Name: _____

Teacher: _____

St George Girls High School

Mathematics Extension 1

2020 Year 11 End of Course Examination

General Instructions

- Reading Time: **10 minutes**
- Working time: **90 minutes**
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided
- For questions in **Section I,** use the multiple-choice answer sheet provided
- For questions in **Section II:**
  - Answer the questions in the writing booklets provided
  - Begin each question in a separate writing booklet
  - Extra writing booklets are available if required
  - Show relevant mathematical reasoning and/or calculations
  - Marks may not be awarded for incomplete or poorly presented solutions, or where multiple solutions are provided

Total marks: 60

Section I – 6 marks (pages 3 – 5)

- Attempt Questions 1 – 6
- Allow about 10 minutes for this section

Section II – 54 marks (pages 6 – 11)

- Attempt all questions
- Allow about 1 hour and 20 minutes for this section

Q1 – 6	/6
Q7	/9
Q8	/9
Q9	/9
Q10	/8
Q11	/10
Q12	/9
Total	**/60**
	%

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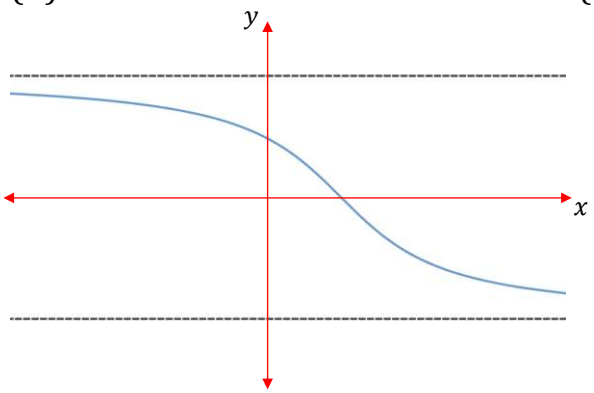
Section I

6 marks
Attempt Questions 1 – 6
Allow about 10 minutes for this section

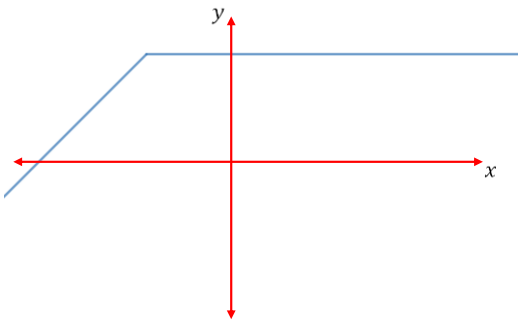
Use the multiple-choice answer sheet provided for Questions 1 to 6.

1. Which of the following is the graph of a function that has an inverse function?

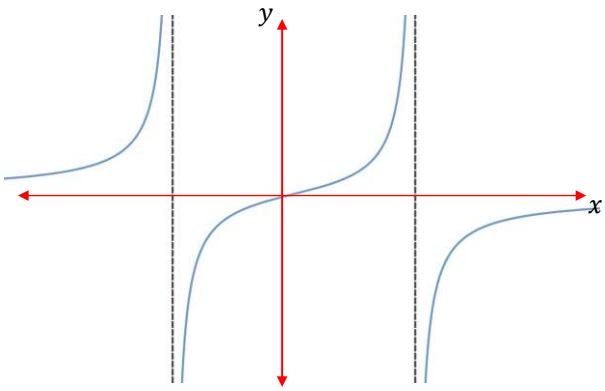
(A)



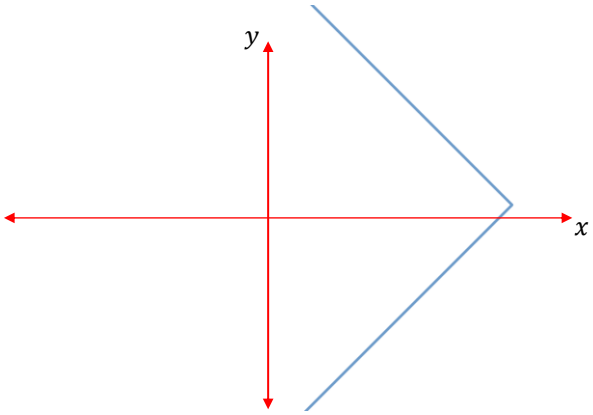
(B)



(C)



(D)



