

**Paper 1 - CALCULATOR INACTIVE**

*Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written work. You are advised to show all working.*

**SECTION A**

*Answer all questions in the spaces provided.*

1. Solve the equation  $0 = (x + 2)^2 - 9$

(3)

2. Fully factor  $6x^2 + 3x - 18$ .

(3)

3. Determine the equation of the axis of symmetry of  $f(x) = -3(x + 4)(x - 9)$ .

(3)

4. Determine the range of the quadratic function  $f(x) = -\frac{1}{2}(x - 4)^2 + 8$ .

(3)

5. Given the quadratic function  $g(x) = 2x^2 - 6x + 3$ , determine the value of the discriminant and explain what this value tells you about the quadratic function.

(3)

6. Fadi would like to use the quadratic formula to find the roots of  $y = 3x(x + 2) + 2$ . Show/explain to Fadi whether or not this equation quadratic in the first place. Then, solve the equation.

(3)

7. Titus thinks that the function  $f(x) = -2(x + 1)(2 - x)$  has a minimum value. Show/explain to Titus how he can determine whether or not this is true. Finally, does this parabola have a minimum value or does it not?

(3)

**Section B**

*Do NOT write solutions on this page. Answer all questions on the answer sheets provided.*

1. The quadratic function  $T(m) = -m^2 + 14m - 45$  models the monthly temperatures of a scientific research station in Siberia, Russia, where  $T$  is the average daily temperature in  $^{\circ}\text{C}$  and  $m$  is the month of the year. In this model,  $m = 0$  represents the beginning of January (Jan 1<sup>st</sup>) and so  $m = 5.5$  would represent the middle of June (so around June 15<sup>th</sup>).

(10 marks)

- a. Use any suitable algebraic method to find the maximum value of  $T(m)$ .

(4)

- b. Use any suitable algebraic method in order to solve  $T(m) = -5$  and then interpret the meaning of your answer.

(3)

- c. State the domain for this function and explain your reasoning.

(3)

2. Find the intersection point(s) of  $f(x) = 2x - 2$  and  $g(x) = 2x^2 + 3x - 5$ .

(6 marks)

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**SECTION A**

*Answer all questions in the spaces provided.*

1. Solve the equation  $0 = (x - 3)^2 - 16$

(3)

2. Fully factor  $6x^2 + 8x - 8$ .

(3)

3. Determine the equation of the axis of symmetry of  $f(x) = -4(x + 3)(x - 11)$ .

(3)

4. Determine the **domain of the inverse** of the quadratic function  $f(x) = -\frac{1}{2}(x - 4)^2 + 8$ .

(3)

5. Given the quadratic function  $g(x) = 2x^2 - 3x + 6$ , determine the value of the discriminant and explain what this value tells you about the quadratic function.

(3)

6. Ziyad would like to use the quadratic formula to find the roots of  $y = -3x(x + 2) + 5$ . Show/explain to Ziyad whether or not this equation is quadratic in the first place. Then, solve the equation.

(3)

7. Tamer thinks that the function  $f(x) = -2(3 - x)(x + 4)$  has a minimum value. Show/explain to Tamer how he can determine whether or not this is true. Finally, does this parabola have a minimum value or does it not?

(3)

## Section B

*Do NOT write solutions on this page. Answer all questions on the answer sheets provided.*

1. The quadratic function  $T(m) = -m^2 + 14m - 45$  models the monthly temperatures of a scientific research station in Siberia, Russia, where  $T$  is the average daily temperature in  $^{\circ}\text{C}$  and  $m$  is the month of the year. Here  $m = 0$  represents the beginning of January (Jan 1<sup>st</sup>) and so  $m = 5.5$  would represent the middle of June (so around June 15<sup>th</sup>).

(7 marks)

- a. Use any suitable algebraic method in order to solve  $T(m) = -5$  and then interpret the meaning of your answer.

(3)

- b. State the domain for this function (**given the context of the problem**) and explain your reasoning.

(4)

2. Given the quadratic function,  $f(x) = 2x^2 - 8x + 5$ .

(9 marks)

- a. Write the equation in vertex form (HINT: use completing the square OR find the vertex first)

(3)

- b. List the transformations of the parent function.

(3)

- c. Write the equation of the inverse of this quadratic function.

(3)

3. Find the intersection point(s) of  $f(x) = -x^2 - 2x + 2$  and  $g(x) = 2x^2 + 3x$ .

(6 marks)

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**SECTION A**

*Answer all questions in the spaces provided.*

1. Given the following graph of a polynomial function with its y-intercept at the point (0,4), determine its equation. Leave your final answer in factored form.

