Name: ______________________________________

Class: __________________

2018

Year 11

Preliminary Examination

Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – 120 minutes
- Write using black pen
- NESA approved calculators may be used
- In Questions 6–9, show relevant mathematical reasoning and/or calculations

Total marks – 85

Section I – 5 marks (page 2)

- Attempt Questions 1–5

Section II – 80 marks (pages 3–6)

- Attempt Questions 6 –9

Multiple Choice (1 mark each)

1. At what point on the curve $y=(x-2)(x+3)$ is the tangent perpendicular to $x-y+5=0$

(A) (-1, -6)

(B) (0,-6)

(C) (1, -4)

(D) (0, 6)

2. State the domain for $y=\sqrt{4-x^2}$

(A) $-4 \le x \le 4$

(B) $x \le -2 \; or \; x \ge 2$

(C) $-2 \le x \le 2$

(D) $-2 < x < 2$

3. Find x if $2^x \times 4^{x+1} = \frac{1}{2}$

(A) $x = -1$

(B) $x = 1$

(C) $x = 2$

(D) $x = -2$

4. Solve $|2x+5| = x-1$

(A) $x = -6$

(B) $x = -\frac{4}{3}$

(C) $x = 0$

(D) $no\ solution$

5. Evaluate $\lim_{x\to 5} \frac{x^2-25}{x-5}$

(A) -5

(B) 0

(C) 5

(D) 10

Question 6 (20 marks)

(a) Calculate $\dfrac{3}{2.78} + \dfrac{1}{\sqrt{3}}$ correct to 4 significant figures **1**

(b) If $\sqrt{27} + \sqrt{12} = \sqrt{A}$, find *A*. **2**

(c) Solve $t^{\frac{2}{3}} = 16$ **2**

(d) Factorise the following expressions completely

(i) $3x^2 - 12y^2$ **1**

(ii) $8 - 27d^3$ **1**

(e) Given that $3\log_x 2 - \log_x 128 = 4$, find the value of x. **3**

(f) Find the EXACT value of

(i) Sin 225° **1**

(ii) Sec 120° **1**

(g) The point *P*(*x*,*y*) moves so that its distance *PA* is always twice its distance *PB*. Given the points A(1,5) and B(4,-1).

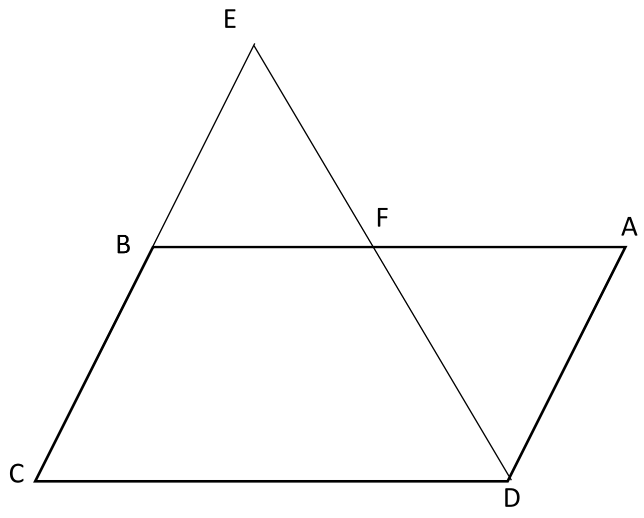
(i) Show that the equation of the locus of P is $x^2 + y^2 - 10x + 6y + 14 = 0$ **2**

(ii) Find the centre and radius of this locus. **1**

(h) ABCD is a parallelogram and F is the midpoint of AB. DF and CB are extended to meet at E.

(i) Prove that ΔBEF ≡ ΔADF **3**

(ii) Prove that B is the midpoint of CE **2**



Question 7 (20 marks)

(a) Differentiate with respect to x:

(i) $x^3 + \sqrt{x}$ **2**

(ii) $\frac{x^2-2}{4x}$ **2**

(iii) $(3x+1)^5$ **1**

(b) Find the equation of the curve, given the gradient function is $4x - 6$ and it passes through the point $(2,4)$ **2**

(c) Solve $3 + x - 2x^2 \geq 0$ **2**

(d) Find the value of k for which the quadratic expression $(k+6)x^2 - 8x + k$ is positive definite. **2**

(e) Show the region of the number plane where the following hold simultaneously: **3**

$$(x-1)^2 + y^2 \leq 9$$

$$y \leq x + 1$$

(f) Solve $2\cos^2\theta = 1$ for $0^\circ \leq \theta \leq 360^\circ$ **2**

(g) Two helicopters leave Airport C at the same time. Helicopter A flies 7.8 km on a bearing of 043°. Helicopter B flies 5.3 km due west.

i) Draw a diagram and mark the relevant information on it. **1**

ii) Find the distance between Helicopter A and Helicopter B to 1 decimal place. **1**

iii) Hence or otherwise, find the true bearing of Helicopter A from Helicopter B **2**

Question 8 (20 marks)

(a) Consider the curve $y = 2x^3 - 3x^2 - 12x + 2$

(i) Find any stationary points and determine their nature **3**

(ii) Find any point(s) of inflexion **2**

(iii) Draw a neat sketch for the domain $-2 \leq x \leq 4$ **1**

(iv) What is the maximum value of the curve in this domain? **1**

(b) Prove that $\tan\theta + \cot\theta = \sec\theta \operatorname{cosec}\theta$ **2**

(c) The points A(-1,-1), B(4,2), C(3,6) and D (x_1, y_1) are the 4 vertices of a quadrilateral ABCD.