2. Which of the following is a polynomial with leading coefficient 4?

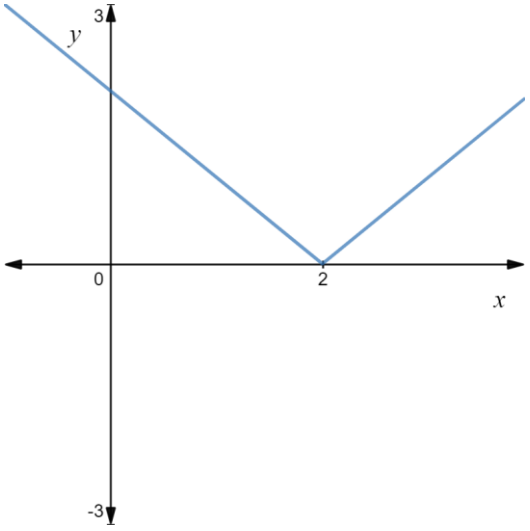
(A) $P(x) = 4x - \frac{7}{2}x^2 + 4x^5$

(B) $Q(x) = 4x - 7x^{-2} + 4x^3$

(C) $R(x) = 4x - 4x^4 + 15x^2$

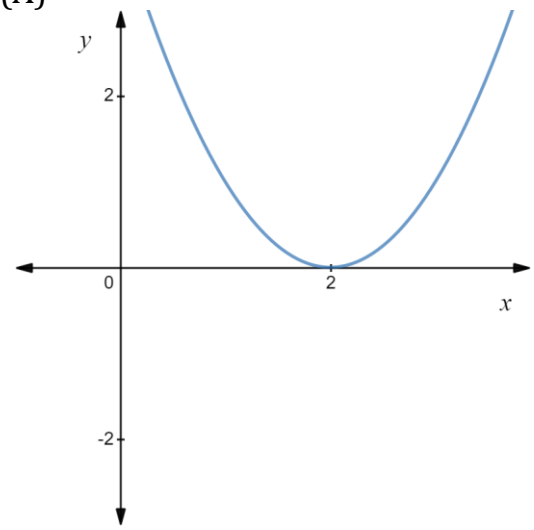
(D) $S(x) = 4\sqrt{x}$

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

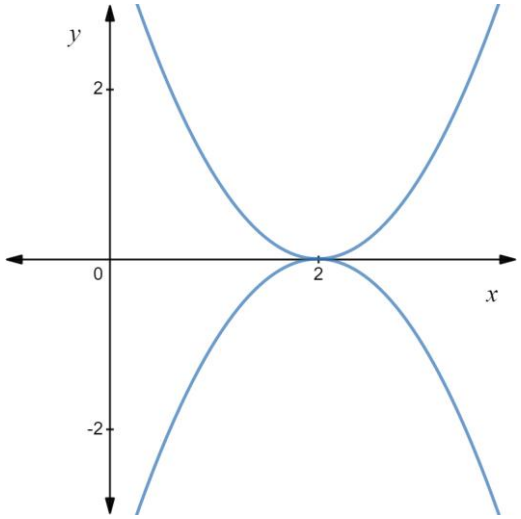


Which of the following is the graph of $y^2 = f(x)$?

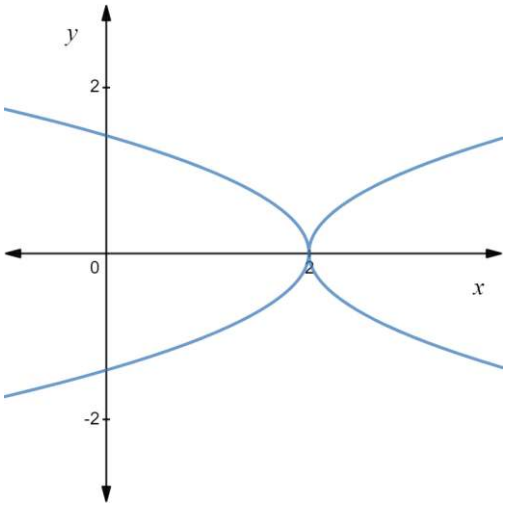
(A)



