STUDENT'S NAME: _____

TEACHER'S NAME: _____

2022

HURLSTONE AGRICULTURAL HIGH SCHOOL

YEAR 11 YEARLY EXAMINATION

Mathematics Extension 1

General Instructions

- Reading time – 10 minutes
- Working time – 90 minutes
- Write using a black pen
- NESA approved calculators may be used
- A reference sheet is provided in the Section I booklet
- This examination paper is not to be removed from the examination centre

Total marks: 60

Section I – 10 marks (pages 2 – 6)

- Attempt Questions 1 – 10. The multiple-choice answer sheet has been provided
- Allow about 15 minutes for this section

Section II – 50 marks (pages 7 – 12)

- You have been provided with 5 separate answer booklets, one for each question.
- Attempt each question, Q11 – 15, in the booklet provided for the question.
- Extra working pages are available if required.
- Allow about 1 hour and 15 minutes for this section.

SECTION I

10 marks

Attempt Questions 1 - 10
Allow about 15 minutes on this section.

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

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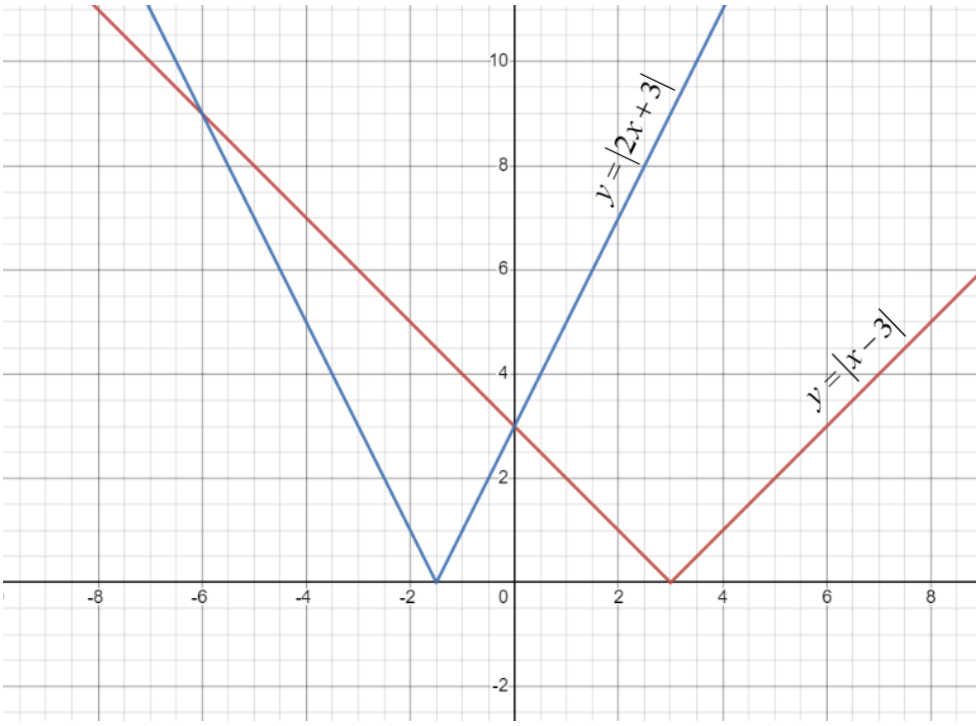
1. Which of the following is the solution to $|2x-1|>5$?

(A) $x<-2,\ \ x>3$ (B) $-2<x<3$

(C) $-3<x<2$ (D) $x<-3,\ \ x>2$

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2. The graphs of the equations $y=|x-3|$ and $y=|2x+3|$ have been provided below.



Which of the following is the solution to the inequality $|2x+3|\le|x-3|$?

(A) $-\frac{3}{2}\le x\le 3$ (B) $-6\le x\le 0$

(C) $-\frac{3}{2}<x<3$ (D) $-6<x<0$

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3. Given that α and β are both acute angles, which of the following is the value of $\cos(\alpha+\beta)$ if $\cos\alpha = \frac{12}{13}$ and $\cos\beta = \frac{4}{5}$?

