HORNSBY GIRLS HIGH SCHOOL

Mathematics Advanced

Year 11 Assessment 2 Term 2 2023

STUDENT NUMBER: _____

General Instructions

- Reading Time – 5 minutes
- Working Time – 60 minutes
- Write using black pen
- Calculators approved by NESA may be used
- In Questions 6 – 11, show relevant mathematical reasoning and/or calculations
- Marks may be deducted for untidy and poorly arranged work
- Do not use correction fluid or tape
- Do not remove this paper from the examination
- Students are permitted to refer to one double-sided A4 page of handwritten topic summaries which they prepared prior this assessment

Total marks – 53

Section I Pages 2 – 3

5 marks

Attempt Questions 1 – 5

Allow about 8 minutes for this section

Answer on the Objective Response Answer Sheet provided

Section II Pages 4 – 15

48 marks

Attempt Questions 6 -11

Allow about 52 minutes for this section

Write your answers in the space provided.

Question	***1-5***	***6***	***7***	***8***	***9***	***10***	***11***	***Total***
Total	*/5*	*/8*	*/9*	*/9*	*/8*	*/7*	*/7*	*/53*

This assessment task constitutes 35% of the Preliminary Higher School Certificate Course School Assessment

Section I

5 marks
Attempt Questions 1 – 5
Allow about 8 minutes for this section

Use the Objective Response answer sheet for Questions 1 – 5

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1 Which of the following is **NOT** equal to $\sin 30^0$?

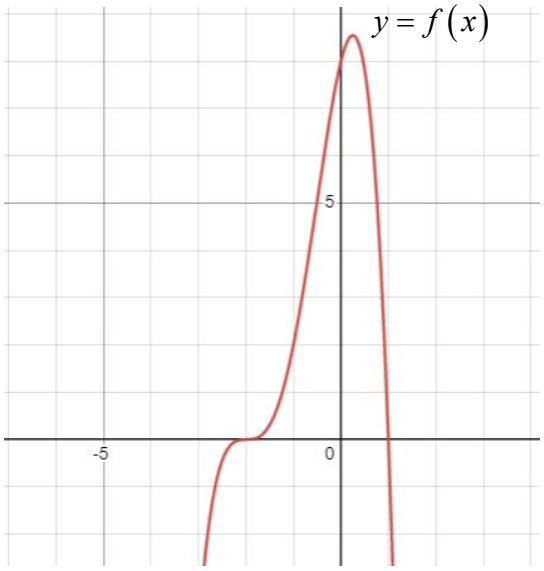
A. $\cos 60^0$

B. $\sin\left(-30^0\right)$

C. $-\sin 210^0$

D. $\sin\dfrac{5\pi}{6}$

2 The graph of $y = f\left(x\right)$ is shown on the number plane below.



Which of the following could be the equation of this graph?

A. $y = (x-1)(2-x)^3$

B. $y = (x+1)(x+2)^3$

C. $y = (1-x)(x+2)^3$

D. $y = (1+x)(x-2)^3$

3 What are the coordinates of the vertex of the parabola $y = -(x-3)^2 + 2$?

A. $(3, 2)$

B. $(3, -2)$

C. $(-3, 2)$

D. $(-3, -2)$

4 The graph of a particular quadratic equation $y = ax^2 + bx + c$ is a concave down parabola with no x-intercepts. Which of the following gives the correct values for a and the discriminant, Δ?

A. $a > 0, \Delta > 0$

B. $a > 0, \Delta < 0$

C. $a < 0, \Delta > 0$

D. $a < 0, \Delta < 0$

5 Let $h(x) = f(g(x))$ where the function $f(x)$ is an even function and the function $g(x)$ is an odd function.

Which of the following statements is **true**?

A. $h(x)$ is an even function.

B. $h(x)$ is an odd function.

C. $h(x)$ is both an even and an odd function.

D. $h(x)$ is neither an even nor an odd function.

End of Section I

Section II

50 marks

Attempt Questions 6-11

Allow about 52 minutes for this section

Question 6 (8 marks)

(a) Find the exact value of $\sin 120^0$. **1**

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(b) Find the exact value of $\cos\frac{5\pi}{4}$. **1**

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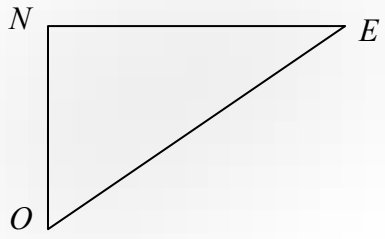
(c) A ship sails from a point O due north for 8 km to a point N, and then sails due east for 12 km to a point E. What is the bearing of O from E, to the nearest degree? **2**



NOT TO SCALE

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Question 6 continues on page 5