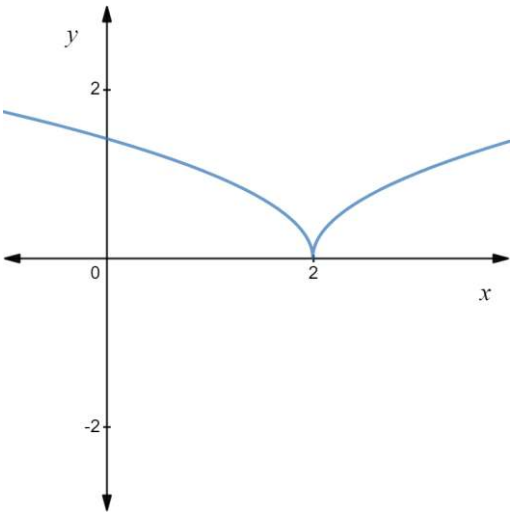
(B)



(C)



(D)



4. Which of the following is the inverse relation of $\{ (0,2), (4,-3), (5,6), (-3,0) \}$?

(A) $\{ (0,-2), (-4,3), (-5,-6), (3,0) \}$

(B) $\{ (-3,0), (5,6), (4,-3), (0,2) \}$

(C) $\left\{ \left(0,\frac{1}{2}\right), \left(\frac{1}{4},-\frac{1}{3}\right), \left(\frac{1}{5},\frac{1}{6}\right), \left(-\frac{1}{3},0\right) \right\}$

(D) $\{ (-3,4), (6,5), (0,-3), (2,0) \}$

5. Solve $|x+5| < 6$.

(A) $x < 1$

(B) $x > -11$

(C) $x < -11, x > 1$

(D) $-11 < x < 1$

6. Which of the following polynomials has a remainder of 7 when divided by $(x-2)$?

(A) $P(x) = 3x^3 - 7x^2 + 11$

(B) $Q(x) = x^3 + 4x^2 - x + 7$

(C) $R(x) = -2x^3 + x^2 - 4x + 5$

(D) $S(x) = 4x^3 - 3x - 15$

End of Section I

Section II 54 marks

Attempt Questions 7 - 12
Allow about 1 hour and 20 minutes for this section

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

In Questions 7 – 12, your responses should include relevant mathematical reasoning and/or calculations.

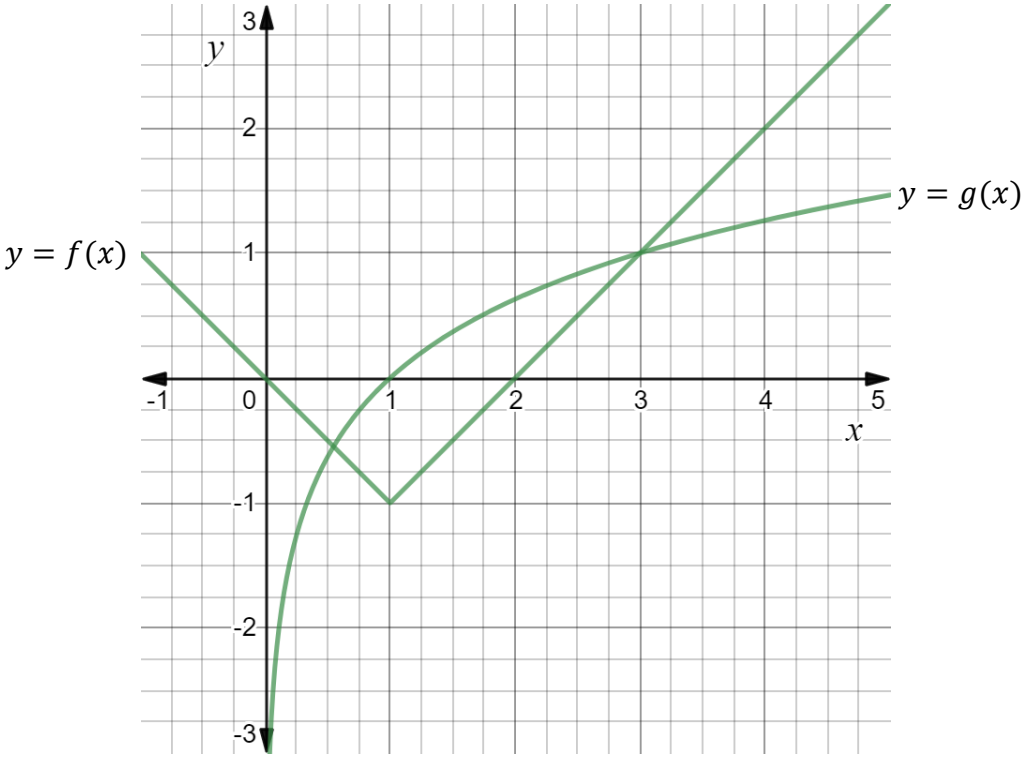
Question 7 (9 marks) Begin a new writing booklet. **Marks**

