)** and then equating like vectors	
	$\frac{2}{3} = \frac{7}{8}\mu,\ \mu = \frac{16}{21}$ Allow 0.762	A1			
	$\frac{1}{3}\lambda = \frac{1}{8},\ \lambda = \frac{3}{8}$ Allow 0.375	A1			

9 **CHOOSE/ANSWER ONLY ONE.**

(a) Given that $7^x \times 49^y = 1$ and $5^{5x} \times 125^{\frac{2y}{3}} = \frac{1}{25}$, calculate the value of x and y. [4]

Question	Answer	Marks	AO Element	Notes	Guidance
1	**M1** Either $7^x \times 7^{2y}$ or $49^{\frac{x}{2}} \times 49^y$ or $5^{5x} \times 5^{2y}$ or $25^{\frac{5x}{2}} \times 25^y$	**5**		For expressing the terms on the left hand side of either one of the 2 equations in terms of powers of 7, 49, 5 or 25	
	A1 $7^x \times 7^{2y} = 7^0$ or $49^{\frac{x}{2}} \times 49^y = 49^0$				
	A1 $5^{5x} \times 5^{2y} = 5^{-2}$ or $25^{\frac{5x}{2}} \times 25^y = 25^{-1}$				
	M1 leading to $x + 2y = 0$ and $5x + 2y = -2$			For attempt to solve two linear equations, with integer coefficients and constants, in terms of x and y	
	A1 $x = -\frac{1}{2}$, $y = \frac{1}{4}$				
					[Total: 5]

(b) Without using a calculator, express $\frac{\left(\sqrt{5}-3\right)^2}{\sqrt{5}+1}$ in the form of $p\sqrt{5} + q$, where p and q are integers. [4]

Question	Answer	Marks	AO Element	Notes	Guidance
1	**M1** $\left(\sqrt{5}-3\right)^2 = 5 + 9 - 2(3)\sqrt{5}$	**4**			
	M1 $\frac{\textit{their}\ \left(14-6\sqrt{5}\right)}{\sqrt{5}+1} \times \frac{\sqrt{5}-1}{\sqrt{5}-1}$			Attempts to rationalise or forms a pair of simultaneous equations e.g. $5p + q = 14$, $p + q = -6$	
	M1 $\frac{\textit{their}\ \left(14\sqrt{5} - 30 - 14 + 6\sqrt{5}\right)}{5-1}$			multiplies out; numerator must have at least 3 terms; condone one sign error in numerator; denominator may be 4 or $5 - \sqrt{5} + \sqrt{5} - 1$ or solves *their* simultaneous equations to find one unknown	
	A1 $5\sqrt{5} - 11$			or $p = 5$, $q = -11$	
					[Total: 4]

10 The polynomial $p(x) = (2x - 1)(x + k) - 12$, where k is a constant.

(a) Write down the value of $p(-k)$. [1]

(b) When $p(x)$ is divided by $(x + 3)$, the remainder is 23.
Find the value of k. [2]

(c) Using your value of k **in part (b)**, show that the equation $p(x) = -25$ has no real solutions. [3]

Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	**B1** -12	**1**			
1(b)	**M1** $(2 \times -3 - 1)(k - 3) - 12 = 23$ oe or $2(-3)^2 + (2k - 1)(-3) - k - 12 = 23$ **A1** $k = -2$	**2**			
1(c)	**M1** $(2x - 1)(x - 2) - 12 = -25$ $2x^2 - 5x + 15 = 0$ **M1** Discriminant: $25 - (4 \times 2 \times 15)$ $= -95$ **A1** which is < 0 so no real solutions	**3**		expansion and simplification to a 3 term quadratic equation equated to zero, using *their k.* using discriminant for their three term quadratic equation cao for correct discriminant and correct conclusion	
					[Total: 6]

- END OF EXAMINATION -