(d) Simplify $\tan(2\pi - \theta)$ **1**

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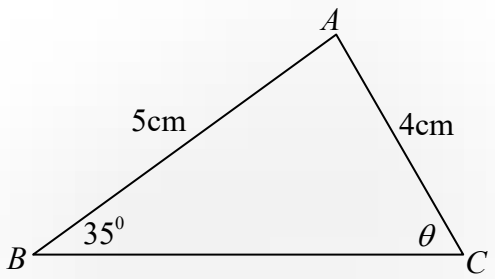
(e)



NOT TO SCALE

Find the size of $\angle ACB$ correct to the nearest degree. **3**

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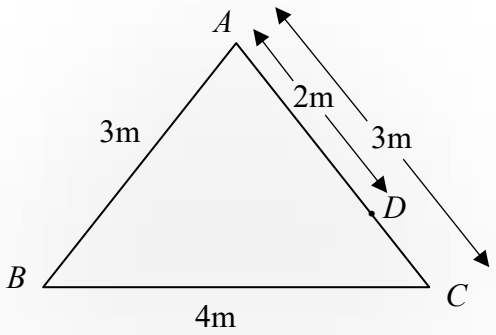
End of Question 6

Question 7 (9 marks)

(a) In the diagram AB=3m, AC=3m and BC=4m.
The point D on AC is such that AD=2m.



NOT TO SCALE

(i) Find the value of $\angle A$, to the nearest minute. **2**

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(ii) Calculate the length of BD, correct to 2 decimal places. **2**

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(iii) Find the area of ΔABD, correct to 2 decimal places. **2**

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Question 7 continues on page 7

(b) A plane is travelling at a constant speed of 600 km/h. At a certain instant it is directly overhead. Twelve seconds later, its angle of elevation is 68^0.
Find the height of the plane above the ground to the nearest metre. **3**

End of Question 7

Question 8 (9 marks)

(a) Given that $f(x) = x^2$ and $g(x) = \sqrt{x}$, state the domain of $f(g(x))$. **1**

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(b) Find the equation of the cubic function $f(x) = kx^3 + c$ if it passes through the point $(-1, 2)$ and has y intercept -3. **2**

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(c) Find the points of intersection of the graphs of $y = x^2 - x$ and $y = 2x - 2$. **3**

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Question 8 continues on page 9

(d) Find the points of intersection of the graphs of $4x - 3y = 22$ and $3x + 4y = 29$.

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End of Question 8

Question 9 (8 marks)

(a) Solve $\left|\frac{x}{3}-2\right|-1=0$. **2**

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(b) $A(-1, 3)$ is a vertex of the rectangle $ABCD$ whose side AD has equation $x+2y-5=0$.
Find the equation of the side AB. **2**

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Question 9 continues on Page 11

Question 9 (continued)

(c) (i) If $f(x) = \dfrac{1}{x-2} + 1$, find $f(3)$. **1**

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(ii) State the domain of the function $f(x) = \dfrac{1}{x-2} + 1$. **1**

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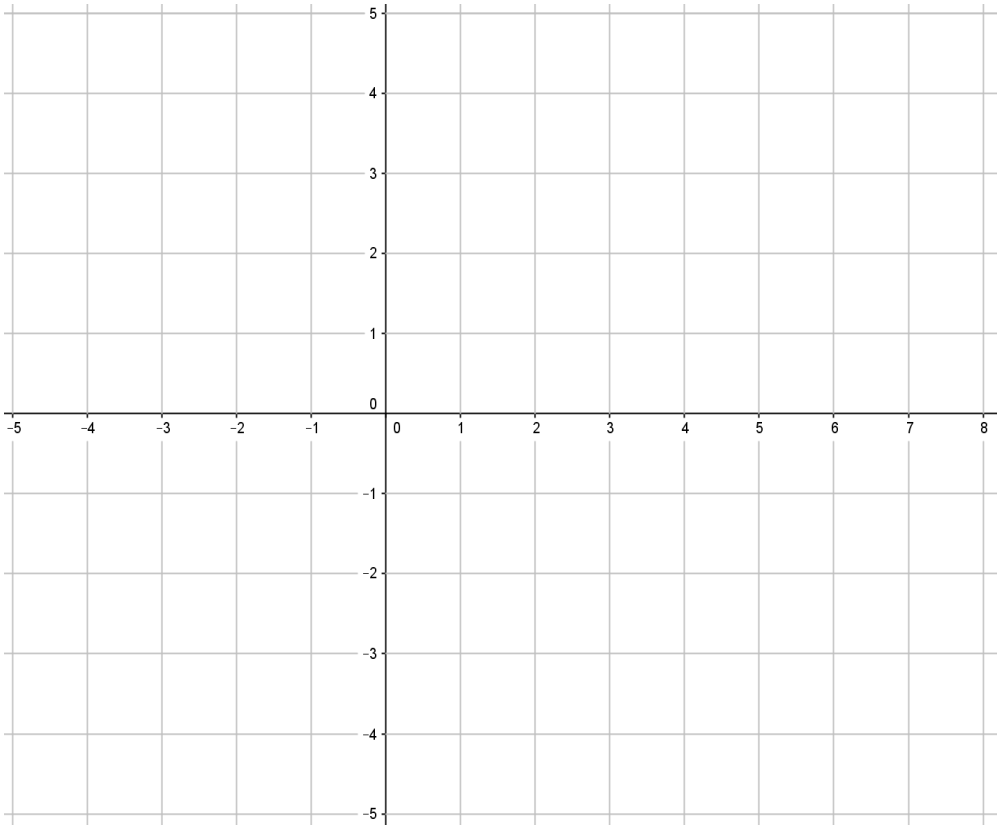
(iii) Sketch the graph of the function $f(x) = \dfrac{1}{x-2} + 1$, showing the x and y intercepts and the equations of any asymptotes. **2**