(i) Draw a number plane and mark A, B and C on it. **1**

(ii) Find the gradient of line AB. **1**

(iii) Show that the line l parallel to AB and going through C is $3x - 5y + 21 = 0$ **2**

(iv) If the equation of the line *k* through point A parallel to BC is $4x + y + 5 = 0$, find the point D (x_1, y_1), the intersection of lines l and *k*. Mark this point on your diagram. **2**

(v) Find the acute angle (to the nearest degree) that the line AB makes with the positive *x*-axis. **1**

(vi) Find the perpendicular distance between point B and line l as an exact value. **2**

(vii) Find the exact area of ABCD. **2**

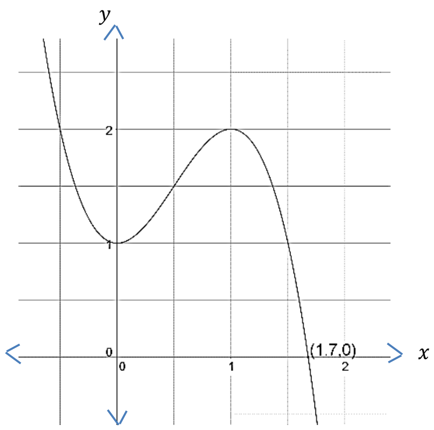
Question 9 (20 marks)

(a) A parabola has its focus at $(2,4)$ and directrix at y=0. Find the equation of the parabola **2**

(b) Sketch the graph $(y-3)^2 = -12(x+1)$
Label the focus, vertex, directrix **3**

(c) Sketch the graph $y = \frac{2x+1}{x}$. State its domain and range. **3**

(d) The function $f(x)$ is shown below:



Sketch the graph of the derivative, $f'(x)$ **1**

(e) Let $y = 2x^2 - 2x$. Show that
$x^2y" - 2xy' + 2y = 0$ **2**

(f) Find by first principles, the derivative of $y = 2\sqrt{x}$ **2**

(g) Find the gradient of the curve $y = \dfrac{x}{x^2+1}$ at the origin and hence find the equation of the tangent to this curve at the origin. **2**

(h) Kerry is on a kayak 500 metres from the nearest point P of a straight stretch of beach.

Her destination is 2 kilometres along the beach from P.

Kerry can paddle her kayak at 1.5 km/hour and she can walk along the sand at 2km/hour.

Let x be her landing point on the beach.

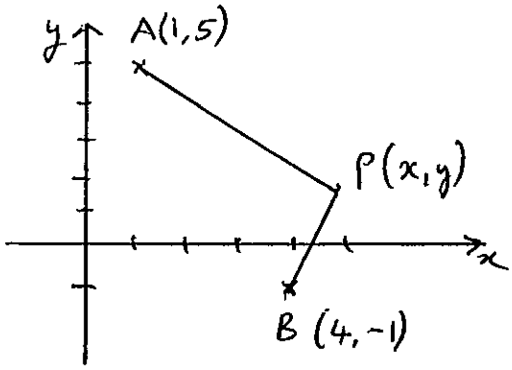
(α) Draw a diagram to represent this situation. **1**

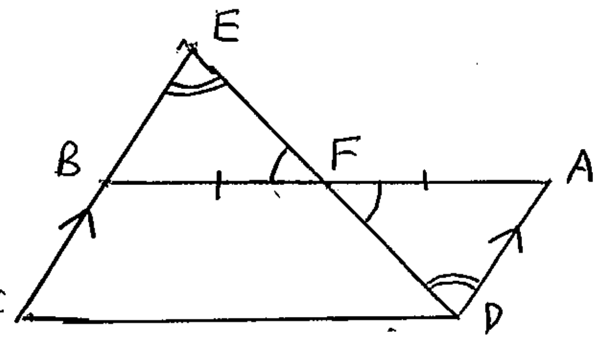
(β) Show the total time taken to reach her destination is $\frac{\sqrt{x^2+0.5^2}}{1.5} + \frac{2-x}{2}$ **2**

(γ) Towards what point on the beach should she row to reach her destination in the least possible time? **2**

