

Name: \_\_\_\_\_

Class: 11MTA22\_\_\_\_\_

## CHERRYBROOK TECHNOLOGY HIGH SCHOOL



**2022**

**YEAR 11**

**AP2**

## MATHEMATICS ADVANCED

*Time allowed – 2 hours plus 10 minutes reading time*

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**General  
Instructions**

- Attempt all questions
- Write your name on the question paper
- Write using black pen
- NESA approved calculators may be used
- The NESA reference sheet has been provided
- For questions in Section II, show relevant mathematical reasoning and/or calculations

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**Total marks:  
70**

**Section I – 10 marks (pages 3 – 6)**

- Attempt Questions 1-10
- Allow about 15 minutes for this section

**Section II – 60 marks (pages 7 – 23)**

- Attempt Questions 11-30
- Allow about 1 hour and 45 minutes for this section

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## Section I

10 marks

Attempt Questions 1 – 10

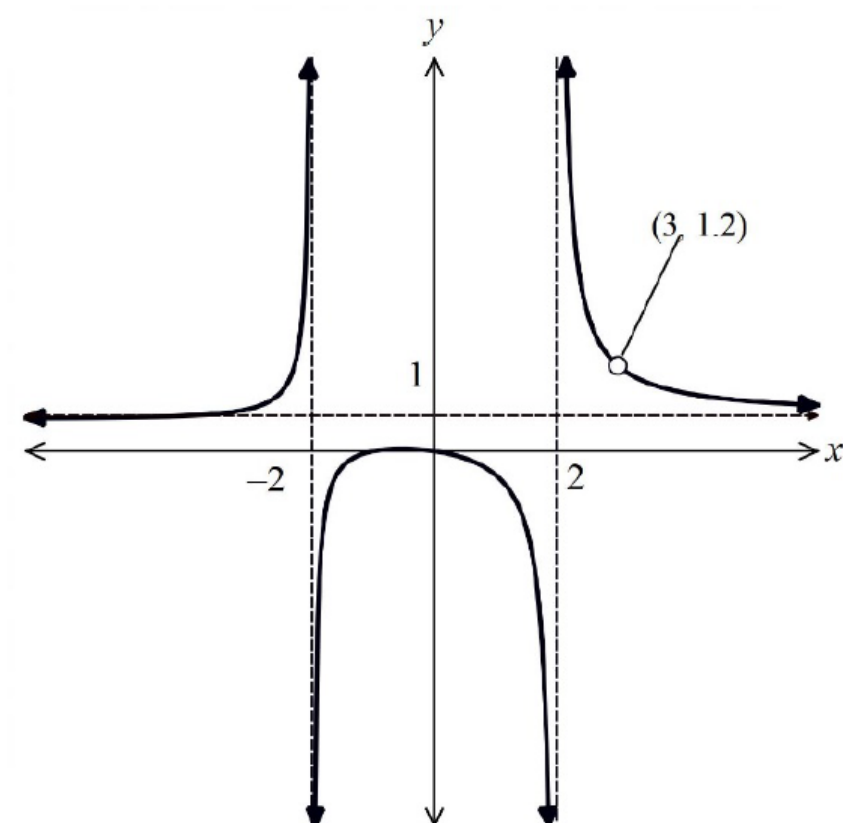
Allow about 10 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 10.

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- 1 What is the domain of the function  $f(x) = \sqrt{x+3}$  ?
- (A)  $x > 3$
  - (B)  $[-3, \infty)$
  - (C)  $x \leq 3$
  - (D)  $[-3, \infty]$
- 2 What is the centre and radius of the circle with equation  $(x+3)^2 + (y-1)^2 = 25$  ?
- (A) Centre  $(-3, 1)$  and radius 25
  - (B) Centre  $(-3, 1)$  and radius 5
  - (C) Centre  $(3, -1)$  and radius 25
  - (D) Centre  $(3, -1)$  and radius 5
- 3 Consider the functions  $f(x) = x^2$  and  $g(x) = x + 2$  . Which of the following expressions is equal to  $f(g(x)) - g(f(x))$  ?
- (A)  $4x + 2$
  - (B) 2
  - (C)  $4x + 4$
  - (D)  $x^2 - x - 2$

- 4 The graph of  $y = f(x)$  is shown below.



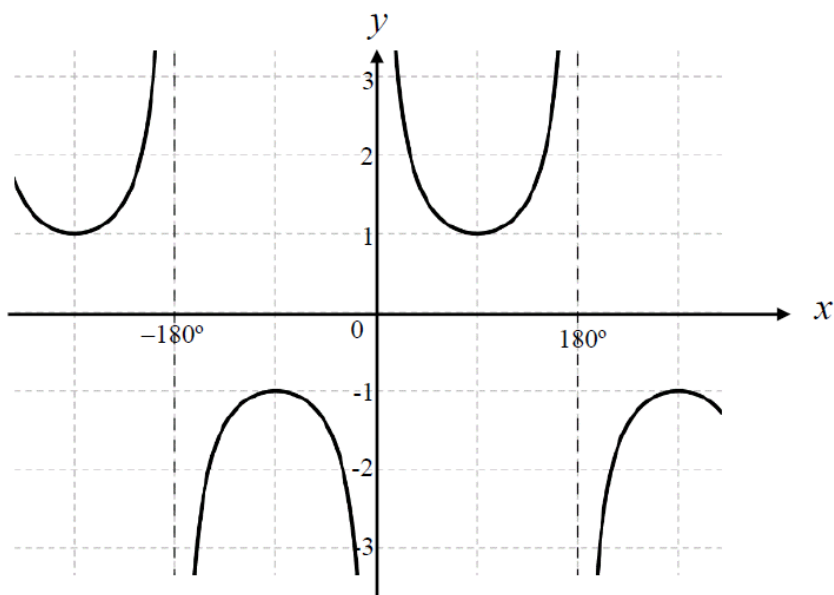
For what values of  $x$  is the curve discontinuous?

- (A)  $x = -2$  and  $x = 2$
  - (B)  $x = -2$ ,  $x = 1$  and  $x = 2$
  - (C)  $x = -2$ ,  $x = 2$ ,  $x = 1.2$
  - (D)  $x = -2$ ,  $x = 2$ ,  $x = 3$
- 5 A bag contains 4 green marbles and 6 blue marbles. Two marbles are selected at random without replacement.

What is the probability that at least one of the marbles selected is green?