(5 marks)

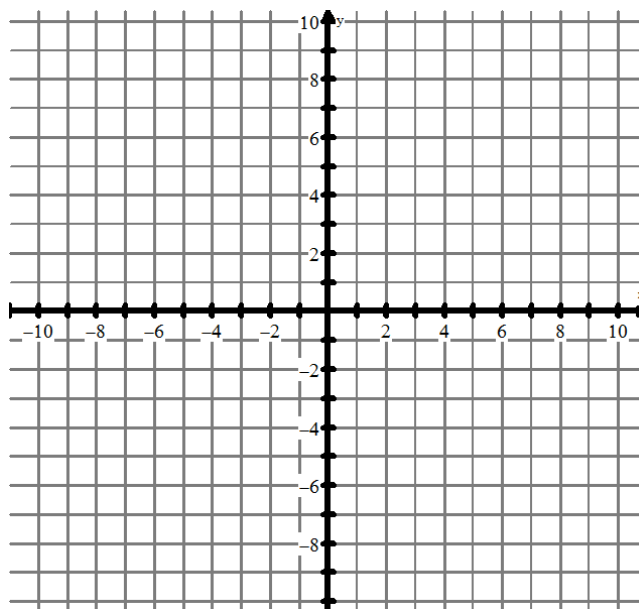


2. Evaluate  $P(2)$  when  $P(x) = x^4 - 2x^3 - x + 2$ . Based upon your value of  $P(2)$ , what is one conclusion can you make about the polynomial?  
(3 marks)
3. Determine the domain interval in which  $p(x) > 0$  if  $p(x) = -2(x + 3)(x - 1)(x + 5)$ .  
(4 marks)
4. Use synthetic division to divide  $x^3 + x - 14$  by  $x + 2$ . State the quotient and the remainder of the division.  
(4 marks)



5. On the grid provided, sketch the rational function  $r(x) = \frac{1}{x+4} + 5$  and label the asymptotes in your sketch and determine the value of the y-intercept as well.

(4 marks)



6. Knowing that  $x = -4$  is an  $x$ -intercept of the cubic function  $p(x) = 2x^3 + 11x^2 + 10x - 8$ , fully factor the polynomial. Once factored, state the values of the zeroes of  $p(x)$ .

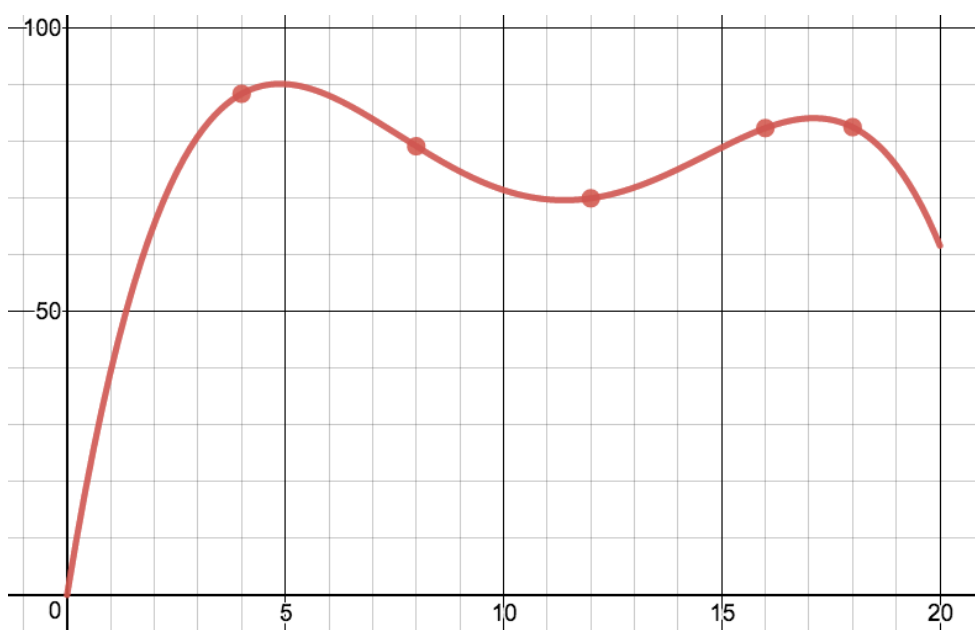
(6 marks)

## Section B

*Do NOT write solutions on this page. Answer all questions on the answer sheets provided.*