End of Question 9

Question 10 (7 marks)

(a) The SRC are selling daffodils for \$5 each. They buy the daffodils for \$3 each and have other costs of \$100. The equation for their sales, S, in terms of x, where x is the total number of daffodils (all daffodils are sold) is $S = 5x$.

(i) Write an equation for their costs, C, in terms of x. **1**

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(ii) Find the number of daffodils at the break-even point. **1**

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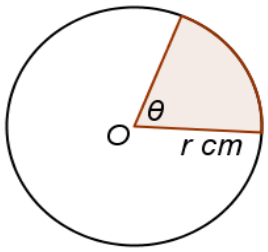
Question 10 continues on page 13

(b) In the circle below with centre O, radius r cm, and angle at the centre of the shaded sector θ radians, the perimeter of the shaded sector is 14 cm and its area is 12 cm^2.



NOT TO SCALE

(i) Show that $\theta = \dfrac{14 - 2r}{r}$. **1**

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(ii) Show that $\theta = \dfrac{24}{r^2}$. **1**

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(iii) Find the possible values of the radius of the circle. **3**

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End of Question 10

Question 11 (7 marks)

(a) The area, A, of a pizza slice varies inversely with the number of slices, n, into which it is cut. When it is cut into 8 slices, the area of each slice is 88 cm^2.

(i) Find the equation relating A and n. **1**

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(ii) What is the area of one pizza slice when it is cut into 10 slices? **1**

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(iii) How many slices are there if each slice has an area of $100 \cdot 57$ cm^2. **1**

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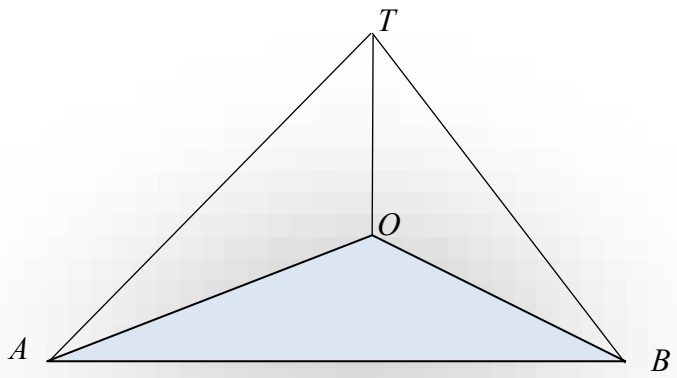
Question 11 continues on page 15

(b) Alex walks along a straight road on level ground. At one point, A, a tower is noticed on a bearing of 053^0, with an angle of elevation of 21^0. After Alex walks a further 230 m to a point B, the tower is on a bearing of 342^0 with an angle of elevation of 26^0.
Let the base of the tower be the point O and the top of the tower be the point T.



(i) State the size of $\angle AOB$. **1**

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(ii) Find the height of the tower correct to the nearest metre. **3**

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Mathematics Advanced

Year 11 Assessment 2
Term 2 2023

STUDENT NUMBER: _____

Section I – Multiple Choice Answer Sheet

Allow about 15 minutes for this section
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.