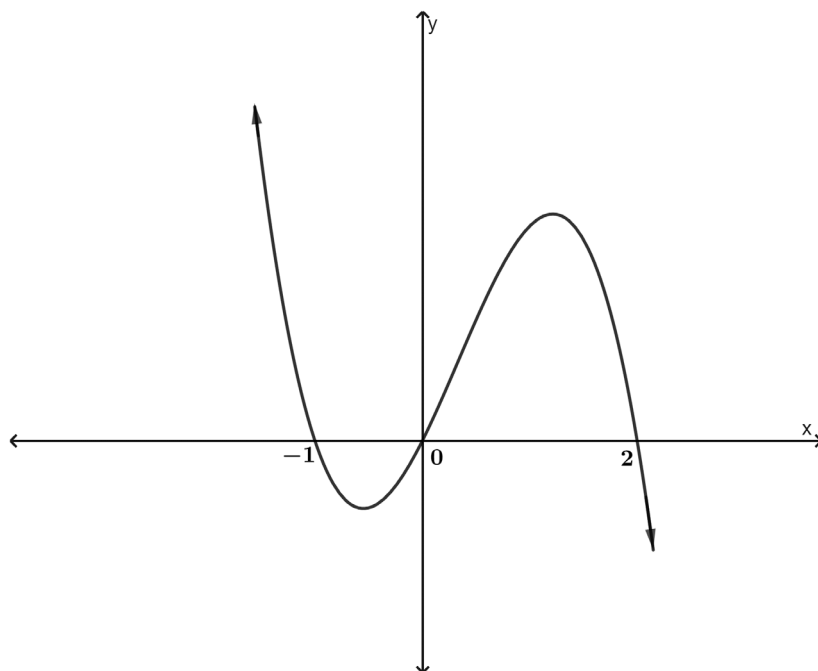
- (A)  $\frac{2}{5}$
- (B)  $\frac{13}{15}$
- (C)  $\frac{2}{3}$
- (D)  $\frac{8}{15}$

6 Which of the following best represents the graph below?



- (A)  $y = \operatorname{cosec} x$
- (B)  $y = \sec x$
- (C)  $y = \cot x$
- (D)  $y = -\sec x$

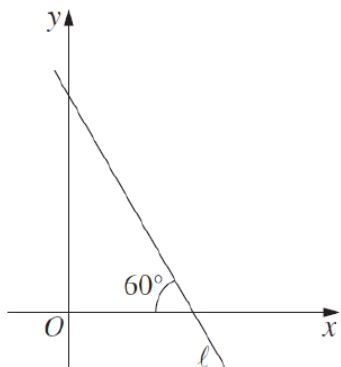
7



What is the equation of this curve?

- (A)  $y = x(x + 1)(x - 2)$
- (B)  $y = -x(x - 1)(x + 2)$
- (C)  $y = x(x - 1)(x + 2)$
- (D)  $y = -x(x + 1)(x - 2)$

8 Observe the following diagram:



What is the gradient of the line  $\ell$  ?

- (A)  $\sqrt{3}$
- (B)  $\frac{1}{\sqrt{3}}$
- (C)  $-\sqrt{3}$
- (D)  $-\frac{1}{\sqrt{3}}$

9 Which expression is equivalent to  $\frac{x^2 - 5x + 6}{4 - x^2}$  ?

- (A)  $\frac{-5x + 6}{4}$
- (B)  $\frac{x - 3}{2 + x}$
- (C)  $-\frac{x - 3}{x + 2}$
- (D)  $\frac{x - 3}{x - 2}$

10 There are two events A and B. In which case are the events A and B independent?

- (A)  $P(A|B) = 0.5$  and  $P(A) = 0.4$  and  $P(B) = 0.5$
- (B)  $P(A) = 0.9$  and  $P(B) = 0.4$  and  $P(A \cap B) = 0.36$
- (C)  $P(A|B) = \frac{3}{4}$  and  $P(A) = \frac{3}{5}$  and  $P(B) = \frac{7}{10}$
- (D)  $P(A) = \frac{1}{5}$  and  $P(B) = \frac{1}{3}$  and  $P(A \cap B) = \frac{1}{5}$

**End of Section I**

Section II

60 marks  
Attempt Questions 11 – 30  
Allow about 1 hour and 45 minutes for this section

- Instructions**
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
  - Your responses should include relevant mathematical reasoning and/or calculations.
  - Extra writing space is provided at the back of this booklet.  
If you use this space, clearly indicate which question you are answering.

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|                    |           |              |
|--------------------|-----------|--------------|
| <b>Question 11</b> | (2 marks) | <b>Marks</b> |
|--------------------|-----------|--------------|

|                                                              |          |
|--------------------------------------------------------------|----------|
| What is the exact value of $\cot 240^\circ \cos 120^\circ$ ? | <b>2</b> |
|--------------------------------------------------------------|----------|

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**Question 12** (2 marks)

|                                                             |          |
|-------------------------------------------------------------|----------|
| Find the value of $x$ if $\sqrt{75} + \sqrt{27} = \sqrt{x}$ | <b>2</b> |
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Question 13 (4 marks)

Marks

Given that  $\log_a b = 2.75$  and  $\log_a c = 0.25$  , find the value of:

(a)  $\log_a \left(\frac{b}{c}\right)$ 1

(b)  $\log_c b$ 1

(c)  $\log_a (bc)^2$ 2



Question 14 (2 marks)

Marks

Using first principles,  $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ , differentiate  $f(x) = 2x^2 + x$ .

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Question 15 (2 marks)

Given  $\cos \theta = -\frac{2}{3}$  and  $\tan \theta > 0$ , find the exact value of  $\sin \theta$ .

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**Question 16** (2 marks)

**Marks**

Solve  $2 \cos \theta + 1 = 0$  for  $0 < \theta < 360^\circ$

**2**

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**Question 17** (2 marks)

A function is defined as  $f(x) = 4 - 2^{-x}$ .

(a) Find the value of  $f(-2)$

**1**

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(b) Determine if  $f(x)$  is even, odd or neither, justify your answer with working.

**1**

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**Questions 11-17 are worth 16 marks in total**

Differentiate the following with respect to  $x$ . Leave your answers in simplified form with positive indices:

(a)

$y = 7x^3 - 5x + 2$

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(b)

$y = \sqrt{2x - 3}$

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(c)

$y = \frac{x + 3}{x^2 - 4}$

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Question 18 continues on page 12

(d)  $y = 3x^4(2 - x)^3$

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**Question 19**    (2 marks)

A jar contains 12 lollies in wrapping. Six lollies have red wrapping, four have yellow wrapping and two have green wrapping. Two lollies are drawn without replacement. Find the probability that the lollies have the same coloured wrapping.

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Prove that  $\frac{\sin x}{1 + \cos x} + \frac{1 + \cos x}{\sin x} = 2\operatorname{cosec} x$

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A tangent is drawn to the parabola  $y = x^2 - 4x$  at the point  $P$ . The tangent has a gradient of 6.