1. Here is a graph showing the relationship between Sarah's grade in IM3 and the number of weeks that have passed this semester (since the **start** of SEM 2). Use the graph to help determine the following. (10 marks)
  - a. Interpret the meaning of  $P(8) = 79$ , given the context of this problem. (1)
  - b. Estimate Sarah's maximum mark and when it occurred. (2)
  - c. Estimate the domain interval(s) in which her marks are increasing. (2)
  - d. For how many weeks has Sarah's mark been over 80%? (2)
  - e. If the semester ends at 20 weeks, what is Sarah's final mark in IM3? (1)
  - f. **MULTIPLE CHOICE QUESTION**: Pick one of the following options and explain WHY you selected this option. To write an equation for this polynomial, you would choose to use: (2)

I. a positive quartic	III. a positive quintic	V. a negative quintic
II. a negative cubic	IV. a negative quartic	VI. a positive cubic



2. Here is a rational function  $r(x) = \frac{3x+1}{x-2}$  and a graph of the function. Determine:

(9 marks)

a. The domain and range of the function.

(2)

b. Determine the x-intercept of the function

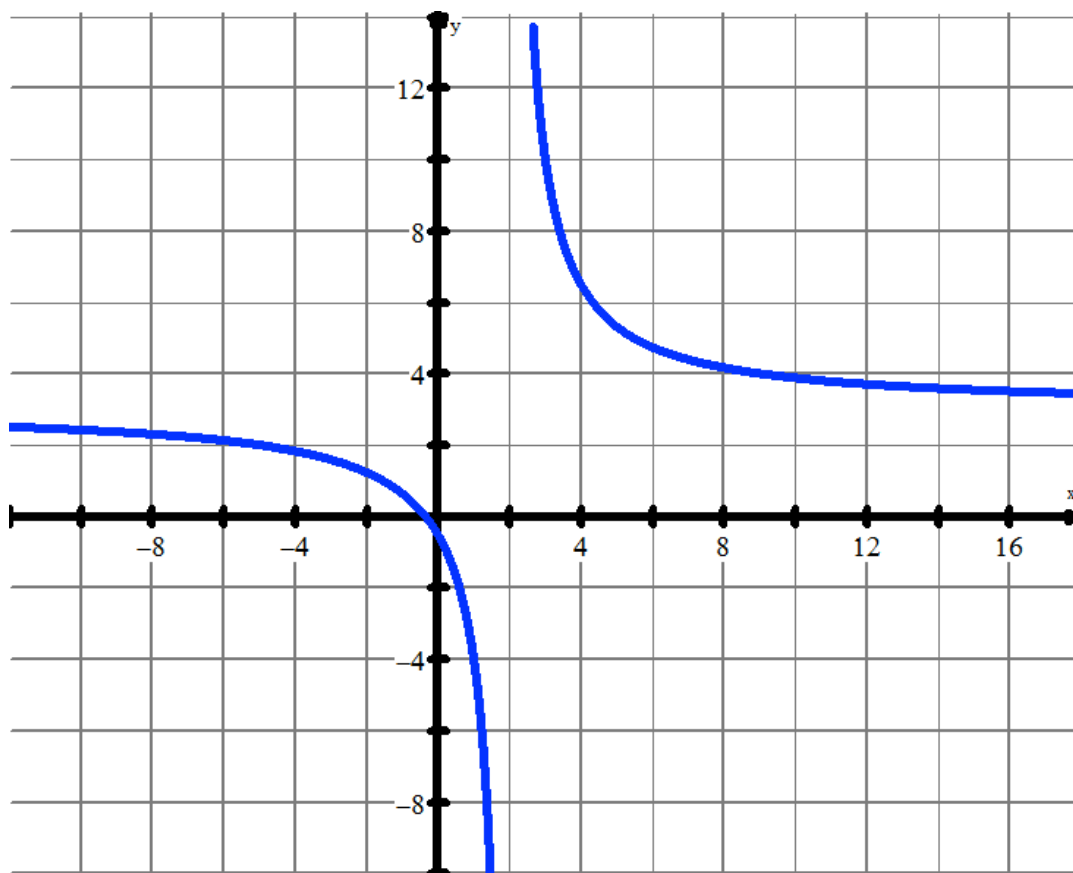
(2)

c. State the end behaviours of the function.