A ⊗ B ⊗ (correct) C ○ D ○

1. A○ B○ C○ D○
2. A○ B○ C○ D○
3. A○ B○ C○ D○
4. A○ B○ C○ D○
5. A○ B○ C○ D○

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Mathematics Advanced

Year 11 Assessment 2 Term 2 2023

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Total	/5	/8	/9	/9	/8	/7	/7	/53

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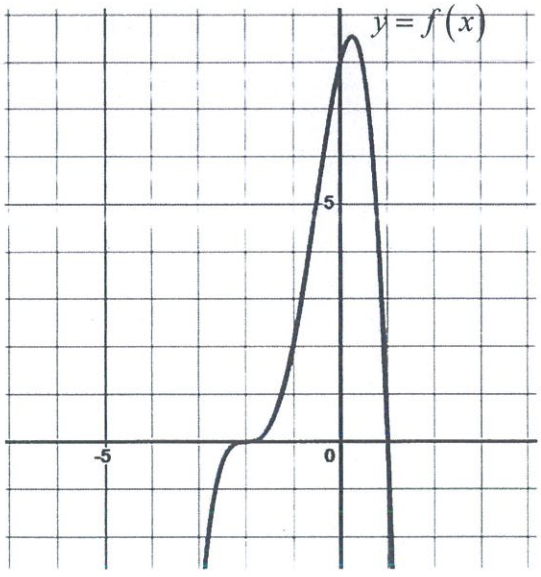
A. $\cos 60^0$ = $\sin 30^\circ$

B. $\sin(-30^0)$ = $-\sin 30^\circ$

C. $-\sin 210^0$ = $-(-\sin 30^\circ)$ 3rd quad.

D. $\sin\frac{5\pi}{6}$ = $\sin\frac{\pi}{6} = \sin 30$.

2 The graph of $y = f(x)$ is shown on the number plane below.



Which of the following could be the equation of this graph?

A. $y = (x-1)(2-x)^3$

B. $y = (x+1)(x+2)^3$ ×

C. $y = (1-x)(x+2)^3$

D. $y = (1+x)(x-2)^3$ ×

Concave down $\therefore -x^4$
$\therefore$ not B or D

behaves like a cubic at $x = -2$
$\therefore (x+2)^3$ $\therefore$ C

3 What are the coordinates of the vertex of the parabola $y = -(x-3)^2 + 2$?

A. $(3,2)$

B. $(3,-2)$

C. $(-3,2)$

D. $(-3,-2)$

4 The graph of a particular quadratic equation $y = ax^2 + bx + c$ is a concave down parabola with no x intercepts. Which of the following gives the correct values for a and the discriminant, Δ?

A. $a > 0, \Delta > 0$

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Which of the following statements is **true**?

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D. $h(x)$ is neither an even nor an odd function.

End of Section I

Section II

50 marks

Attempt Questions 6-11

Allow about 52 minutes for this section

Question 6 (8 marks)

(a) Find the exact value of $\sin 120^0$. **1**

$= \sin(180° - 60°)$

$= \sin 60°$

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

Well done!

(b) Find the exact value of $\cos\frac{5\pi}{4}$. **1**

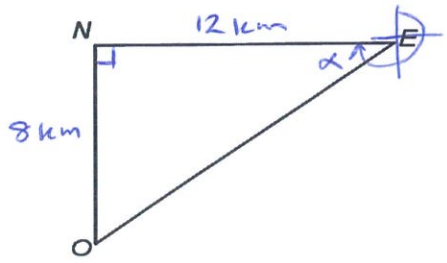
$= \cos\left(\pi + \frac{\pi}{4}\right)$

$= -\cos\frac{\pi}{4}$

$= -\frac{1}{\sqrt{2}}$

Well done!

(c) A ship sails from a point O due north for 8 km to a point N, and then sails due east for 12 km to a point E. What is the bearing of O from E, to the nearest degree? **2**



NOT TO SCALE

$\tan\alpha = \frac{8}{12} = \frac{2}{3}$

$\alpha = 33.690067\ldots$

$\alpha \doteq 34°$ 1 for angle

Bearing of O from E is $270 - 34° = 236°$

OR $90 - 34° = 56° \therefore S56°W$

1 for bearing in either form

Generally well done! Some students forgot to calculate the bearing.

Question 6 continues on page 5

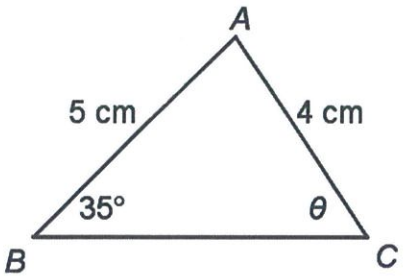
(d) Simplify $\tan(2\pi - \theta)$ **1**

S	A
T	C

$= -\tan\theta$

Well done!

(e)



NOT TO SCALE

Find the size of $\angle ACB$ correct to the nearest degree. **3**

$\frac{\sin\theta}{5} = \frac{\sin 35^\circ}{4}$

$\sin\theta = \frac{5\sin 35^\circ}{4}$ 1.

$\sin\theta = 0.716970545$

$\theta = 45.80492614^\circ$ or $180^\circ - 45.8^\circ$

$\theta = 46^\circ$ or 134° 1.