YR 11 PRELIM. 2U **MATHEMATICS: Question** 6 page 1 of 3

Suggested Solutions	Marks	Marker's Comments
a) $\dfrac{3}{2\cdot78} + \dfrac{1}{\sqrt{3}} = 1\cdot65648\ldots$		Must be exactly right.
$= \underline{\underline{1\cdot656}}$ (4 s.f.)	1	
b) $\sqrt{27} + \sqrt{12} = 3\sqrt{3} + 2\sqrt{3}$	1	
$= 5\sqrt{3}$		
$= \sqrt{75}$		
$\therefore \underline{\underline{A = 75}}$	1	
c) $t^{2/3} = 16$		Many missed the −ve sign
$t^{1/3} = \pm 4$	1	
$\underline{\underline{t = \pm 64}}$	1	
d) i) $3x^2 - 12y^2 = 3(x^2 - 4y^2)$		
$= \underline{\underline{3(x-2y)(x+2y)}}$	1	No half marks
ii) $8 - 27d^3 = 2^3 - (3d)^3$		
$= \underline{\underline{(2-3d)(4+6d+9d^2)}}$	1	
e) $\log_x 2^3 - \log_x 2^7 = 4$		Several ways of approach. If −ve sign appeared in logic it had to be explained away.
$\log_x \dfrac{2^3}{2^7} = 4$	1	
$\log_x 2^{-4} = 4$		
$-4\log_x 2 = 4$		
$\log_x 2 = -1$	1	
$\therefore 2 = x^{-1}$		
$\underline{\underline{x = 1/2}}$	1	
f) i) $\sin 225^\circ = \underline{\underline{-1/\sqrt{2}}} = \underline{\underline{-\sqrt{2}/2}}$	1	No half marks
ii) $\sec 120^\circ = \underline{\underline{-2}}$	1	

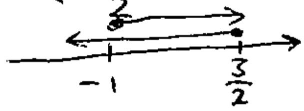
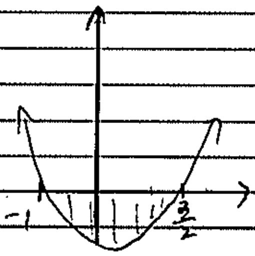
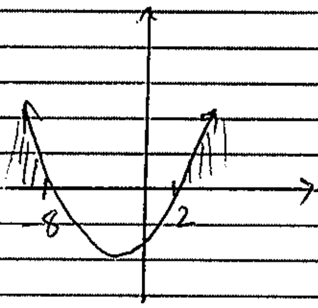
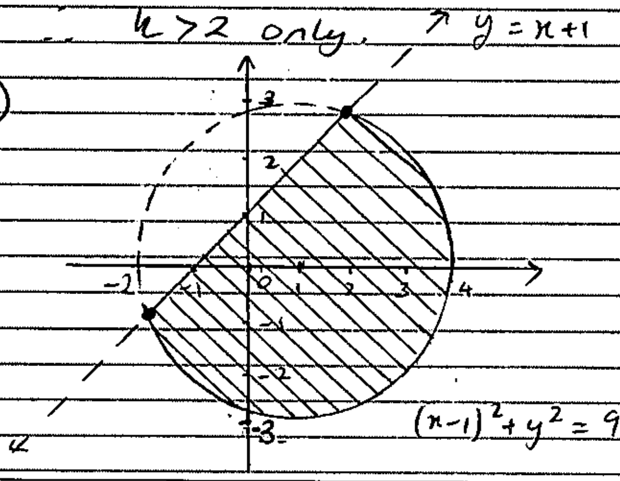
Suggested Solutions	Marks	Marker's Comments
g) i)		
		
Let P be (x, y)		
$\|PA\| = 2\|PB\|$		
$(PA)^2 = 4(PB)^2$		
$(x-1)^2+(y-5)^2 = 4\{(x-4)^2+(y+1)^2\}$	1	or the square root equivalent.
$x^2-2x+1+y^2-10y+25 = 4x^2-32x+64+4y^2+8y+4$		
$3x^2+3y^2-30x+18y+42=0$		
$\underline{\underline{x^2+y^2-10x+6y+14=0}}$	1	
ii) $(x-5)^2-25+(y+3)^2-9+14=0$		
$(x-5)^2+(y+3)^2 = 20$		All parts had to be correct.
$\therefore$ Centre $\underline{\underline{(5,-3)}}$		
Radius $= \underline{\underline{\sqrt{20} = 2\sqrt{5} \text{ units}}}$	1	

Suggested Solutions	Marks	Marker's Comments
h) i) 		
In Δs BEF, ADF BF = AF (F given midpoint) $\angle AFD = \angle BFE$ (Vertically opposite angles are equal)	1	There were several approaches. Test needed to be included.
$\angle ADF = \angle BEF$ (Alternating angles on parallels AD, BE)	1	
$\therefore \Delta BEF \equiv \Delta ADF$ (AAS)	1	
ii) BE = AD (Corresponding sides in congruent triangles)	1	Most people got this out. There were other options.
AD = BC (Opposite sides of a parallelogram are equal)	1	
$\therefore$ BE = BC i.e. B is the midpoint of CE.		