(2)

d. Rewrite the equation of the rational function in transformational form, as  $r(x) = \frac{A}{x-2} + B$

(3)



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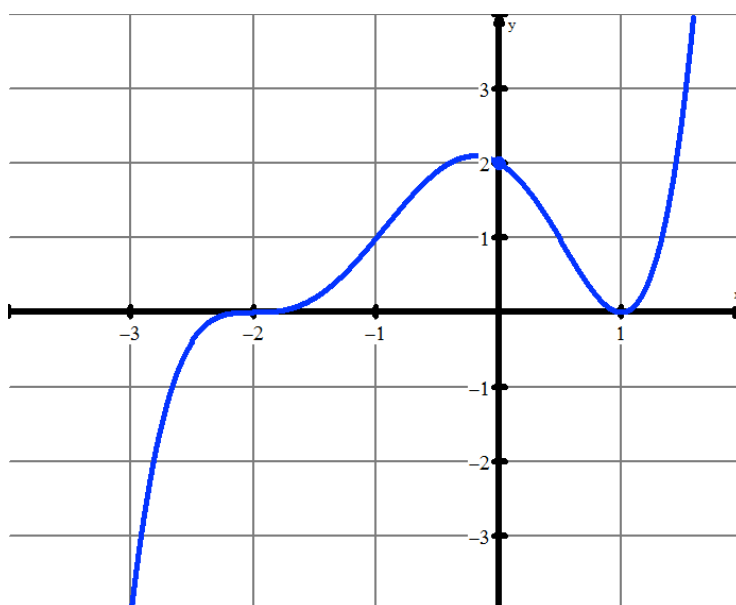
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**SECTION A**

*Answer all questions in the spaces provided.*

1. Given the following graph of a polynomial function with its y-intercept at (0,2), determine its equation. Leave your final answer in factored form.

(5 marks)

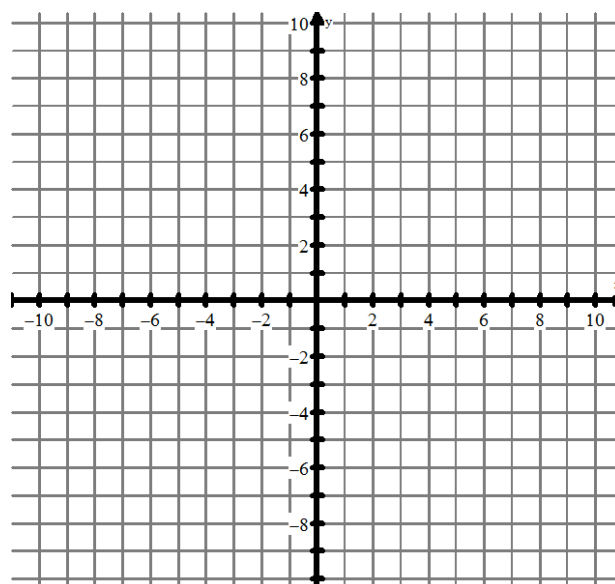


2. Determine the remainder when  $P(x) = x^3 - x^2 + 2x + 3$  is divided by  $x - 2$ . Hence, is  $x - 2$  a factor of the polynomial? Why or why not?

(4 marks)

3. Sketch a graph of the parent function  $f(x) = \frac{1}{x}$  and label the points  $(1,1)$  and  $(-1,-1)$ . First, vertically stretch the function by a factor of two. Now, translate this graph 3 units to the left and 4 units down. Show a sketch of this new function.

(4 marks)



4. Determine the domain interval in which  $p(x) < 0$  if  $p(x) = -2(x + 3)(x - 1)(x + 5)$ . (A sketch may be helpful)

(4 marks)

5. Knowing that  $x = -5$  is an  $x$ -intercept of the cubic function  $p(x) = 2x^3 + 11x^2 - x - 30$ , fully factor the polynomial. Once factored, state the values of the zeroes of  $p(x)$ .

(6 marks)