- (a)            Find the coordinates of  $P$
- 2

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- (b)            Find the equation of the normal at  $P$  in gradient-intercept form.
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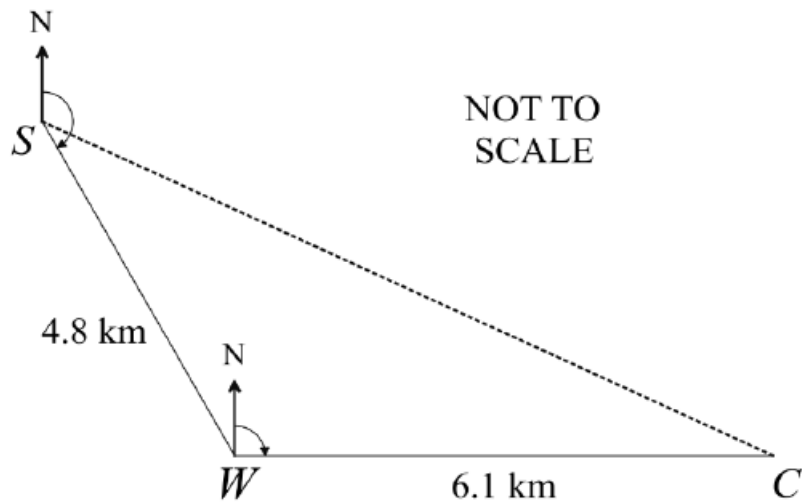
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Malachi sets out on a bushwalk leaving the start of the track ( $S$ ) on a bearing of  $150^\circ\text{T}$  for 4.8 km until he reaches the waterfall ( $W$ ).

He then walks due east for 6.1 km until he arrives at the edge of the canyon ( $C$ ).



(a)

What is the size of  $\angle SWC$ ?

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(b)

Show that the distance of the canyon ( $C$ ) from the start of the track ( $S$ ) is 9.5 km, correct to one decimal place.

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Question 22 continues on page 16

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**1**



For the probability distribution below, it is given that  $E(X) = 2.1$  .

3

|            |     |     |     |
|------------|-----|-----|-----|
| $x$        | 1   | 2   | 3   |
| $P(X = x)$ | $a$ | 0.5 | $b$ |

Find the values of  $a$  and  $b$ .

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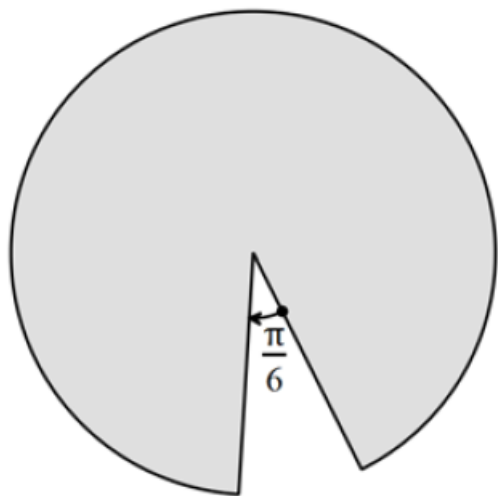
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The area of the major sector shown below is  $33\pi \text{ cm}^2$ .

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Find the radius of the sector.

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The table below represents a discrete probability distribution.

|            |     |     |     |      |      |
|------------|-----|-----|-----|------|------|
| $x$        | 0   | 1   | 2   | 3    | 4    |
| $P(X = x)$ | 0.1 | 0.4 | 0.3 | 0.15 | 0.05 |

(a)

Calculate the value of  $P(1 \leq X < 4)$

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(b)

Given  $E(X) = 1.65$ , find the value of the variance,  $\text{Var}(X)$ .

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Question 27    (3 marks)

Given that the area of  $\triangle ABC$  is  $12\text{ cm}^2$  with side lengths  $AB = 8$  and  $BC = 6$ , find the size of  $\angle ABC$ .

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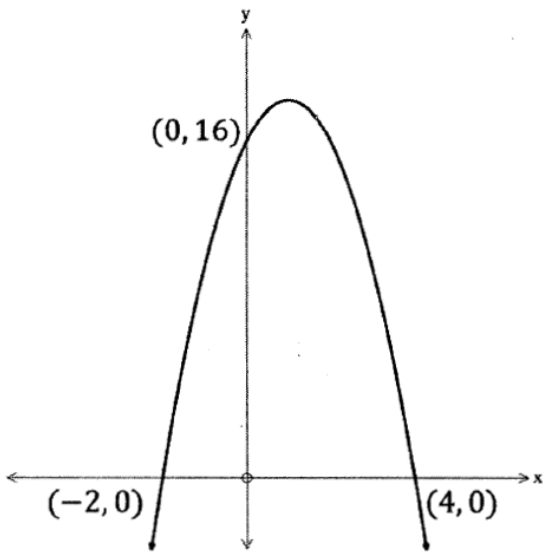
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If  $y = a(x + b)^2 + c$  represents the parabola shown below, find the values of  $a$ ,  $b$  and  $c$ .

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**Question 29** (3 marks)

## Marks

Solve the equation  $2 \log_2 x - \log_2(x + 3) = 2$

3

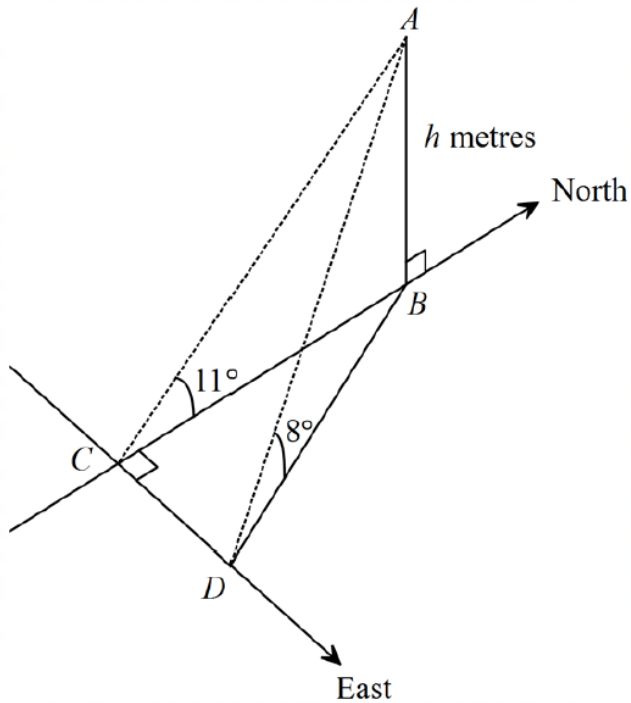
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**Question 30** (4 marks)

**Marks**

In the diagram below, a vertical tower  $AB$  and a straight road  $CD$  are on level ground. The tower is due north of  $C$  and  $D$  is 1000 metres due east of  $C$ .

From  $C$  and  $D$ , a person observes the angle of elevation of the top of the tower to be  $11^\circ$  and  $8^\circ$  respectively.



Let  $h$  be the height of the tower  $AB$ .

- (a) Show that  $BC = h \cot 11^\circ$

**1**

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**Question 30 continues on page 23**

### Marks

3

(b) Find the height of the tower, correct to one decimal place.