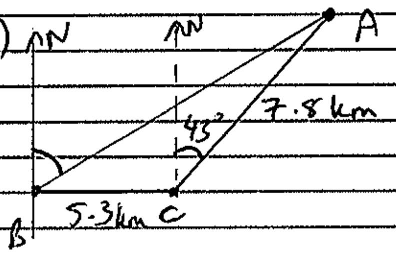
MATHEMATICS: Question 7

Suggested Solutions	Marks	Marker's Comments
a i) $y = x^3 + \sqrt{x}$ $= x^3 + x^{\frac{1}{2}}$ $y' = 3x^2 + \frac{1}{2}x^{-\frac{1}{2}}$ $= 3x^2 + \frac{1}{2\sqrt{x}}$	2	1 mark for differentiating each term correctly
ii) $y = \frac{x^2 - 2}{4x}$ $= \frac{x^2}{4x} - \frac{2}{4x}$ $= \frac{x}{4} - \frac{1}{2x}$ $= \frac{x}{4} - \frac{1}{2}x^{-1}$ $y' = \frac{1}{4} + \frac{1}{2}x^{-2}$ $= \frac{1}{4} + \frac{1}{2x^2}$	2	1 mark for differentiating each term correctly
OR $y = \frac{x^2 - 2}{4x}$ $y' = \frac{2x(4x) - 4(x^2 - 2)}{(4x)^2}$ $= \frac{8x^2 - 4x^2 + 8}{16x^2}$ $= \frac{4x^2 + 8}{16x^2}$ $= \frac{x^2 + 2}{4x^2}$	2	Students lost marks for doing $\frac{uv' - u'v}{v^2}$ instead of $\frac{u'v - uv'}{v^2}$
iii) $y = (3x+1)^5$ $y' = 5(3x+1)^4(3)$ $= 15(3x+1)^4$	1	

MATHEMATICS: Question....7...

Suggested Solutions	Marks	Marker's Comments
b) $y' = 4x - 6$		
$y = \frac{4x^2}{2} - 6x + c$		
$= 2x^2 - 6x + c$	1	for integrating correctly
Passes through $(2, 4)$		
$\therefore 4 = 2(2)^2 - 6(2) + c$ $c = 8$	1	for substituting & getting the constant
$\therefore y = 2x^2 - 6x + 8$		
c) $3 + x - 2x^2 \geq 0$		Note: you lost a mark if you wrote $x \geq -1$ or $x \leq \frac{3}{2}$
$2x^2 - x - 3 \leq 0$ $(2x - 3)(x + 1) \leq 0$	1	
$-1 \leq x \leq \frac{3}{2}$	1	
		
d) for positive definite $a > 0$ & $\Delta < 0$		
$k + 6 > 0 \quad k > -6$		
$\Delta = (-8)^2 - 4(k+6)k$ $= 64 - 4k^2 - 24k$		
$\therefore 64 - 4k^2 - 24k < 0$ $k^2 + 6k - 16 > 0$ $(k+8)(k-2) > 0$		
		
$k < -8, \quad k > 2$ but $k > -6$	1	
$\therefore k > 2$ only.	1	
e) 	1 1 1	for correct line for correct circle for correct region Students lost marks on having uneven scales or not labelling scales at all. You must Show intercepts when possible.

MATHEMATICS: Question……..

Suggested Solutions	Marks	Marker's Comments
f) $2\cos^2\theta = 1$ $\cos^2\theta = \frac{1}{2}$ $\cos\theta = \pm\frac{1}{\sqrt{2}}$ $\theta = 45°, 135°, 225°, 315°$	2	for all 4 solutions. Only 1 mark if students forgot the ± & got only 2 solutions.
g) i) 	1	correctly labelled diagram with all relevant information
ii) $\angle ACB = 43° + 90°$ $= 133°$ $AB^2 = AC^2 + BC^2 - 2 \times AC \times BC \cos 133$ $= 7.8^2 + 5.3^2 - 2 \times 7.8 \times 5.3 \cos 133$ $AB = 12.054775\ldots$ $AB = 12.1$ km (1dp)	1	
iii) let $\angle ABC = \alpha$ $\frac{\sin\alpha}{7.8} = \frac{\sin 133}{AB}$ $\sin\alpha = \frac{7.8 \sin 133}{AB}$	1	for using sine or cosine rule to find α.
$\alpha = 28°15'$ using the exact value of AB $\alpha = 28°8'$ using $AB = 12.1$ $\therefore$ bearing is $90 - \alpha$ so $90 - 28°15'$ or $90 - 28°8'$ $= 061°45'$ $= 061°52'$ $= 062°$ $= 062°$ OR using cosine rule $\cos\alpha = \frac{AB^2 + 5.3^2 - 7.8^2}{2 \times AB \times 5.3}$ $\alpha = 28°15'$ using the exact value of AB $\alpha = 27°36'$ using $AB = 12.1$	1	for final bearing - students were not penalised for not having the 0 in front of 62°

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$\therefore$ bearing $061°45'$ $= 062°$ or $062°24'$ $= 062°$

MATHEMATICS: Question..8....

Suggested Solutions	Marks	Marker's Comments

Suggested Solutions

(a) $y = 2x^3 - 3x^2 - 12x + 2$

(i) Find stationary points and determine their nature.

$$\frac{dy}{dx} = 6x^2 - 6x - 12$$
$$= 6(x^2 - x - 2)$$
$$6(x-2)(x+1)$$

For SP to occur $\frac{dy}{dx} = 0$

$\therefore x - 2 = 0$ or $x + 1 = 0$

$x = 2$ $\quad x = -1$ ✓

when $x = 2$; $y = 16 - 12 - 24 + 2 = -18$

$x = -1$; $y = -2 - 3 + 12 + 2 = 9$.