## Section B

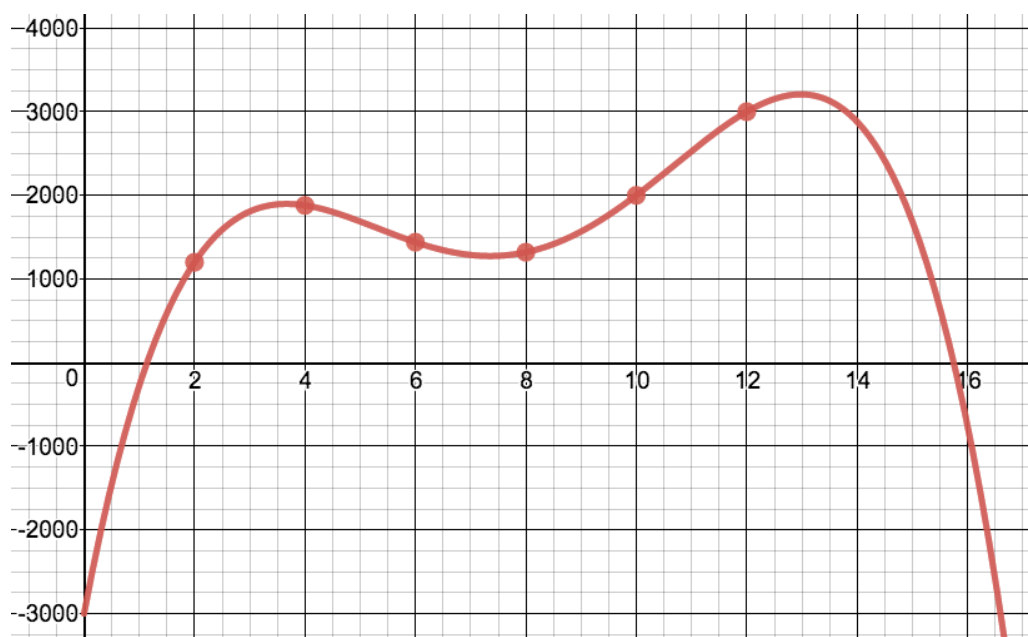
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1. My brother has a carpentry business and his profits from January 2014 to April 2015 are modeled on the graph below. His profits are given in dollars and  $x$  refers the month of the year (using  $x = 0$  to represent January) Use the graph to determine the following.

(10 marks)

- Interpret the meaning of  $P(8) = 1320$ , given the context of this problem. (1)
- Estimate when the business had its maximum profits and what the maximum profits were. (2)
- The domain interval in which the profits are increasing. (2)
- My brother will hire an apprentice in months when his business earns at least \$2,000 per month. For how long will an apprentice be employed? (2)
- Suggest a range for the model and explain why you made this choice. (1)
- MULTIPLE CHOICE QUESTION**: Pick one of the following options and explain WHY you selected this option. To write an equation for this polynomial, you would choose to use: (2)

I. a positive quartic	III. a positive quintic	V. a negative quintic
II. a negative cubic	IV. a negative quartic	VI. a positive cubic



2. Here is a rational function  $r(x) = \frac{9 - 6x}{2x - 6}$  and a sketch of the function. Determine:

(11 marks)

- a. the domain and range of the function.

(2)

- b. the x-intercept of the function. Hence, solve the inequality  $r(x) > 0$ .

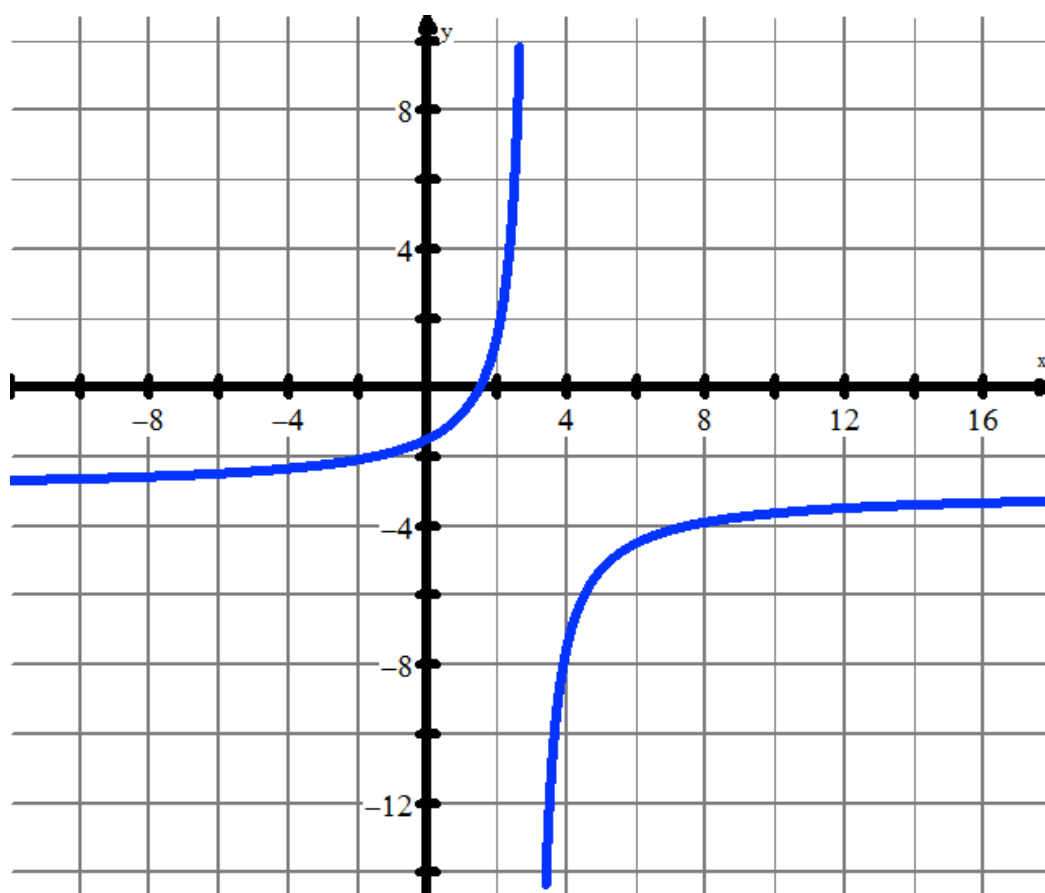
(4)