(A) $\frac{16}{65}$ (B) $\frac{33}{65}$

(C) $\frac{56}{65}$ (D) $\frac{63}{65}$

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4. If $t = \tan\frac{\theta}{2}$ which of the following expressions is equivalent to $4\sin\theta + 3\cos\theta + 5$?

(A) $\frac{2(t+2)^2}{1-t^2}$ (B) $\frac{(t+4)^2}{1-t^2}$

(C) $\frac{2(t+2)^2}{1+t^2}$ (D) $\frac{(t+4)^2}{1+t^2}$

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5. The polynomial $4x^3 - 2x^2 + 8x - 1 = 0$ has zeros α, β and γ.
What is the value of $\frac{1}{\alpha\beta} + \frac{1}{\alpha\gamma} + \frac{1}{\beta\gamma}$?

(A) -2 (B) $-\frac{1}{2}$

(C) 2 (D) $\frac{1}{2}$

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6. Which of the following pairs of parametric equations represents a circle that passes through the origin?

(A) $x=3+4\cos\theta;\ \ y=4+4\sin\theta$

(B) $x=3+5\cos\theta;\ \ y=4+5\sin\theta$

(C) $x=3+3\cos\theta;\ \ y=4+3\sin\theta$

(D) $x=3+7\cos\theta;\ \ y=4+7\sin\theta$

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7. A rowing team consists of 8 rowers and a coxswain.

The rowers are selected from 12 students in year 10.

The coxswain is selected from 4 students in year 9.

In how many ways could the team be selected?

(A) ${}^{12}C_8 \times {}^{4}C_1$

(B) ${}^{12}C_8 + {}^{4}C_1$

(C) ${}^{12}P_8 + {}^{4}P_1$

(D) ${}^{12}P_8 \times {}^{4}P_1$

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8. After a sports tournament every player shakes hands with every other player once.

If there are 36 handshakes in total, how many players are at the tournament?

(A) 18

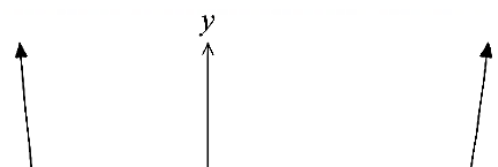
(B) 8

(C) 10

(D) 9

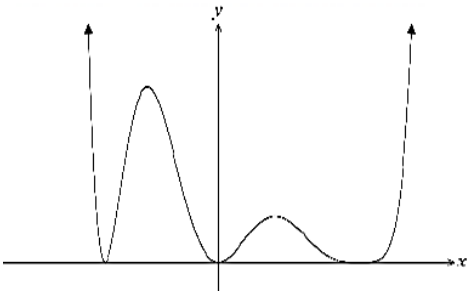
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9. The diagram shows the graph of $y = f(x)$.

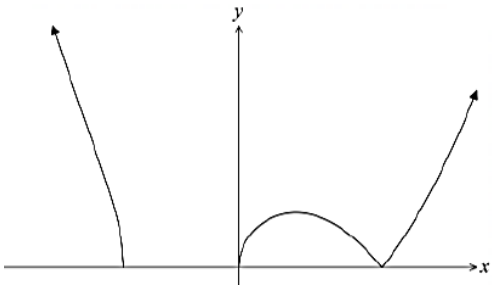


Which of the following best represents the graph of $y^2 = f(x)$?