$\therefore$ points are $(2, -18)$ and $(-1, 9)$ ✓

Test Nature

Method 1

Point $(2, -18)$

x	0	2	3
$\frac{dy}{dx}$	−12	—	24

Concave up

$\therefore$ Minimum TP

Point $(-1, 9)$

x	−2	−1	0
$\frac{dy}{dx}$	24	—	−12

Concave down

$\therefore$ Maximum TP.

Method 2

$f''(x) = 12x - 6$

at $x = 2$

$f''(x) = 18$

Since $f''(x) > 0$

Minimum TP

when $x = -1$

$f''(x) = -18$

< 0

$\therefore$ Maximum TP

$\therefore$ There is a minimum Turning Point at $(2, -18)$ and Maximum TP at $(-1, 9)$

Marks

3

Marker's Comments

✓1 mark for puting $\frac{dy}{dx} = 0$ and getting $x = 2$ or -1

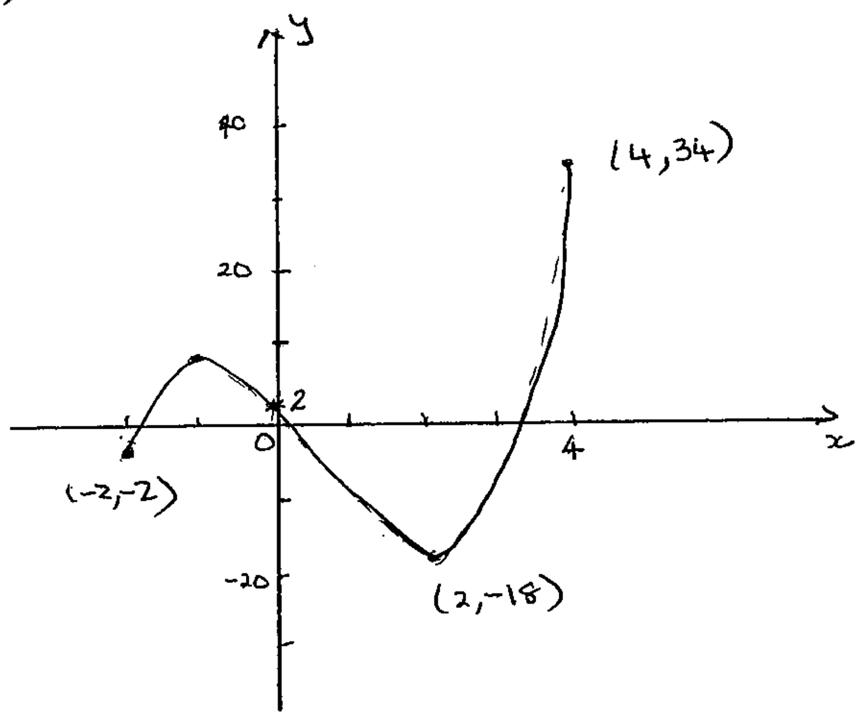
✓ 1 mark for getting correct points $(-2, 18)$ and $(-1, 9)$

✓ 1 mark for Testing the nature.

students who used other values to test nature should have

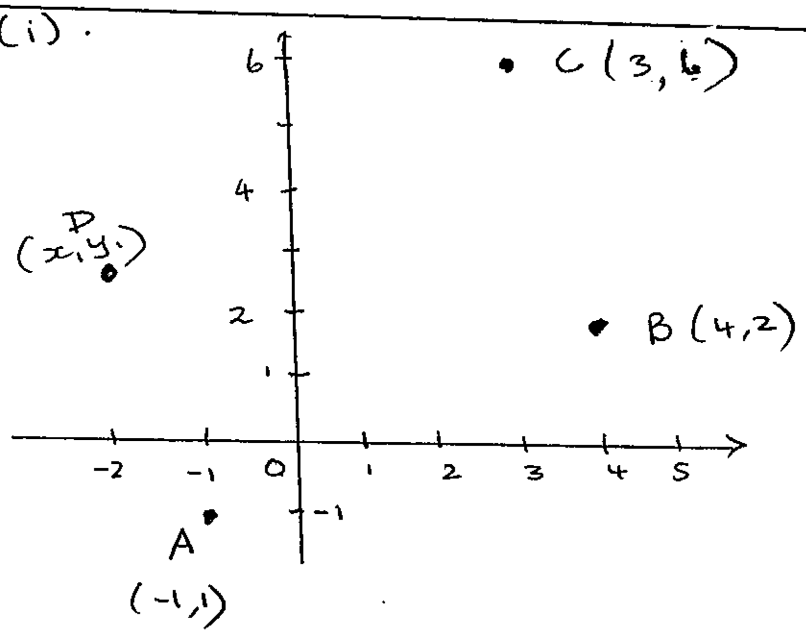
x	$\frac{dy}{dx}$.
1.5	−7.5
1.9	−1.74
2.1	1.86
2.5	10.5
−0.5	−7.5
−0.9	−1.74
−1.1	1.86
−1.5	10.5

MATHEMATICS: Question……..