- c. The end behaviour of the function.

(2)

- d. Rewrite the equation of the rational function in transformational form, as  $r(x) = \frac{A}{2x - 6} + B$ .

(3)





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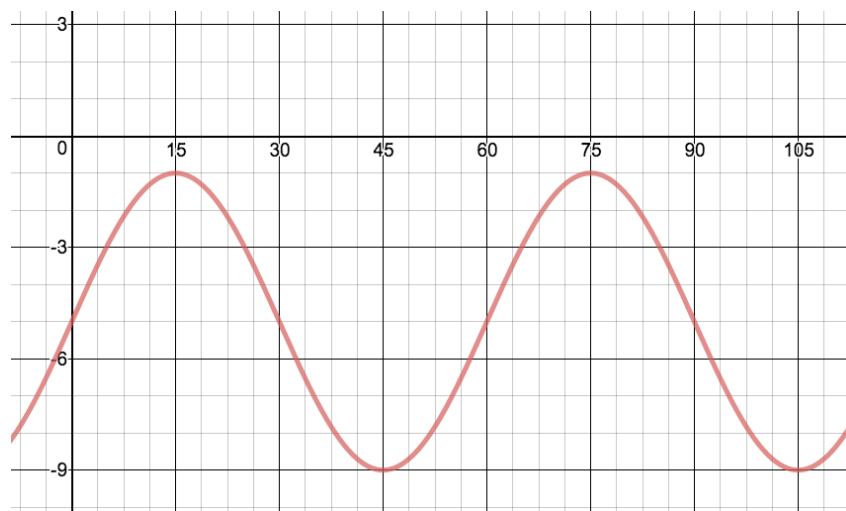
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**SECTION A**

Answer all questions in the spaces provided.

1. The graph of the function  $y = A\sin(kx) + D$  is given below.

(7 marks)



- a. Determine the values of  $A$ ,  $k$ , and  $D$  and hence, write the equation of this function.

(3)

- b. List the transformations that were applied to the parent function  $y = \sin(x)$ .

(2)

- c. This function could also be written using a cosine function. Determine an equation for this function using cosine rather than sine.

(1)

2. In this question, you will work with a our special right triangles.

(7 marks)

a. Draw and correctly label the angles and sides of the 30 – 60 – 90 triangle. (1)

b. You will now use the special triangles to evaluate two trigonometric expressions:

i. Evaluate  $2(\cos 30^\circ)^2 - 1$ .

(2)

ii. State the value of  $\cos(60^\circ)$

(1)

iii. What conclusion could you make about the equation  $\cos(2x) = 2(\cos x)^2 - 1$  ?  
Explain your reasoning.

(1)