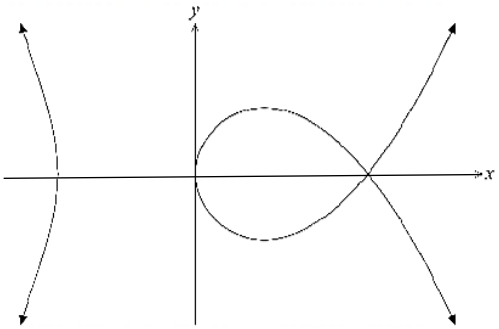
(A)



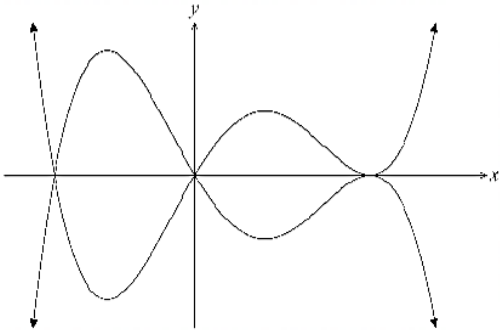
(B)



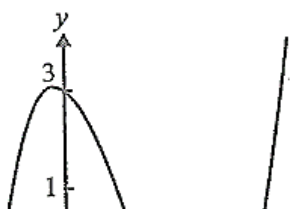
(C)



(D)

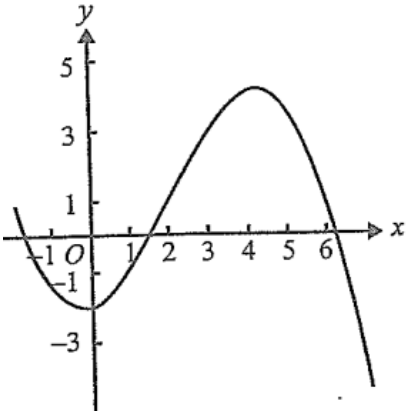


10. The graph of a function *f*, with domain $(-\infty, \infty)$, is as shown.

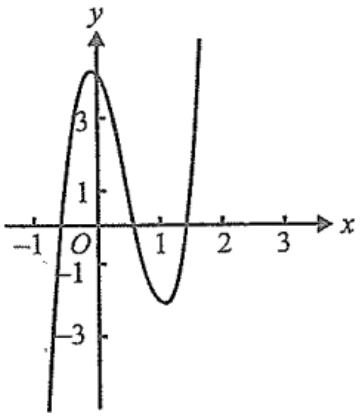


Which of the following graphs best represents $1-f\left(2x\right)$?

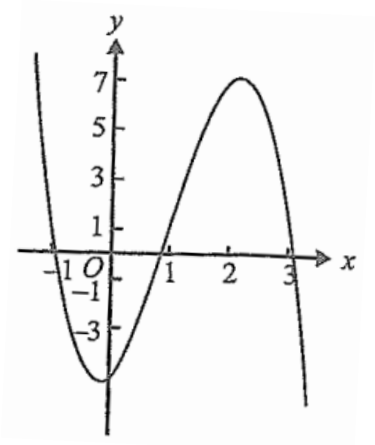
(A)



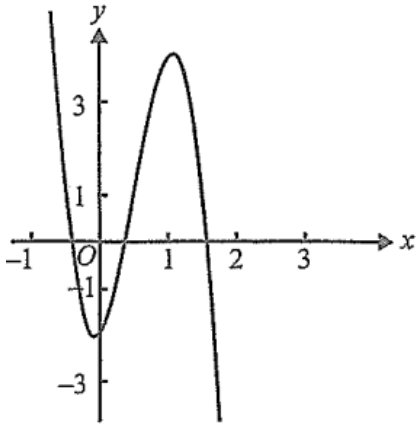
(B)



(C)



(D)



~ End of Section I ~

SECTION II
50 marks

Attempt Questions 11 - 15

Allow about 1 hour and 15 minutes on this section.
For questions in Section II, your responses should include relevant mathematical reasoning and/or calculations.
Answer each question in the separate answer booklet provided for each question.