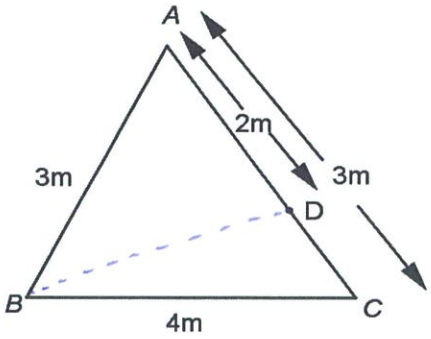
1.

Many students forgot to check for ambiguous case.

End of Question 6

Question 7 (9 marks)

(a) In the diagram $AB = 3$ m, $AC = 3$ m and $BC = 4$ m.
The point D on AC is such that $AD = 2$ m.



NOT TO SCALE

(i) Find the value of $\angle A$, to the nearest minute. **2**

$\cos A = \frac{3^2 + 3^2 - 4^2}{2 \times 3 \times 3}$

1 for correct application of Cosine Rule

$= \frac{18 - 16}{18}$

$= \frac{2}{18}$

* Generally done well.

$\cos A = \frac{1}{9}$

$A = 83.620629\,79^\circ \doteq 83^\circ 37'$ 1.

= Nearest minute is required.

(ii) Calculate the length of BD, correct to 2 decimal places. **2**

$BD^2 = 3^2 + 2^2 - 2 \times 3 \times 2 \times \cos A$

$= 9 + 4 - 12 \times \frac{1}{9}$ 1

$= 13 - \frac{12}{9}$

* Generally done well.

$BD^2 = 11\frac{2}{3}$

$BD = \pm\sqrt{11\frac{2}{3}}$ but $BD > 0$

$BD \doteq 3.415650255$

$BD \doteq 3.42$m to 2 decimal places 1

(iii) Find the area of ΔABD, correct to 2 decimal places. **2**

$\text{Area} = \frac{1}{2} \times 3 \times 2 \times \sin A$

$= 3 \sin 83^\circ 37'$ 1 or $3 \times \frac{\sqrt{80}}{9}$

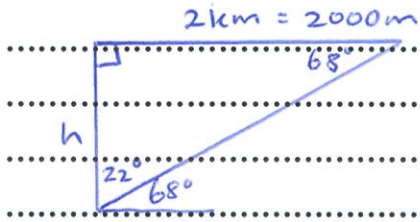
$= 2.981400900$

$= 2.98\ m^2$ to 2 decimal places

* Many found area of ΔABC. 1

Question 7 continues on page 7

(b) A plane is travelling at a constant speed of 600 km/h. At a certain instant it is directly overhead. Twelve seconds later, its angle of elevation is 68^0.
Find the height of the plane above the ground to the nearest metre. **3**



600 km/h
$= 600$ km / 60 min
$= 10$ km / min
$= \frac{10}{60}$ km / s
$= 1$ km / 6 s
$= 2$ km / 12 s 1 for correct distance travelled in 12 seconds

* Many did not place angle of elevation in correct position. This was a recurring error.

$\tan 68^\circ = \frac{h}{2000}$ 1 for correct equation

$h = 2000 \tan 68^\circ$

$h = 4950.173707$

$h = 4950$ m or 4.950 km 1 for correct evaluation

* Many concluded that the distance was 5m.

or $\tan 68 = \frac{h}{2}$ or $\tan 22 = \frac{2000}{h}$ or $\tan 22 = \frac{2}{h}$

End of Question 7

Question 8 (9 marks)

(a) Given that $f(x) = x^2$ and $g(x) = \sqrt{x}$, state the domain of $f(g(x))$. **1**

D: all real x D: $x \geq 0$

D: $x \geq 0$

Mostly did not know how to find the domain.

(b) Find the equation of the cubic function $f(x) = kx^3 + c$ if it passes through the point $(-1, 2)$ and has y intercept -3. **2**

y intercept is -3 ∴ passes through $(0, -3)$

$f(0) = k \times 0 + c = -3$

$c = -3$

∴ $f(x) = kx^3 - 3$ 1.

Passes through $(-1, 2)$

∴ $f(-1) = k(-1)^3 - 3 = 2$

$-k - 3 = 2$

$k = -5$ 1.

∴ $f(x) = -5x^3 - 3$

Mostly did well.
It's a worry when student used $m = \frac{y_2 - y_1}{x_2 - x_1}$ to find k when it is not a linear function.

(c) Find the points of intersection of the graphs of $y = x^2 - x$ and $y = 2x - 2$. **3**

$x^2 - x = 2x - 2$

$x^2 - 3x + 2 = 0$ 1 for method (could do it graphically)

$(x - 2)(x - 1) = 0$

$x = 2$ or $x = 1$ 1 for correct x values

$y = 2$ $y = 0$

The points of intersection are $(2, 2)$ and $(1, 0)$

1 for both correct solutions

Mostly did well, however it is a worry that some student did not even know how to do this question.