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## End of Paper

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**If you use this space, clearly indicate which question you are answering.**

## 2022 Year 11 Mathematics Advanced AP2 Section I – Answer Sheet

Name: \_\_\_\_\_

Class: 11MTA22\_\_\_\_\_

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 ☒ C ☐ D ☐  
correct

- 
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 ☐
  6. A ☐ B ☐ C ☐ D ☐
  7. A ☐ B ☐ C ☐ D ☐
  8. A ☐ B ☐ C ☐ D ☐
  9. A ☐ B ☐ C ☐ D ☐
  10. A ☐ B ☐ C ☐ D ☐

Name: Solutions

Class: 11MTA22\_\_\_\_\_

## CHERRYBROOK TECHNOLOGY HIGH SCHOOL



2022

YEAR 11

AP2

## MATHEMATICS ADVANCED

*Time allowed – 2 hours plus 10 minutes reading time*

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**General  
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**Total marks:  
70**

**Section I – 10 marks (pages 3 – 6)**

- Attempt Questions 1-10
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**Section II – 60 marks (pages 7 – 23)**

- Attempt Questions 11-30
- Allow about 1 hour and 45 minutes for this section

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## Section I

10 marks

Attempt Questions 1 – 10

Allow about 10 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 10.

---

1 What is the domain of the function  $f(x) = \sqrt{x+3}$  ?

(A)  $x > 3$

(B)  $[-3, \infty)$

(C)  $x \leq 3$

(D)  $[-3, \infty]$

$$\begin{aligned}x+3 &\geq 0 \\x &\geq -3\end{aligned}$$

2 What is the centre and radius of the circle with equation  $(x+3)^2 + (y-1)^2 = 25$  ?

(A) Centre  $(-3, 1)$  and radius 25

(B) Centre  $(-3, 1)$  and radius 5

(C) Centre  $(3, -1)$  and radius 25

(D) Centre  $(3, -1)$  and radius 5

$$(x-h)^2 + (y-k)^2 = r^2$$

3 Consider the functions  $f(x) = x^2$  and  $g(x) = x + 2$ . Which of the following expressions is equal to  $f(g(x)) - g(f(x))$  ?

(A)  $4x + 2$

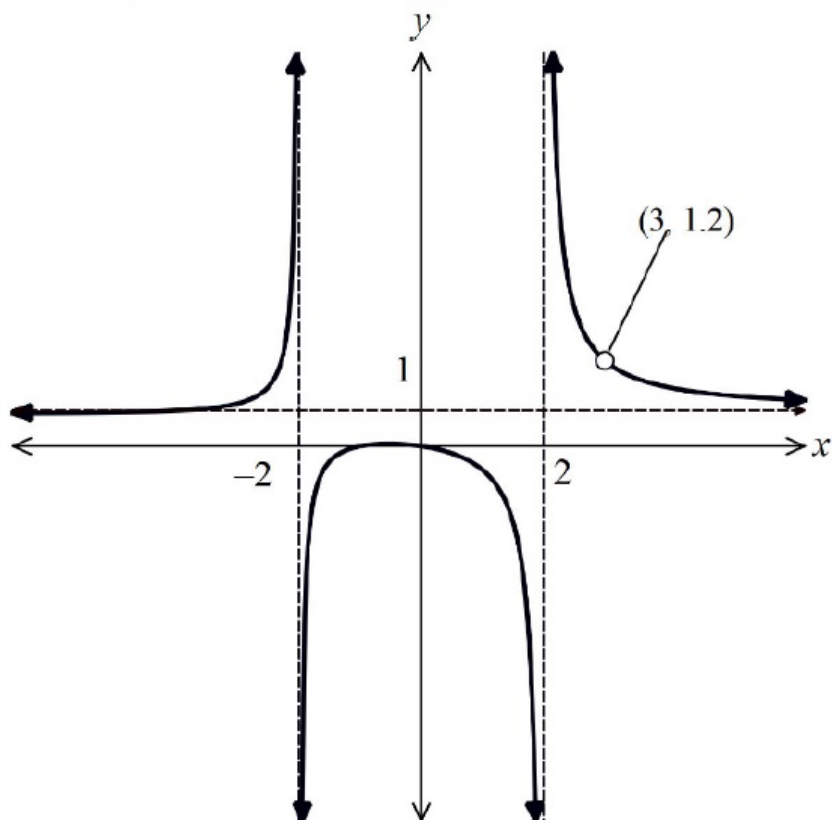
(B) 2

(C)  $4x + 4$

(D)  $x^2 - x - 2$

$$\begin{aligned}&f(x+2) - g(x^2) \\&= (x+2)^2 - (x^2+2) \\&= x^2 + 4x + 4 - x^2 - 2 \\&= 4x + 2\end{aligned}$$

- 4 The graph of  $y = f(x)$  is shown below.



For what values of  $x$  is the curve discontinuous?

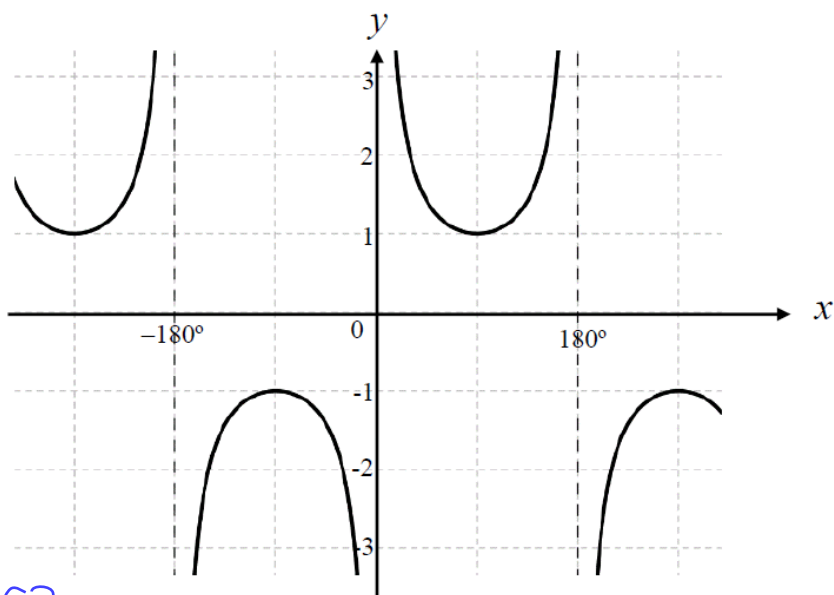
- (A)  $x = -2$  and  $x = 2$
- (B)  $x = -2$ ,  $x = 1$  and  $x = 2$
- (C)  $x = -2, x = 2, x = 1.2$
- (D)  $x = -2, x = 2, x = 3$

- 5 A bag contains 4 green marbles and 6 blue marbles. Two marbles are selected at random without replacement.

What is the probability that at least one of the marbles selected is green?

