



STUDENT'S NAME \_\_\_\_\_

TEACHER'S NAME \_\_\_\_\_

**DO NOT OPEN THIS EXAMINATION PAPER UNTIL  
YOU ARE TOLD BY THE SUPERVISOR TO BEGIN**

MIDYEAR EXAMINATION  
**MATHEMATICS 3204**

January 24, 2012

Value: 100 Marks

Time: 3 hours

***General Instructions***

1. Students are required to do **ALL** items.
2. The examination consists of the following parts:  
**PART I:** Selected Response Value: 50%  
**PART II:** Constructed Response Value: 50%
3. Scientific and graphing calculators may be used.
4. Answers to **PART I** items are to be shaded on the computer scorable answer sheet. If a second sheet is provided for **PART I** items, letters should be clearly written and this sheet ***stapled to the front*** of the examination paper.
5. For **PART II** items, students are reminded to show all necessary steps and calculations as credit may be given for incomplete or for partially correct solutions. Correct answers without calculations will not merit full marks.

***Student Checklist***

***The following items are your responsibility. Please ensure that they are completed.***

Check that you are doing the correct exam.

Write your name on the top of this page and on any answer sheet.

Check that the bubble sheet is adequately shaded.

Check this exam to ensure that there are no missing pages.

At the end of the examination period check that you have completed or at least attempted **ALL** items.

Student's Name: \_\_\_\_\_

Teacher's Name: \_\_\_\_\_

### Teacher Grading Sheet (PART I)

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|-----------|-----------|
| 1. _____  | 26. _____ |
| 2. _____  | 27. _____ |
| 3. _____  | 28. _____ |
| 4. _____  | 29. _____ |
| 5. _____  | 30. _____ |
| 6. _____  | 31. _____ |
| 7. _____  | 32. _____ |
| 8. _____  | 33. _____ |
| 9. _____  | 34. _____ |
| 10. _____ | 35. _____ |
| 11. _____ | 36. _____ |
| 12. _____ | 37. _____ |
| 13. _____ | 38. _____ |
| 14. _____ | 39. _____ |
| 15. _____ | 40. _____ |
| 16. _____ | 41. _____ |
| 17. _____ | 42. _____ |
| 18. _____ | 43. _____ |
| 19. _____ | 44. _____ |
| 20. _____ | 45. _____ |
| 21. _____ | 46. _____ |
| 22. _____ | 47. _____ |
| 23. _____ | 48. _____ |
| 24. _____ | 49. _____ |
| 25. _____ | 50. _____ |

## Part 1

Total Value: 50%

Answer all items. Shade the letter of the correct answer on the computer scorable answer sheet.

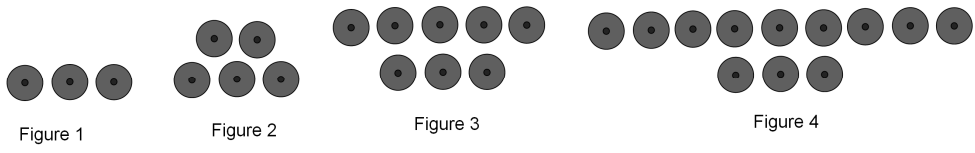
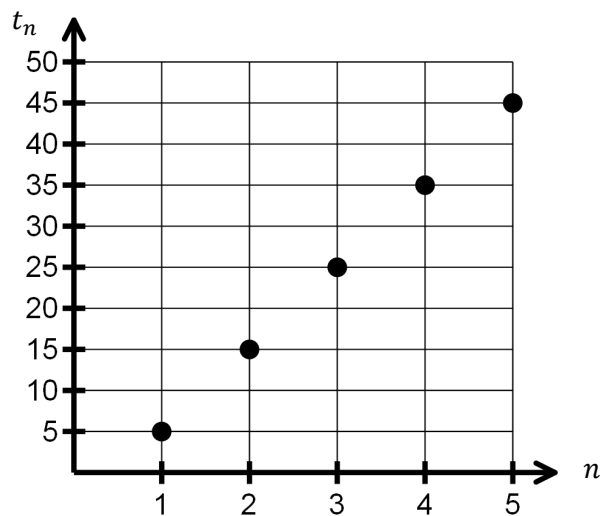
- Which is a cubic sequence?
  - $\{3, 6, 9, 12, 15, \dots\}$
  - $\{3, 9, 27, 81, 243, \dots\}$
  - $\{4, 7, 12, 19, 28, \dots\}$
  - $\{4, 11, 30, 67, 128, \dots\}$
- What is the first level difference of the sequence represented by  $t_n = 5 - 3n$ ?
  - 8
  - 3
  - 2
  - 5
- Which equation is represented by the sequence  $\{8, 2, -4, -10, -16, \dots\}$ ?
  - $t_n = -6n + 8$
  - $t_n = -6n + 14$
  - $t_n = 6n + 8$
  - $t_n = 6n + 14$
- What type of function best models the sequence of dots?