Question 8 continues on page 9

(d) Find the points of intersection of the graphs of $4x - 3y = 22$ and $3x + 4y = 29$.

3

$4x - 3y = 22$ —— ①

$3x + 4y = 29$ —— ②

① × 3 = ③ $12x - 9y = 66$ — ③

② × 4 = ④ $12x + 16y = 117$ —— ④ 1 for method

④ − ③ $25y = 50$

$y = 2$

Sub $y = 2$ into ②

$3x + 4 \times 2 = 29$

$3x + 8 = 29$

$3x = 21$

$x = 7$ 1.

Point of intersection is $(7, 2)$ 1.

Mostly did well.

Again it is a worry when some students did not know how to do this simultaneous equations at all.

End of Question 8

Question 9 **(8 marks)**

Generally well done. Some student only found one answer.

(a) Solve $\left|\frac{x}{3}-2\right|-1=0$. **2**

$\left|\frac{x}{3}-2\right|=1$ or $\left(\frac{x}{3}-2\right)^2=1^2$

$\frac{x}{3}-2=\pm 1$ 1. $\frac{x^2}{9}-\frac{4x}{3}+4=1$

$\frac{x}{3}=2\pm 1$ $x^2-12x+36=9$

$\frac{x}{3}=3$ or 1 $x^2-12x+27=0$

$x=9$ or 3 1. $(x-9)(x-3)=0$

$x=9$ or 3

(b) $A(-1, 3)$ is a vertex of the rectangle $ABCD$ whose side AD has equation $x+2y-5=0$. Find the equation of the side AB. **2**

$x+2y-5=0$

$2y=-x+5$

$y=-\frac{1}{2}x+\frac{5}{2}$

$\therefore m_{AD}=-\frac{1}{2}$ but $AD \perp AB$ adjacent sides of a rectangle

$\therefore m_{AB}=2$ 1.

Many students were able to find the gradient. Generally well done.

Equation of AB

$y-y_1=m_{AB}(x-x_1)$

$y-3=2(x-(-1))$

$y-3=2(x+1)$

$y-3=2x+2$

$y=2x+5$ or $2x-y+5=0$

1.

Question 9 continues on Page 11

Question 9 (continued)

(c) (i) If $f(x) = \dfrac{1}{x-2} + 1$, find $f(3)$. **1**

$f(3) = \frac{1}{3-2} + 1$

$= \frac{1}{1} + 1$

$f(3) = 2$

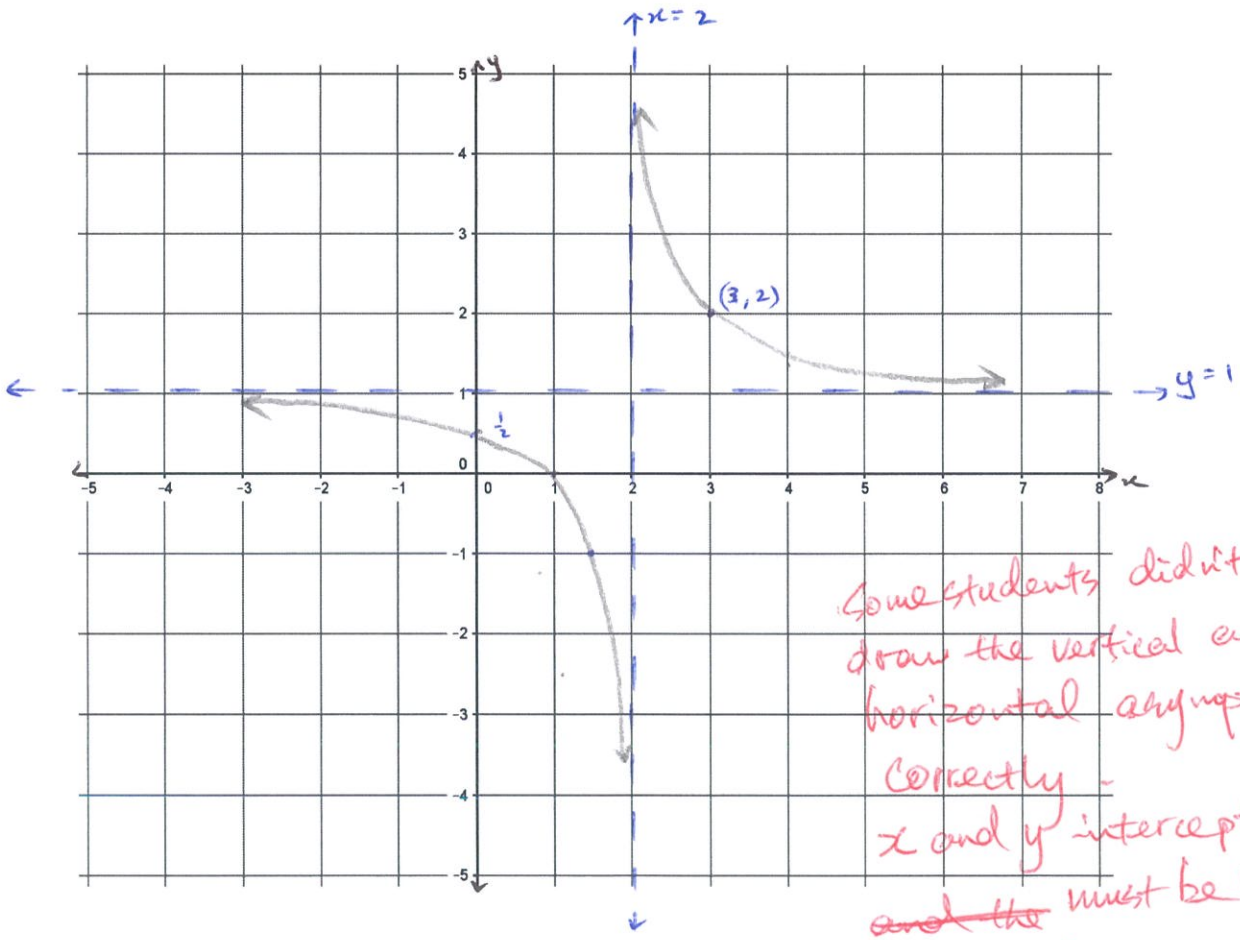
Generally well done.