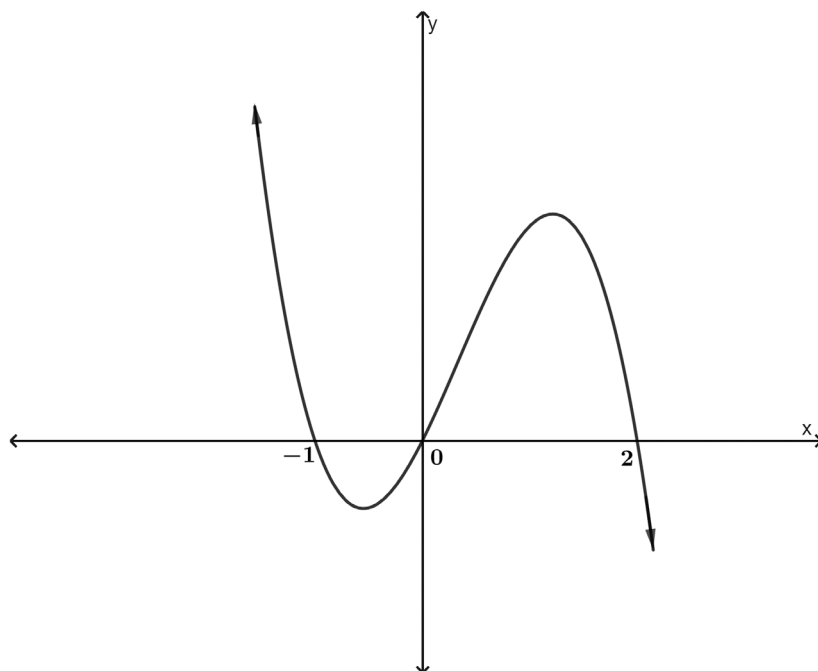
- (A)  $\frac{2}{5}$
  - (B)  $\frac{13}{15}$
  - (C)  $\frac{2}{3}$
  - (D)  $\frac{8}{15}$
- Handwritten solution:
- $$\begin{aligned} &1 - P(\text{no green}) \\ &= 1 - P(BB) \\ &= 1 - \left( \frac{6}{10} \times \frac{5}{9} \right) \end{aligned}$$

6 Which of the following best represents the graph below?



- (A)  $y = \operatorname{cosec} x$   
 (B)  $y = \sec x$   
 (C)  $y = \cot x$   
 (D)  $y = -\sec x$

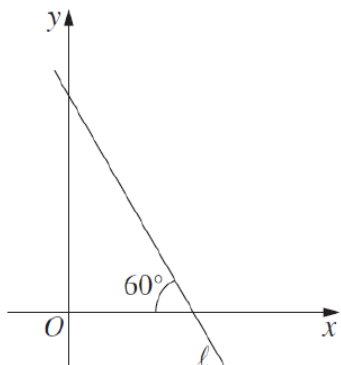
7



What is the equation of this curve?

- (A)  $y = x(x + 1)(x - 2)$   
 (B)  $y = -x(x - 1)(x + 2)$   
 (C)  $y = x(x - 1)(x + 2)$   
 (D)  $y = -x(x + 1)(x - 2)$

8 Observe the following diagram:



gradient is negative

$$m = -\tan 60$$

or  
 $m = \tan 120$

What is the gradient of the line  $l$ ?

(A)  $\sqrt{3}$

(B)  $\frac{1}{\sqrt{3}}$

(C)  $-\sqrt{3}$

(D)  $-\frac{1}{\sqrt{3}}$

$$\therefore m = -\frac{\sqrt{3}}{1}$$

$$\therefore m = -\sqrt{3}$$

9 Which expression is equivalent to  $\frac{x^2 - 5x + 6}{4 - x^2}$ ?

(A)  $\frac{-5x + 6}{4}$

(B)  $\frac{x - 3}{2 + x}$

(C)  $-\frac{x - 3}{x + 2}$

(D)  $\frac{x - 3}{x - 2}$

$$\frac{(x - 3)(x - 2)}{(2 - x)(2 + x)}$$

$$= \frac{(x - 3)(\cancel{x - 2})}{-(\cancel{x - 2})(2 + x)}$$

$$\Rightarrow = \frac{x - 3}{-(2 + x)}$$

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

10 There are two events A and B. In which case are the events A and B independent?

(A)  $P(A|B) = 0.5$  and  $P(A) = 0.4$  and  $P(B) = 0.5$

(B)  $P(A) = 0.9$  and  $P(B) = 0.4$  and  $P(A \cap B) = 0.36$

(C)  $P(A|B) = \frac{3}{4}$  and  $P(A) = \frac{3}{5}$  and  $P(B) = \frac{7}{10}$

(D)  $P(A) = \frac{1}{5}$  and  $P(B) = \frac{1}{3}$  and  $P(A \cap B) = \frac{1}{5}$

$$P(A) \times P(B) = P(A \cap B)$$

End of Section I



## Section II

60 marks

Attempt Questions 11 – 30

Allow about 1 hour and 45 minutes for this section

### Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
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If you use this space, clearly indicate which question you are answering.

### Question 11 (2 marks)

Marks

What is the exact value of  $\cot 240^\circ \cos 120^\circ$ ?

2

$$\frac{1}{\tan 240} \times \cos 120$$

$$= \frac{1}{\sqrt{3}} \times -\frac{1}{2}$$

$$= -\frac{1}{2\sqrt{3}} \text{ or } -\frac{\sqrt{3}}{6}$$

### Question 12 (2 marks)

Find the value of  $x$  if  $\sqrt{75} + \sqrt{27} = \sqrt{x}$

2

$$245 = \sqrt{25} \times \sqrt{3} + \sqrt{9} \times \sqrt{3}$$

$$= 5\sqrt{3} + 3\sqrt{3}$$

$$= 8\sqrt{3}$$

$$= \sqrt{64} \times \sqrt{3} = \sqrt{192} \quad \therefore x = 192$$

**Question 13** (4 marks)**Marks**Given that  $\log_a b = 2.75$  and  $\log_a c = 0.25$ , find the value of:

(a)  $\log_a \left( \frac{b}{c} \right)$

**1**

$$= \log_a b - \log_a c$$

$$= 2.75 - 0.25$$

$$= 2.5$$

(b)  $\log_c b$

**1**

$$\log_c b = \frac{\log_a b}{\log_a c}$$

$$= \frac{2.75}{0.25}$$

$$= 11$$

(c)  $\log_a (bc)^2$

**2**

$$= 2 \log_a (bc)$$

$$= 2 (\log_a b + \log_a c)$$

$$= 2 (2.75 + 0.25)$$

$$= 6$$

Question 14 (2 marks)

Marks

Using first principles,  $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ , differentiate  $f(x) = 2x^2 + x$ .

2

$$\begin{aligned} f(x+h) &= 2(x+h)^2 + (x+h) \\ &= 2(x^2 + 2xh + h^2) + x + h \\ &= 2x^2 + 4xh + 2h^2 + x + h \end{aligned}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{2x^2 + 4xh + 2h^2 + x + h - (2x^2 + x)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\cancel{2x^2} + 4xh + 2h^2 + \cancel{x} + h - \cancel{2x^2} - \cancel{x}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{4xh + 2h^2 + h}{h}$$

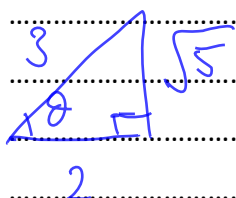
$$= \lim_{h \rightarrow 0} \frac{h(4x + 2h + 1)}{h} = 4x + 1$$

Question 15 (2 marks)

Given  $\cos \theta = -\frac{2}{3}$  and  $\tan \theta > 0$ , find the exact value of  $\sin \theta$ .