a) Solve $\cos^{-1} x = 2$, correct to 3 significant figures. 2

b) Divide $P(x) = x^3 + 2x + 4$ by $A(x) = x - 3$, and express your answer in the form $P(x) = A(x).Q(x) + R(x)$. 2

c) Prove $\cos\theta - \sin\theta \sin 2\theta = \cos\theta \cos 2\theta$. 2

d) The graphs of $y = f(x)$ and $y = g(x)$ are shown below. 3



Using the tear-off page at the back of this exam, sketch $y = f(x) \times g(x)$.

Question 8 (9 marks) Begin a new writing booklet. **Marks**

a) Consider the function $f(x) = \cos^{-1} 2x$.

i) Determine the equation of the inverse function, $f^{-1}(x)$. 1

ii) State the domain and range of $f^{-1}(x)$. 2

b) For a certain cubic polynomial, the following information is known: 1

$f(-5) = 0$

$f(0) = 0$

$f(3) = 0$

$f'(-2) = 0$

$f'(1) = 0.$

The domain of the polynomial is to be restricted so that its inverse is a function.

Suggest **one** possible restricted domain that would achieve this aim.

c) The displacement of a particle is given by $x = 18t - 3t^2 + 2$, where x is displacement in metres, and t is time in seconds.

i) Where is the particle initially? 1

ii) When and where is the particle stationary? 2

iii) How far does the particle move in the first 4 seconds? 2

Question 9 (9 marks) Begin a new writing booklet. **Marks**

a) Find the values of a and b, given $\sin ax - \sin bx = 2 \sin 3x \cos 7x$. 2

b) Let α, β, and γ be the roots of $2x^3 - 4x + 5 = 0$. Find, in simplest form:

i) $\alpha + \beta + \gamma$ 1

ii) $\alpha\beta + \beta\gamma + \gamma\alpha$ 1

iii) $\alpha\beta\gamma$ 1

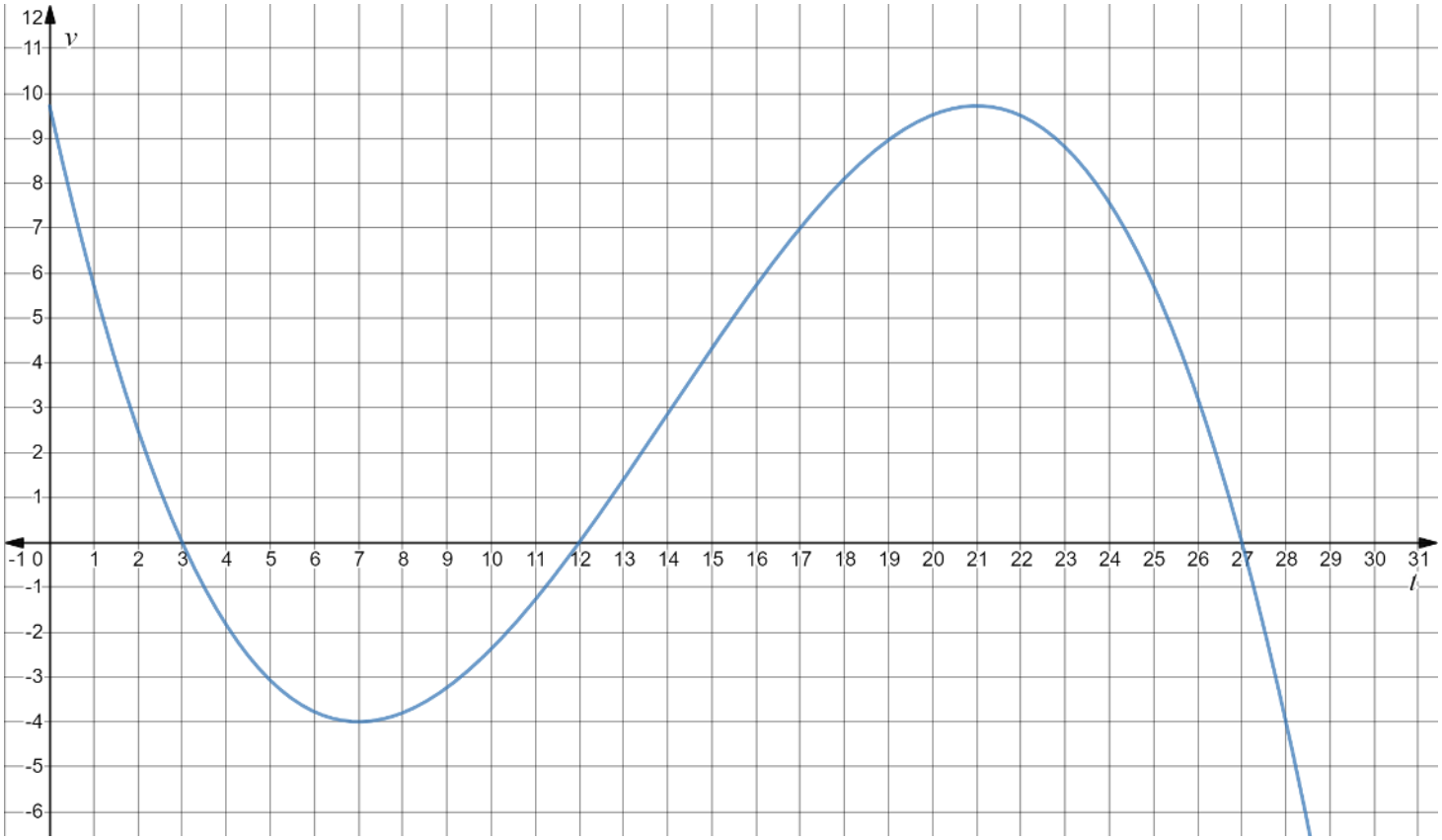
iv) $\frac{1}{\alpha\beta} + \frac{1}{\beta\gamma} + \frac{1}{\gamma\alpha}$ 2