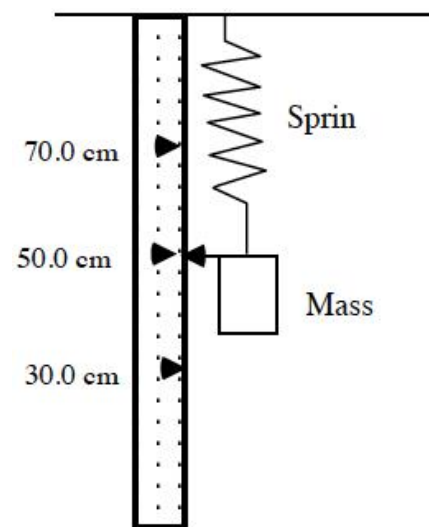
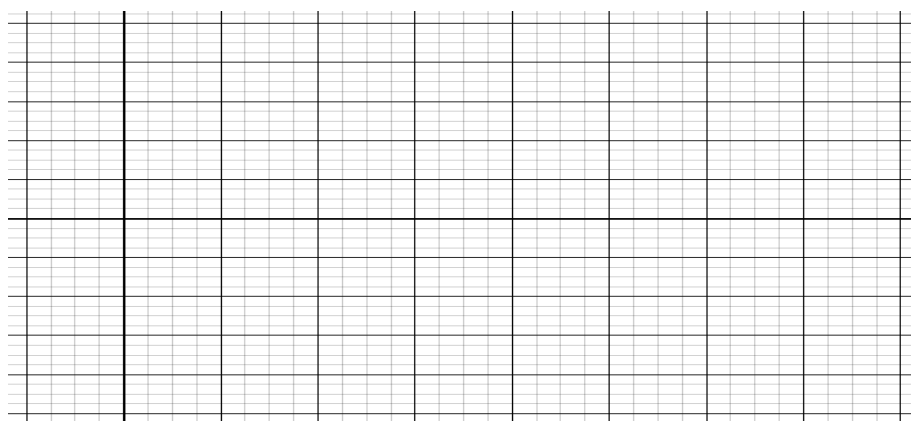
c. Solve the equation  $\tan(x) = \frac{1}{\sqrt{3}}$  on the domain of  $-360^\circ \leq x \leq 360^\circ$ .

(2)

3. Mr D is performing an experiment, wherein he is investigating the motion of a vertical oscillator (see diagram included). A data table is included from his experiment, where  $h$  is the height above the ground, measured in centimeters, and  $t$  is time in seconds

Time (sec)	0	2.25	4.5	6.75	9	11.25	13.5
Height (cm)	30	50	70	50	30	50	70

- a. Graph the data on the grid provided. (2)



- b. Determine an equation for the oscillating motion of the mass in the form of  $h(t) = A \cos(kt) + D$ , where  $h$  is height above the ground, measured in centimeters, and  $t$  is time in seconds.

(3)

Mr S now wonders if the **increasing the weight of the mass** affects the period of the oscillation. He repeats the experiment with a heavier weight and wishes to model the height-time relationship of his new set up for the oscillator.

- c. If the oscillator now takes **MORE time** to complete a complete cycle, write a NEW equation in the form of  $h(t) = P \cos(Qt) + R$ , explaining your reasoning for the values for  $P$ ,  $Q$  and  $R$  (HINT: which may or may not change???)

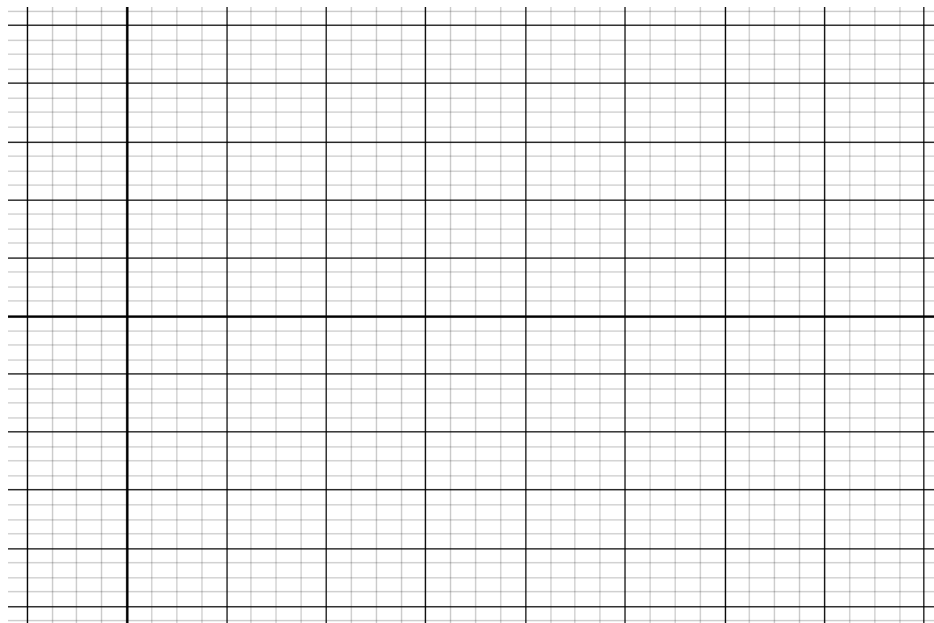
(2)

4. Given the function  $f(x) = 3\cos(9x) + 5$ , determine the:

(7 marks)

- a. Graph two cycles, labelling each maximum and minimum points in these two cycles.