Suggested Solutions	Marks	Marker's Comments
9 (ii) Find point(s) of inflexion Points of inflexion occurs when $f''(x) = 0$ i.e $12x - 6 = 0$ $x = \frac{1}{2}$. when $x = \frac{1}{2}$ $y = 2\left(\frac{1}{2}\right)^3 - 3\left(\frac{1}{2}\right)^2 - 12\left(\frac{1}{2}\right) + 2$ $= -4\frac{1}{2}$. Test for concavity x: 0, ½, 1; y'': −6, –, 6 Concavity changes ∴ Point of inflexion occurs at $\left(\frac{1}{2}, -\frac{9}{2}\right)$	2	✓ getting pt $\left(\frac{1}{2}, -\frac{9}{2}\right)$ ✓ Testing concavity.
(iii) sketch 	1	Must have the correct • end points $(-2,-2)$ and $(4,34)$ • y-intercept is 2. Graphs poorly done • Scaling on axis • labelling points

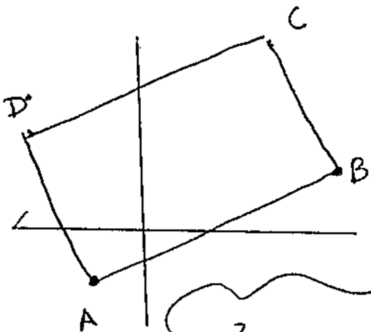
x	0	½	1
y''	−6	–	6

MATHEMATICS: Question…8….

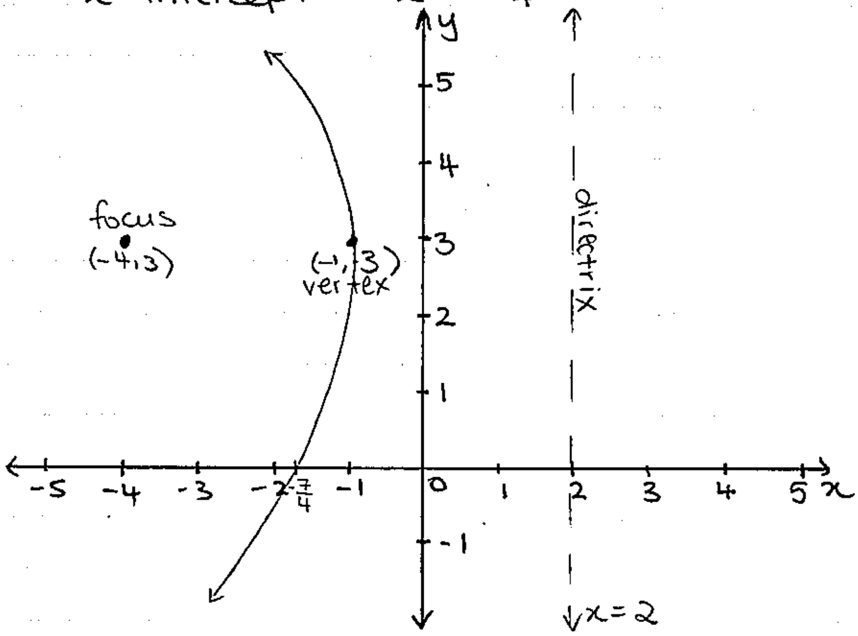
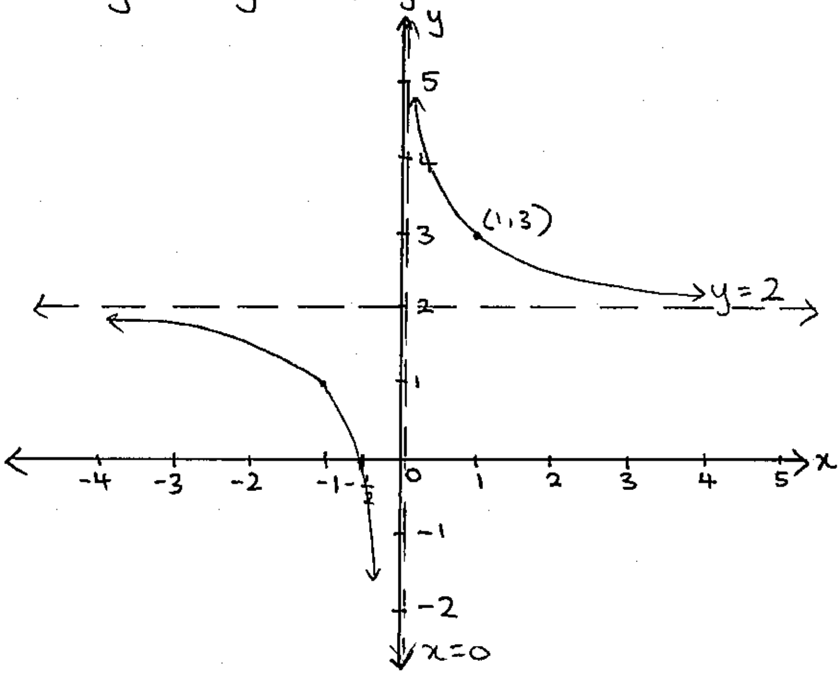
Suggested Solutions	Marks	Marker's Comments
iv) Maximum value is 34	1	needed only the y value • Points (4,34) not accepted.
(b) Prove $\tan\theta + \cot\theta = \sec\theta \operatorname{cosec}\theta$ Method 1 LHS $\tan\theta + \cot\theta$ $\frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta}$ $= \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta}$ $= \frac{1}{\sin\theta\cos\theta}$ $= \sec\theta \operatorname{cosec}\theta$ = RHS. Method 2 LHS $\tan\theta + \cot\theta$ $\tan\theta + \frac{1}{\tan\theta}$ $= \frac{\tan^2\theta + 1}{\tan\theta}$ $= \frac{\sec^2\theta}{\tan\theta}$ $= \frac{1}{\cos^2\theta} \times \frac{\cos\theta}{\sin\theta}$ $= \frac{1}{\cos\theta\sin\theta}$ $= \sec\theta \operatorname{cosec}\theta$	2	well done. Be careful with setting out.
(c) (i) 	1	Plot all points correctly
(ii) Gradient of AB $M_{AB} = \frac{2-(-1)}{4-(-1)} = \frac{3}{5}$	1	Gradient of 3/5