2

$\cos \theta < 0$ ,  $\tan \theta > 0 \therefore$  3rd quadrant



$$\sin \theta = -\frac{\sqrt{5}}{3}$$

**Question 16** (2 marks)**Marks**Solve  $2 \cos \theta + 1 = 0$  for  $0 < \theta < 360^\circ$ **2**

$$2 \cos \theta = -1$$

$$\cos \theta = -\frac{1}{2}$$

$$\theta = \cos^{-1}\left(-\frac{1}{2}\right)$$

$$\theta = 120^\circ \text{ or } 240^\circ$$

**Question 17** (2 marks)A function is defined as  $f(x) = 4 - 2^{-x}$ .

- (a) Find the value of
- $f(-2)$

**1**

$$f(-2) = 4 - 2^{-(-2)}$$

$$= 4 - 4$$

$$= 0$$

- (b) Determine if
- $f(x)$
- is even, odd or neither, justify your answer with working.

**1**

$$f(-x) = 4 - 2^{-(-x)}$$

$$= 4 - 2^x \neq f(x)$$

$$-f(x) = -(4 - 2^{-x}) \quad \therefore \text{neither}$$

$$= -4 + 2^{-x}$$

$$\neq f(-x)$$

**Questions 11-17 are worth 16 marks in total**

**Question 18** (8 marks)**Marks**

Differentiate the following with respect to  $x$ . Leave your answers in simplified form with positive indices:

(a)  $y = 7x^3 - 5x + 2$

**1**

$$\frac{dy}{dx} = 21x^2 - 5$$

(b)  $y = \sqrt{2x - 3}$

**2**

$$y = (2x - 3)^{\frac{1}{2}}$$
$$\frac{dy}{dx} = \frac{1}{2} (2x - 3)^{-\frac{1}{2}} \times 2$$
$$= (2x - 3)^{-\frac{1}{2}} = \frac{1}{\sqrt{2x - 3}}$$

(c)  $y = \frac{x+3}{x^2-4}$

**2**

$$u = x+3 \quad v = x^2-4$$
$$u' = 1 \quad v' = 2x$$
$$\frac{dy}{dx} = \frac{(x^2-4)(1) - (x+3)(2x)}{(x^2-4)^2}$$
$$= \frac{x^2-4-2x^2-6x}{(x^2-4)^2}$$
$$= \frac{-x^2-6x-4}{(x^2-4)^2} \quad \text{OR} \quad \frac{-(x^2+6x+4)}{(x^2-4)^2}$$

Question 18 continues on page 12

(d)

$$y = 3x^4(2-x)^3$$

$$u = 3x^4$$

$$u' = 12x^3$$

$$v = (2-x)^3$$

$$v' = 3(2-x)^2 \times -1$$

$$= -3(2-x)^2$$

$$\frac{dy}{dx} = (2-x)^3 (12x^3) + (3x^4) (-3(2-x)^2)$$

$$= 12x^3(2-x)^3 - 9x^4(2-x)^2$$

$$= 3x^3(2-x)^2 [4(2-x) - 3x]$$

$$= 3x^3(2-x)^2 (8-7x)$$

**Question 19** (2 marks)

2

A jar contains 12 lollies in wrapping. Six lollies have red wrapping, four have yellow wrapping and two have green wrapping. Two lollies are drawn without replacement. Find the probability that the lollies have the same coloured wrapping.

$$P(RR) + P(YY) + P(GG)$$

$$= \left( \frac{6}{12} \times \frac{5}{11} \right) + \left( \frac{4}{12} \times \frac{3}{11} \right) + \left( \frac{2}{12} \times \frac{1}{11} \right)$$

$$= \frac{1}{3}$$

Prove that  $\frac{\sin x}{1 + \cos x} + \frac{1 + \cos x}{\sin x} = 2 \operatorname{cosec} x$

3

$$\text{LHS} = \frac{\sin^2 x + (1 + \cos x)^2}{\sin x (1 + \cos x)}$$

$$= \frac{\sin^2 x + 1 + 2 \cos x + \cos^2 x}{\sin x (1 + \cos x)}$$

$$= \frac{1 + 1 + 2 \cos x}{\sin x (1 + \cos x)}$$

$$= \frac{2 + 2 \cos x}{\sin x (1 + \cos x)}$$

$$= \frac{2(1 + \cos x)}{\sin x (1 + \cos x)}$$

$$= \frac{2}{\sin x} = 2 \operatorname{cosec} x \\ = \text{RHS}$$

**Question 21** (4 marks)**Marks**

A tangent is drawn to the parabola  $y = x^2 - 4x$  at the point  $P$ . The tangent has a gradient of 6.

- (a) Find the coordinates of  $P$

**2**

$$\begin{aligned}\frac{dy}{dx} &= 2x - 4 \\ 6 &= 2x - 4 \\ 2x &= 10 \\ x &= 5\end{aligned}$$

sub  $x=5$ :

$$\begin{aligned}y &= (5)^2 - 4(5) \\ &= 5 \\ \therefore P(5, 5)\end{aligned}$$

- (b) Find the equation of the normal at  $P$  in gradient-intercept form.

**2**

$$\begin{aligned}m &= 6 \\ \therefore m_n &= -\frac{1}{6}\end{aligned}$$

$$\text{At } P(5, 5):$$

$$y - 5 = -\frac{1}{6}(x - 5)$$

$$y - 5 = -\frac{1}{6}x + \frac{5}{6}$$

$$y = -\frac{1}{6}x + \frac{35}{6}$$

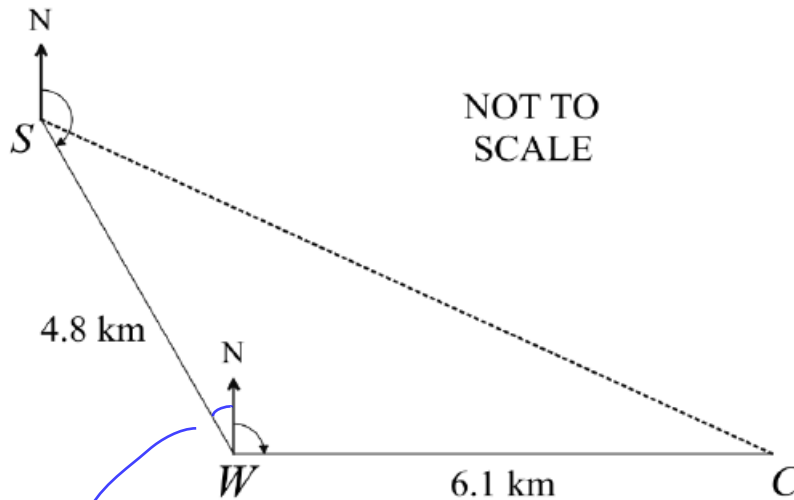


**Question 22** (6 marks)

**Marks**

Malachi sets out on a bushwalk leaving the start of the track ( $S$ ) on a bearing of  $150^\circ\text{T}$  for 4.8 km until he reaches the waterfall ( $W$ ).