(ii) State the domain of the function $f(x) = \dfrac{1}{x-2} + 1$. **1**

Generally well done

D: all real x, $x \neq 2$ or $(-\infty, 2) \cup (2, \infty)$

(iii) Sketch the graph of the function $f(x) = \dfrac{1}{x-2} + 1$, showing the x and y intercepts and the equations of any asymptotes. **2**



Some students didn't draw the vertical and horizontal asymptotes correctly - x and y intercepts ~~and the~~ must be correct. The point (3, 2) is on the curve.

End of Question 9

Question 10 (7 marks)

(a) The SRC are selling daffodils for \$5 each. They buy the daffodils for \$3 each and have other costs of \$100. The equation for their sales, S, in terms of x, where x is the total number of daffodils (all daffodils are sold) is $S = 5x$.

(i) Write an equation for their costs, C, in terms of x. **1**

$C = 3x + 100$

Done well by most students.

(ii) Find the number of daffodils at the break-even point. **1**

$5x = 3x + 100$

$2x = 100$

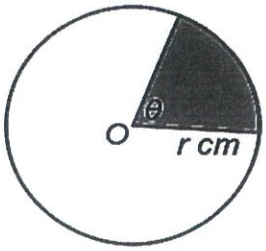
$x = 50$

There are 50 daffodils at the break-even point.

Some students had no idea how to attempt this question

Question 10 continues on page 13

(b) In the circle below with centre O, radius r cm, and angle at the centre of the shaded sector θ radians, the perimeter of the shaded sector is 14 cm and its area is 12 cm^2.



NOT TO SCALE

(i) Show that $\theta = \dfrac{14-2r}{r}$. **1**

$P = 2r + r\theta = 14$ $\quad l = r\theta$

$r\theta = 14 - 2r$ $\quad \theta = \frac{l}{r}$

$\theta = \dfrac{14-2r}{r}$ $\quad \theta = \dfrac{14-2r}{r}$ is insufficient for a 'show that' question

(ii) Show that $\theta = \dfrac{24}{r^2}$. **1**

$A = \frac{1}{2} r^2 \theta = 12$ Done well by most students

$r^2\theta = 24$

$\theta = \dfrac{24}{r^2}$

(iii) Find the possible values of the radius of the circle. **3**

$\dfrac{14-2r}{r} = \dfrac{24}{r^2}$ ✓

$r^2(14-2r) = 24$ since $r > 0$ ✓

$14r - 2r^2 = 24$

$0 = 2r^2 - 14r + 24$

$0 = 2(r^2 - 7r + 12)$

$0 = 2(r-3)(r-4)$

$r = 3$ cm or 4 cm ✓

Some students had no idea how to approach this question. Some tried to substitute the result from part (i) or (ii) back into an equation from the same part, which leads nowhere.

End of Question 10

Question 11 (7 marks)

(a) The area, A, of a pizza slice varies inversely with the number of slices, n, into which it is cut. When it is cut into 8 slices, the area of each slice is 88 cm^2.