MATHEMATICS: Question 8		
Suggested Solutions	**Marks**	**Marker's Comments**
(iii) Show equation of l – which is parallel to AB and passes through C is $3x-5y+21=0$ Gradient of parallel line is also $\frac{3}{5}$ and passes through $(3,6)$ ✓ $\therefore$ equation $y-y_1=m(x-x_1)$ $y-6=\frac{3}{5}(x-3)$ ✓ $5y-30=3x-9$ $0=3x-5y+21$	2	well done. 1 mark for getting $\frac{3}{5}$ as gradient and 1 mark for forming the equation with point C.
iv) Line k is $4x+y+5=0$ line l is $3x-5y+21=0$ Intersection of k and l will give point D $3x-5y+21=0$ — ① $4x+y+5=0$ — ② eq ② $\times 5$ $20x+5y+25=0$ — ③ eq ① + eq ③ $23x+46=0$ $x=-2$ ✓ when $x=-2$ sub in eq ② $4(-2)+y+5=0$ $-8+y+5=0$ $y=3$ $\therefore$ point D is $(-2,3)$ ✓. Also mark D on Number plane	2	1 mark for showing the process of finding point of Intersection and getting $x=-2$ 1 m. for getting the point $(-2,3)$
(v) acute angle $\tan\theta=$ gradient. $\therefore \tan\theta=\frac{3}{5}$ $\theta=30.96375653$ $\therefore \theta=31^\circ$	1	1 mark for rounded off value of θ (31°).

MATHEMATICS: Question 8....

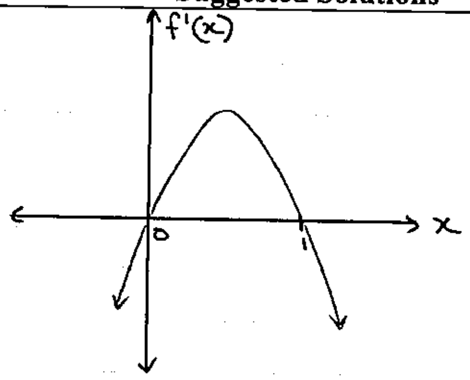
Suggested Solutions	Marks	Marker's Comments
(vi) Perpendicular distance from B to line l. $d = \left\lvert\frac{ax+by+c}{\sqrt{a^2+b^2}}\right\rvert$ $= \left\lvert\frac{4(3)-5(2)+21}{\sqrt{3^2+(-5)^2}}\right\rvert$ $= \frac{\lvert 23\rvert}{\sqrt{34}}$ $\therefore$ perpendicular distance is $\frac{23}{\sqrt{34}}$ or $\frac{23\sqrt{34}}{34}$	2	Note B(4, 2) and $l = 3x-5y+21$ $\therefore a=3$ $b=-5$ $c=21$ $x=4$ $y=2$ 1 mark for correct use of formula 1 mark for Answer
(v) Exact area of ABCD - Area of parallelogram = base × perpendicular height  $= AB \times \frac{23}{\sqrt{34}}$ $= \sqrt{34} \times \frac{23}{\sqrt{34}}$ $= 23$ units ✓ $AB^2 = 2-(-1)^2 + (4--1)^2$ $= 3^2 + 5^2$ $AB = \sqrt{34}$ ✓	2	1 mark for getting distance AB or DC 1 mark for calculating the area.