He then walks due east for 6.1 km until he arrives at the edge of the canyon ( $C$ ).



- (a) What is the size of  $\angle SWC$ ? 1

$30^\circ$  (co-interior  $\angle$ s on parallel lines)  
 $\angle SWC = 30^\circ + 90^\circ$   
 $= 120^\circ$

- (b) Show that the distance of the canyon ( $C$ ) from the start of the track ( $S$ ) is 9.5 km, correct to one decimal place. 2

$$d^2 = (6.1)^2 + (4.8)^2 - 2(6.1)(4.8)\cos 120$$

$$d = \sqrt{(6.1)^2 + (4.8)^2 - 2(6.1)(4.8)\cos 120}$$

$$\therefore d = 9.5 \text{ km (1 d.p.)}$$

Question 22 continues on page 16

- (c) Hence, find the bearing of the start of the track (S) from the canyon (C), to the nearest degree.

$$\frac{\sin 120}{9.5} = \frac{\sin C}{4.8}$$

$$\sin C = 4.8 \times \frac{\sin 120}{9.5}$$

$$C = 25^{\circ} 56' 56.35'' \text{ or } 154^{\circ} 3' 3.65''$$

cannot be a solution  
so reject.

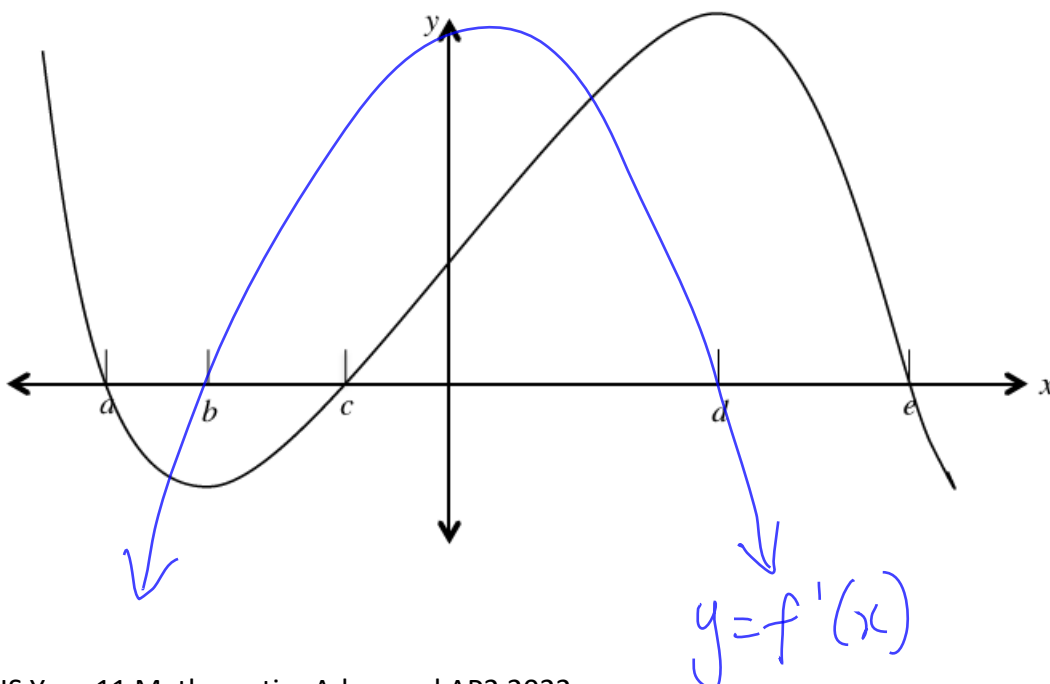
$$\begin{aligned} \therefore \text{Bearing} &= 270^{\circ} + C \\ &= 296^{\circ} \text{ (nearest degree)} \end{aligned}$$

**Question 23** (1 mark)

The curve below represents the graph of  $y = f(x)$ .

1

On the same graph given below, sketch  $y = f'(x)$ .



**Question 24** (3 marks)**Marks**For the probability distribution below, it is given that  $E(X) = 2.1$ .**3**

|            |     |     |     |
|------------|-----|-----|-----|
| $x$        | 1   | 2   | 3   |
| $P(X = x)$ | $a$ | 0.5 | $b$ |

Find the values of  $a$  and  $b$ .

$$E(X) = (1 \times a) + (2 \times 0.5) + (3 \times b)$$
$$= a + 1 + 3b$$

$$2.1 = a + 3b + 1$$

$$1.1 = a + 3b \quad (1)$$

$$\text{Also, } a + 0.5 + b = 1$$

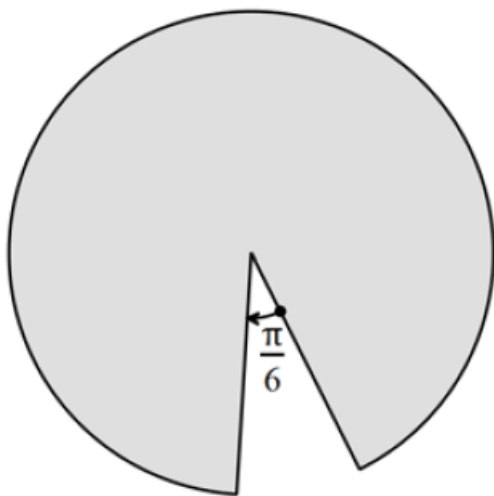
$$a + b = 0.5 \quad (2)$$

$$(1) - (2) :$$

$$2b = 0.6$$

$$b = 0.3$$

$$\therefore a = 0.2$$

**Question 25** (2 marks)**Marks**The area of the major sector shown below is  $33\pi \text{ cm}^2$ .**2**

Find the radius of the sector.

$$\text{Angle of major sector} = 2\pi - \frac{\pi}{6}$$

$$= \frac{11\pi}{6}$$

$$A = \frac{1}{2} r^2 \theta$$

$$33\pi = \frac{1}{2} r^2 \times \frac{11\pi}{6}$$

$$396\pi = r^2 (11\pi)$$

$$r^2 = 36$$

$$\therefore r = 6, r > 0$$

**Question 26** (2 marks)**Marks**

The table below represents a discrete probability distribution.

|            |     |     |     |      |      |
|------------|-----|-----|-----|------|------|
| $x$        | 0   | 1   | 2   | 3    | 4    |
| $P(X = x)$ | 0.1 | 0.4 | 0.3 | 0.15 | 0.05 |

- (a) Calculate the value of  $P(1 \leq X < 4)$

**1**

$$0.4 + 0.3 + 0.15 = 0.85$$

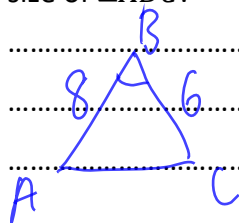
- (b) Given  $E(X) = 1.65$ , find the value of the variance,  $\text{Var}(X)$ .