(i) Find the equation relating A and n. **1**

$A \propto \frac{1}{n}$

$A = \frac{k}{n}$

$88 = \frac{k}{8}$

$k = 8 \times 88$

$k = 704$

$\therefore A = \frac{704}{n}$

Mostly well done however, some students did not read/ignored 'inversely'

(ii) What is the area of one pizza slice when it is cut into 10 slices? **1**

When $n = 10$, $A = \frac{704}{10}$

$A = 70.4$ cm^2

Mostly well done follow on errors were allowed 'cfpe'

(iii) How many slices are there if each slice has an area of 100·57 cm^2. **1**

When $A = 100.57$, $100.57 = \frac{704}{n}$

$n = \frac{704}{100.57}$

$n = 7.000099433$

$n = 7$ slices

Mostly well done and follow on errors allowed 'cfpe'

11 Context!

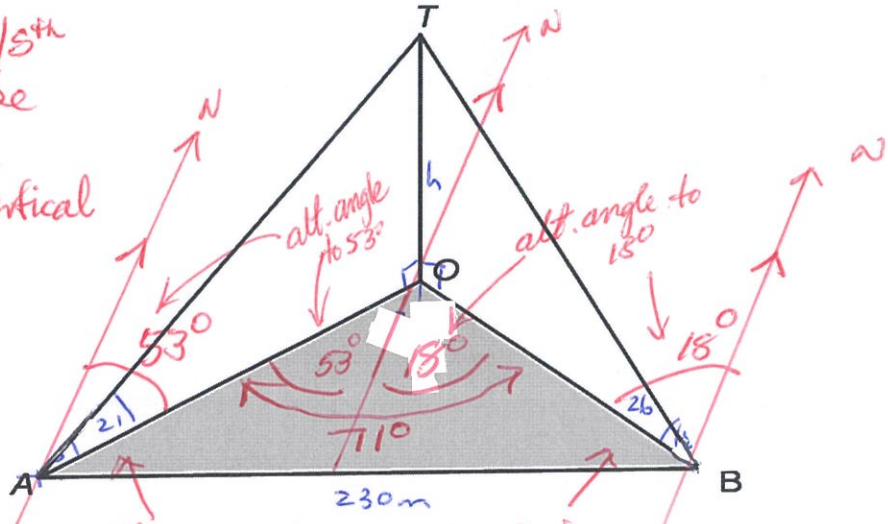
100.57 is NOT 100×57

A dot is used in Algebra for times and it is always written low not in the middle e.g. $a \times b = a.b$ ✓ $= a \cdot b \times$

Question 11 continues on page 15

(b) Alex walks along a straight road on level ground. At one point, A, a tower is noticed on a bearing of 053^0, with an angle of elevation of 21^0. After Alex walks a further 230 m to a point B, the tower is on a bearing of 342^0 with an angle of elevation of 26^0. Let the base of the tower be the point O and the top of the tower be the point T.

In 3D, N^th/S^th lines should be drawn oblique rather than vertical



NOT TO SCALE

These angles could not be written directly from info as AB is NOT East/West

(i) State the size of $\angle AOB$. **1**

$\angle AOB = 53^\circ + 18^\circ = 71^\circ$ — ① Poorly done. Many assumed AB is an East–West line which it isn't.

(ii) Find the height of the tower correct to the nearest metre. **3**

In $\triangle AOT$, $\tan 21^\circ = \frac{h}{OA}$

$OA = \frac{h}{\tan 21^\circ} = h \cot 21^\circ = h \tan 69^\circ$ ①

In $\triangle BOT$, $\tan 26^\circ = \frac{h}{OB}$

$OB = \frac{h}{\tan 26^\circ} = h \cot 26^\circ = h \tan 64^\circ$

In $\triangle AOB$

$AB^2 = OA^2 + OB^2 - 2 \times OA \times OB \times \cos(\angle AOB)$

$230^2 = h^2 \tan^2 69^\circ + h^2 \tan^2 64^\circ - 2 \times h \tan 69^\circ \times h \tan 64^\circ \times \cos 71^\circ$ ①

$230^2 = h^2 (\tan^2 69^\circ + \tan^2 64^\circ - 2 \tan 69^\circ \tan 64^\circ \cos 71^\circ)$

$h^2 = \frac{230^2}{\tan^2 69^\circ + \tan^2 64^\circ - 2 \tan 69^\circ \tan 64^\circ \cos 71^\circ}$

$h^2 = 7041.719265$ but $h > 0$

$h = 83.91495257$

$h \doteqdot 84$ m to the nearest metre. ①

This question was poorly done in general. Cosine rule is the only way with correct information. Carry on errors were allowed if they didn't make the question easier e.g. Right angle OR Sine Rule

END OF PAPER