v) $\alpha^3 + \beta^3 + \gamma^3$. 2

Question 10 (8 marks) Begin a new writing booklet. **Marks**

a) The **velocity** of a particle is shown below. 1

For what values of t is the acceleration of the particle positive?



b) Solve $x \geq \dfrac{3}{x+2}$. 3

c) Factorise $P(x) = x^4 + x^3 - 15x^2 - 9x + 54$, given it has a double root. 4

Express your answer in fully factored form.

Question 11 (10 marks) Begin a new writing booklet. **Marks**

a) Use the t-formulae to prove the identity $1 + \tan^2\theta = \sec^2\theta$. 3

b) Consider the following parametric equations: 4

$x = 5(\cos t) + 4$,

$y = 5(\sin t) - 3$.

By eliminating the parameter, find the Cartesian equation and describe the relationship geometrically, including all important features.

c) Find the exact value of $\tan 22.5°$ in simplest form. 3

Question 12 (9 marks) Begin a new writing booklet. **Marks**

a) Solve $\sin x - \sin^{-1} x = 0$. 1

b) University student Josh Martin has a large TikTok following from posting short videos explaining mathematical concepts. Unfortunately, he posts a video claiming that:

$$\frac{1 + \sin x}{n} = \frac{1 + \sin x}{n}$$
$$= 1 + \sin x$$
$$= 7$$

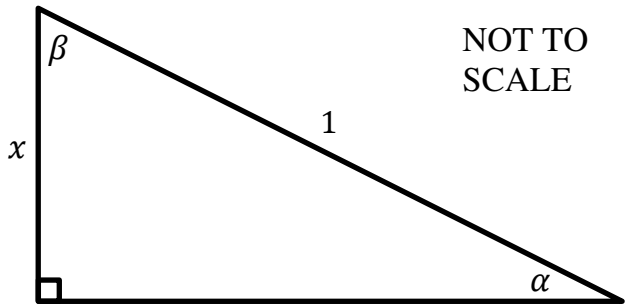
and starts to lose followers.

The number of followers he has is given by $F = t^3 - 10t^2 + t + 150$, where F is the number of followers in 1000s, and t is the number of days after his unfortunate post.

i) At what rate is he losing followers when $t = 1$, correct to the nearest follower? 2

ii) After how many days (correct to the nearest day) does his follower count start increasing again? 2

c) Consider the right-angled triangle below.



i) Use the triangle to find an expression for α in terms of x. 1

ii) By first finding a similar expression for β, solve $\sin^{-1} x - \cos^{-1} x = 0$. 3
Give your answer in exact surd form.