(3)



- b. Explain how would you use your graph to find the value of  $f(1240)$ . What is the value of  $f(1240)$ ?

(2)

- c. Mr S is trying to solve the equation  $2 = 3\cos(9x) + 5$  and he suggests that  $x = 430^\circ$  is one answer. Explain how you would use your graph to decide whether or not Mr S is correct.

(2)

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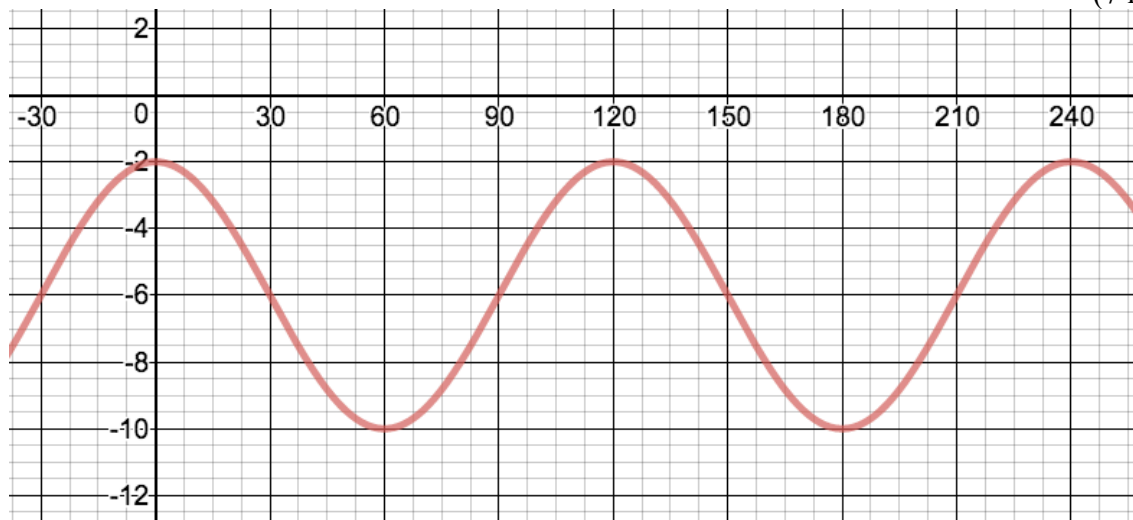
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**SECTION A**

Answer all questions in the spaces provided.

1. The graph of the function  $y = A\cos(kx) + D$  is given below.

(7 marks)



- a. Determine the values of  $A$ ,  $k$ , and  $D$  and hence, write the equation of this function.

(3)

- b. List the transformations that were applied to the parent function  $y = \cos(x)$ .

(3)

- c. This function could also be written using a sine function. Determine an equation for this function using sine rather than cosine.

(1)

2. In this question, you will work with a  $30^\circ - 60^\circ - 90^\circ$  right triangle and angles in standard position.

(8 marks)

- a. Draw and correctly label the angles and sides of this special triangle.

(1)

- b. Use your knowledge of this triangle and angles in standard position, determine the cosine ratio of a  $-150^\circ$  angle.

(3)

- c. The equation  $\sin(x) = \frac{\sqrt{3}}{2}$  had 4 solutions for  $x$  on the domain of  $-360^\circ \leq x \leq 360^\circ$ . Find these 4 solutions.

(3)

- d. Mr S. draws a  $30^\circ - 60^\circ - 90^\circ$  right triangle that has an area of  $8\sqrt{3}$ . Determine the lengths of the sides of Mr. S's triangle.

(1)

3. A Ferris wheel has a radius of 10 meters and the bottom of the wheel is 3 meters above the ground. The wheel rotates at a constant speed, and takes 100 seconds to complete one revolution and a rider gets on to the Ferris wheel when the wheel is at its lowest height.

(8 marks)

- a. Write the equation that models the relationship between a rider's height above the ground and time on this Ferris wheel.

(3)

- b. Using your equation, or using any other strategy, answer the following questions about your ride on this Ferris wheel:

(5)

- i. At what times in the first 5 minutes of your ride will you reach the maximum height of the Ferris wheel?

- ii. Mr D. thinks that his height above the ground at  $t = 8$  minutes will be 13 meters. Show/Explain whether or not this is true.

4. Given the equation  $y = 3\sin(6x) + 5$ , determine the:

(6 marks)

a. The amplitude. (1)

b. The equation of the sinusoidal axis (axis of the curve or equilibrium axis.) (1)

c. Graph two cycles, labelling each maximum and minimum points in these two cycles. (4)