Question 11 (10 marks) Use the Question 11 Answer BOOKLET **Marks**

(a) i) Solve the quadratic inequality $(5-x)(2x+1) \leq 0$. **2**

ii) Solve the linear inequality $4(2x+3)+x > 47-5x$. **1**

iii) Hence, determine the values of x that satisfy both the inequalities $(5-x)(2x+1) \leq 0$ and $4(2x+3)+x > 47-5x$. **1**

(b) Solve the equation $|3x+1| = 2x-5$. **2**

(c) Solve $x+2 \leq \dfrac{4}{x-1}$. **4**

~ End of Question 11 ~

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Question 12 (10 marks) Use the Question 12 Answer BOOKLET **Marks**

(a) Prove $\dfrac{1+\cot^2\theta}{2\cot\theta} = \operatorname{cosec} 2\theta$. **2**

(b) Prove $\cos\left(2x+\dfrac{\pi}{3}\right)+\cos\left(2x-\dfrac{\pi}{3}\right) = \cos 2x$. **2**

(c) Solve $\dfrac{\sin x+\cos x}{\sqrt{2}} = \dfrac{\sqrt{3}}{2}$, for $0° \le x \le 360°$. **3**

(d) Solve $3\cos^2\theta - \sin^2\theta - 6\cos\theta = 3$, for $0° \le x \le 360°$. **3**

~ End of Question 12 ~

Question 13 (10 marks) Use the Question 13 Answer BOOKLET **Marks**

(a) It is given that $P(x) = x^4 - 5x^3 + ax^2 + bx - 48$ where *a* and *b* are constants and that $x = 2$ is a double root of $P(x)$.

i) Find the values of *a* and *b*. **2**

ii) Factorise $P(x)$ completely into linear factors. **2**

(b) The polynomial $P(x) = 2x^3 + x^2 + ax + 6$ has the roots α, $\frac{1}{\alpha}$ and β.
Find the values of the three roots and hence, find the value of *a*. **3**

(c) The parametrisation of a circle is given by $x - 2 = 2\cos\theta$; $y = 2\sin\theta$.

i) Sketch the graph of this circle, labelling its centre and any points, where the graph cuts the *x* and/or *y* axes. **2**

ii) What values of the parameter, θ, give the points on the circle that are below the *x*-axis? **1**

~ End of Question 13 ~

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Question 14 (10 marks) Use the Question 14 Answer BOOKLET **Marks**

(a) Prove that ${}^{n}P_{k} - {}^{n-1}P_{k} = k \times {}^{n-1}P_{k-1}$. **3**

(b) There are 80 jellybeans of different colours contained in a bag.

The distribution of the colours is shown in the table below.

Colour of jelly bean	pink	white	black	green	yellow	orange	brown	red
Number of jelly beans	2	3	4	10	12	15	16	18

What is the least number of jelly beans that can be selected from the bag to ensure that 8 of the selected jellybeans are the same colour? **2**

(c) Seven people are to be seated at a round table. Ms Sabah and Ms Tarannum refuse to sit next to each other.

How many seating arrangements are then possible? **2**

(d) In the expansion of $(4+x)^{n}$, the coefficients of x^{3} and x^{4} are the same value.