MATHEMATICS: Question 9

Suggested Solutions	Marks	Marker's Comments
a) $V = (2,2)$ $\quad a = 2$	1	
$(x-2)^2 = 8(y-2)$	1	
b) $V: (-1,3)$ $\quad a = 3$		
directrix: $x = 2$		
x-intercept: $x = -\frac{7}{4}$		
		1 vertex & shape 1 focus & x-intercept 1 directrix
c) $y = \dfrac{2x+1}{x}$		
Domain: $x \in \mathbb{R}$, $x \neq 0$ Range: $y \in \mathbb{R}$, $y \neq 2$	1	many students did not write all real x/y.
		1 asymptotes 1 intercept & shape

MATHEMATICS: Question 9		
Suggested Solutions	**Marks**	**Marker's Comments**

d)



Marks: 1 — must pass through 0 and 1.

e) $y = 2x^2 - 2x$

$y' = 4x - 2$

$y'' = 4$ (1 mark, for y' and y'')

Show: $x^2y'' - 2xy' + 2y = 0$

$\text{LHS} = x^2(4) - 2x(4x-2) + 2(2x^2 - 2x)$

$= 4x^2 - 8x^2 + 4x + 4x^2 - 4x$ (1 mark)

$= 0$

$= \text{RHS}$

$\therefore x^2y'' - 2xy' + 2y = 0$

f) let $f(x) = 2\sqrt{x}$

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

$= \lim_{h \to 0} \frac{2\sqrt{x+h} - 2\sqrt{x}}{h}$

$= 2 \lim_{h \to 0} \frac{\sqrt{x+h} - \sqrt{x}}{h} \times \frac{\sqrt{x+h} + \sqrt{x}}{\sqrt{x+h} + \sqrt{x}}$ (1 mark)

$= 2 \lim_{h \to 0} \frac{x+h-x}{h(\sqrt{x+h} + \sqrt{x})}$

$= 2 \lim_{h \to 0} \frac{h}{h(\sqrt{x+h} + \sqrt{x})}$

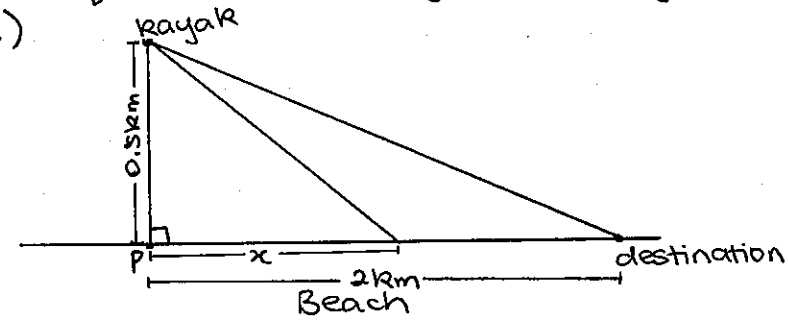
$= 2 \lim_{h \to 0} \frac{1}{\sqrt{x+h} + \sqrt{x}}$ (1 mark)

$= \frac{2}{\sqrt{x} + \sqrt{x}}$

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

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

MATHEMATICS: Question 9

Suggested Solutions	Marks	Marker's Comments
g) $y = \dfrac{x}{x^2+1}$		
$y' = \dfrac{(x^2+1) - x(2x)}{(x^2+1)^2}$	1	
$= \dfrac{1-x^2}{(x^2+1)^2}$		
at origin, $x=0$		
$y' = \dfrac{1-(0)^2}{(0^2+1)^2}$		
$= 1$		
$\therefore$ equation of tangent is : $y = x$	1	
h) α) 	1	
β) Kayak:		
$\text{distance}^2 = x^2 + 0.5^2$ (pythagoras theorem)	1	
$\text{distance} = \sqrt{x^2+0.5^2}$		
$\text{Time} = \dfrac{\text{distance}}{\text{speed}}$	1	
$= \dfrac{\sqrt{x^2+0.5^2}}{1.5}$		
beach:		
$\text{distance} = 2-x$		
$\text{time} = \dfrac{2-x}{2}$		
$\therefore$ total time $= \dfrac{\sqrt{x^2+0.5^2}}{1.5} + \dfrac{2-x}{2}$		

MATHEMATICS: Question 9		
Suggested Solutions	**Marks**	**Marker's Comments**

$\gamma)$ $t = \dfrac{\sqrt{x^2+0.5^2}}{1.5} + \dfrac{2-x}{2}$

$\dfrac{dt}{dx} = \dfrac{2}{3} \times \dfrac{1}{2}(x^2+0.5^2)^{-\frac{1}{2}} \times 2x - \dfrac{1}{2}$

$= \dfrac{2x}{3\sqrt{x^2+0.5^2}} - \dfrac{1}{2}$ — 1

for stationary points, $\frac{dt}{dx} = 0$

$\dfrac{2x}{3\sqrt{x^2+0.5^2}} - \dfrac{1}{2} = 0$

$\dfrac{2x}{3\sqrt{x^2+0.5^2}} = \dfrac{1}{2}$

$4x = 3\sqrt{x^2+0.5^2}$

$16x^2 = 9(x^2+0.5^2)$

$16x^2 = 9x^2 + \frac{9}{4}$

$7x^2 = \frac{9}{4}$

$x^2 = \frac{9}{28}$

$x = \pm\dfrac{3}{\sqrt{28}}$

$x > 0$ for minimum.

when $x = \dfrac{3}{\sqrt{28}}$

x	$\frac{1}{2}$	$\frac{3}{\sqrt{28}}$	1
$\frac{dt}{dx}$	-0.03	0	0.096
	\	—	/

$\therefore$ $x = \dfrac{3}{\sqrt{28}}$ is a minimum — 1 — must test point to show minimum

$\therefore$ she should row roughly 566.95 m along the beach from P towards her destination.