End of Examination

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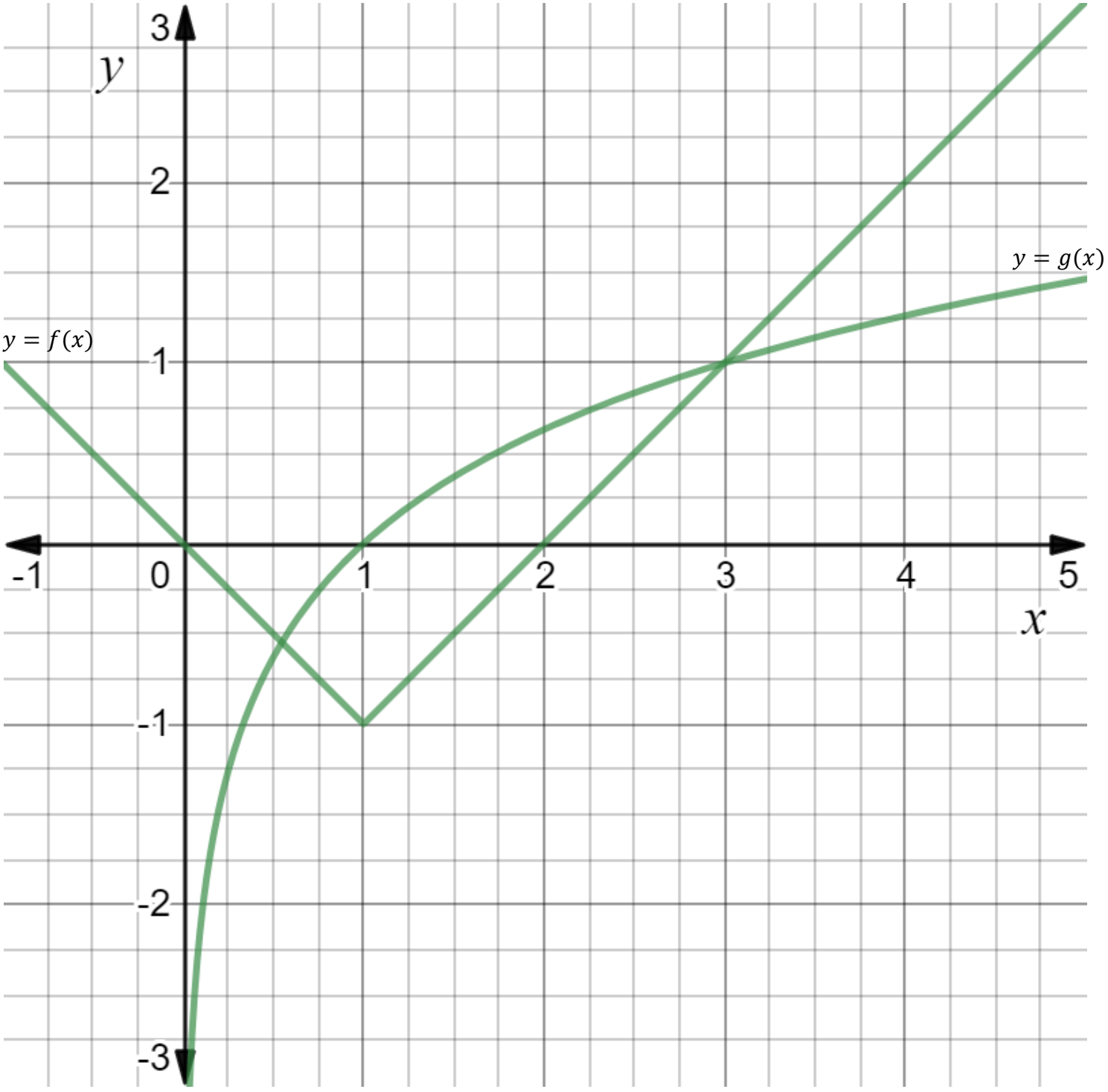
Name: _____

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Answer Sheet for Q7 d)

The graphs of $y = f(x)$ and $y = g(x)$ are shown below.

On the same axes, sketch $y = f(x) \times g(x)$.



Name: _____

Teacher:_____

Section I

Year 11

Mathematics Extension 1

End of Course Examination

2020

Multiple-choice Answer Sheet - Questions 1 – 6

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 this by writing the word *correct* and drawing an arrow as follows:

correct ↙

A ⊗ B ⊗ 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 ○
6. A ○ B ○ C ○ D ○