**1**

$$\begin{aligned} \text{Var}(X) &= (0^2 \times 0.1) + (1^2 \times 0.4) + (2^2 \times 0.3) \\ &\quad + (3^2 \times 0.15) + (4^2 \times 0.05) - (1.65)^2 \\ &= 1.0275 \quad \text{or} \quad \frac{411}{400} \end{aligned}$$

**Question 27** (3 marks)

Given that the area of  $\triangle ABC$  is  $12 \text{ cm}^2$  with side lengths  $AB = 8$  and  $BC = 6$ , find the size of  $\angle ABC$ .

**3**

$$A = \frac{1}{2} ab \sin C$$

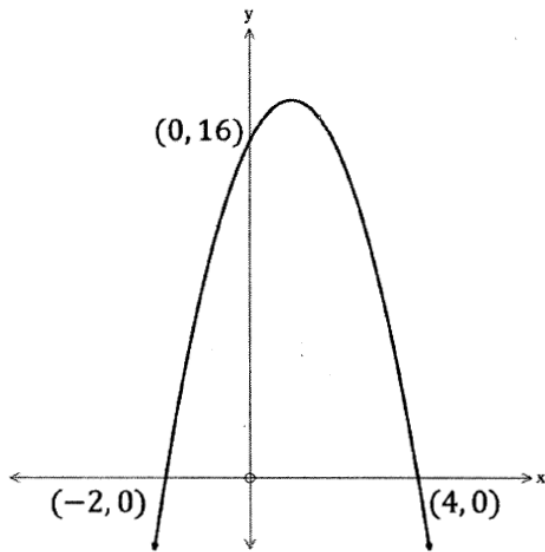
$$= \frac{1}{2} (8)(6) \sin \angle ABC$$

$$12 = 24 \sin \angle ABC$$

$$\sin \angle ABC = \frac{1}{2}$$

$$\therefore \angle ABC = 30^\circ \text{ or } 150^\circ$$

If  $y = a(x + b)^2 + c$  represents the parabola shown below, find the values of  $a$ ,  $b$  and  $c$ .



\* Many methods to this question

$$y = a(x + b)^2 + c$$

$$y = a(x^2 + 2bx + b^2) + c$$

$$y = ax^2 + 2abx + ab^2 + c$$

Axis of symmetry:

$$x = \frac{-2+4}{2}$$

$$x = 1$$

$$\Rightarrow x = -\frac{b}{2a}$$

$$1 = -\frac{2ab}{2a}$$

$$\therefore b = -1$$

sub (0, 16):

$$16 = a(-1)^2 + c$$

$$16 = a + c \quad (1)$$

sub (4, 0):

$$0 = a(4-1)^2 + c$$

$$0 = 9a + c \quad (2)$$

$$(2) - (1):$$

$$-16 = 8a$$

$$a = -2$$

$$(1): a + c = 16$$

$$-2 + c = 16$$

$$\therefore c = 18$$

Solve the equation  $2 \log_2 x - \log_2(x+3) = 2$ 

3

$$\log_2 x^2 - \log_2(x+3) = 2$$

$$\log_2 \left( \frac{x^2}{x+3} \right) = 2$$

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

$$\frac{x^2}{x+3} = 4$$

$$x^2 = 4(x+3)$$

$$x^2 = 4x + 12$$

$$x^2 - 4x - 12 = 0$$

$$(x-6)(x+2) = 0$$

$$x = 6 \text{ or } -2$$

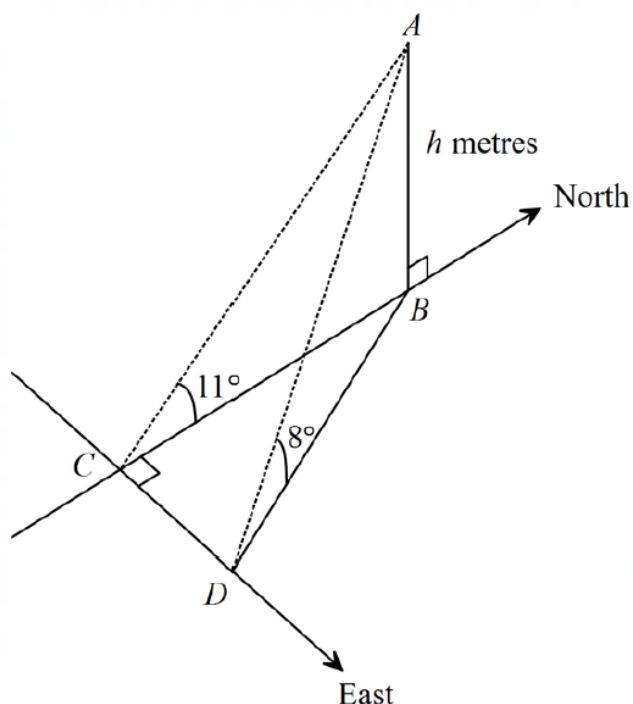
But  $x \neq -2$  since  $2 \log_2(-2)$  is undefined

$$\therefore x = 6$$

**Question 30** (4 marks)**Marks**

In the diagram below, a vertical tower  $AB$  and a straight road  $CD$  are on level ground. The tower is due north of  $C$  and  $D$  is 1000 metres due east of  $C$ .

From  $C$  and  $D$ , a person observes the angle of elevation of the top of the tower to be  $11^\circ$  and  $8^\circ$  respectively.



Let  $h$  be the height of the tower  $AB$ .

- (a) Show that  $BC = h \cot 11^\circ$

**1**

$$\tan 11 = \frac{h}{BC}$$

$$BC = \frac{h}{\tan 11}$$

$$\therefore BC = h \cot 11$$

Question 30 continues on page 23



- (b) Find the height of the tower, correct to one decimal place.

$$\tan 8 = \frac{h}{BD}$$

$$BD = \frac{h}{\tan 8}$$

$$BD = h \cot 8$$

$$BC^2 + 1000^2 = BD^2$$

$$h^2 \cot^2 11 + 1000^2 = h^2 \cot^2 8$$

$$1000^2 = h^2 \cot^2 8 - h^2 \cot^2 11$$

$$1000^2 = h^2 (\cot^2 8 - \cot^2 11)$$

$$h^2 = \frac{1000^2}{\cot^2 8 - \cot^2 11}$$

$$h = \sqrt{\frac{1000^2}{\cot^2 8 - \cot^2 11}}, \quad h > 0$$

$$\therefore h = 203.4 \text{ m (1 d.p.)}$$

End of Paper

[illegible][illegible]

**Section II Extra writing space**

**If you use this space, clearly indicate which question you are answering.**

## 2022 Year 11 Mathematics Advanced AP2 Section I – Answer Sheet

Name: \_\_\_\_\_

Class: 11MTA22\_\_\_\_\_

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 ☒ C ☐ D ☐  
correct

- 
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 ☐
  6. A ☐ B ☐ C ☐ D ☐
  7. A ☐ B ☐ C ☐ D ☐
  8. A ☐ B ☐ C ☐ D ☐
  9. A ☐ B ☐ C ☐ D ☐
  10. A ☐ B ☐ C ☐ D ☐