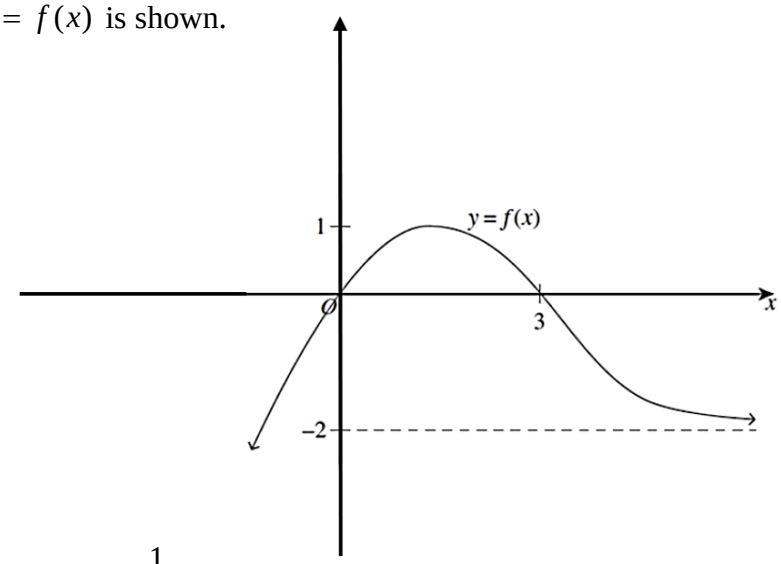
Find the value of *n*. **3**

~ End of Question 14 ~

2022 Mathematics Extension 1 Yearly Examination Section II

Question 15 (10 marks) Use the Question 15 Answer BOOKLET **Marks**

(a) The graph of $y = f(x)$ is shown.



Sketch the graph of $y = \dfrac{1}{f(x)}$, on the graph provided in the Q15 answer booklet. **2**

Clearly show the behaviour of the curves and marking any axes intercepts and asymptotes.

(b) Given below is the graph of the function $h(x) = \dfrac{1}{2}|x-1|,\ -3 \le x \le 3$.



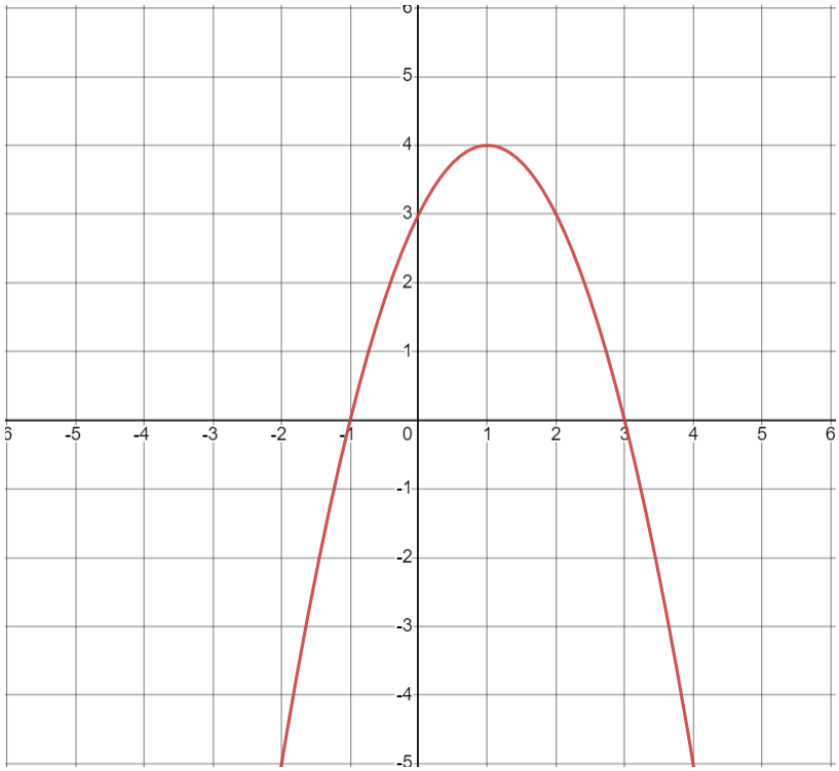
i) On the set of axis provided in Q15 answer booklet, sketch the graph of $t(x) = 2^x,\ -3 \le x \le 3$. **2**

ii) On the same set of axis sketch $h(x) \times t(x)$. **3**

Question 15 continued on page 12 …

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(c) On the graph of $y = g(x)$, shown below and also provided in the Q15 Answer Booklet,



i) Sketch the graph of $y = g(-x)$. **1**

ii) Sketch the graph of $y = |g(-x)|$. **1**

iii) Sketch the graph of $y = g(|x|)$. **1**

~ End of Question 15 ~

~ End of Yearly Examination ~