Figure 1      Figure 2      Figure 3      Figure 4

  - cubic
  - exponential
  - linear
  - quadratic

5. Which equation represents the graph?

- (A)  $t_n = 5n - 10$
- (B)  $t_n = 5n + 10$
- (C)  $t_n = 10n - 5$
- (D)  $t_n = 10n + 5$



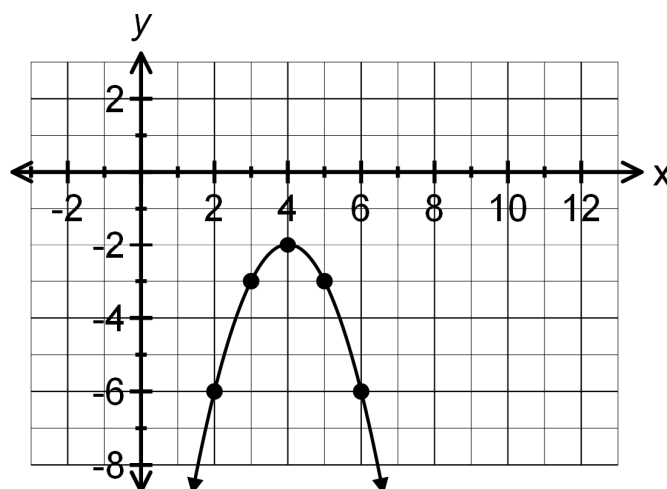
6. Which type of function is shown?

$x$	1	2	3	4	5
$y$	0	2	6	12	20

- (A) cubic
  - (B) exponential
  - (C) linear
  - (D) quadratic
7. The path of a rocket shot in the air is given by  $h(t) = -5t^2 + 20t$  where  $t$  is the time in seconds and  $h(t)$  is the height in metres. At what time, in seconds, does the rocket reach its maximum height?
- (A) 0
  - (B) 2
  - (C) 4
  - (D) 5

8. Which equation represents the graph?

- (A)  $-(y - 2) = (x + 4)^2$
- (B)  $-(y + 2) = (x - 4)^2$
- (C)  $y - 2 = (x + 4)^2$
- (D)  $y + 2 = (x - 4)^2$



9. What is the range of  $(y - 10) = (x + 20)^2$ ?

(A)  $\{y|y \leq -10, y \in R\}$

(B)  $\{y|y \geq -10, y \in R\}$

(C)  $\{y|y \leq 10, y \in R\}$

(D)  $\{y|y \geq 10, y \in R\}$

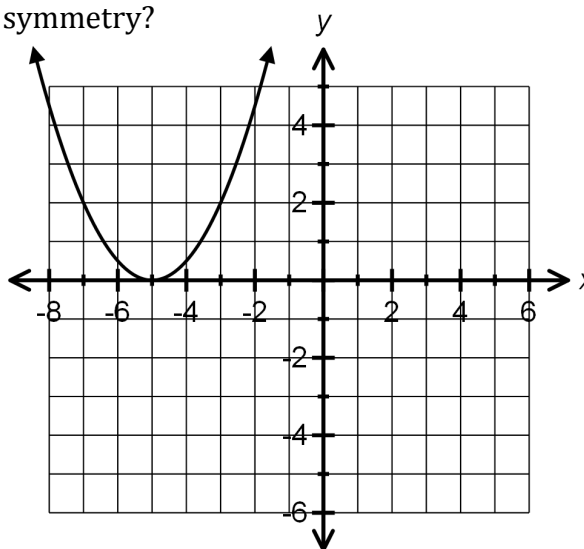
10. What is the equation of the axis of symmetry?

(A)  $x = -5$

(B)  $x = 5$

(C)  $y = -5$

(D)  $y = 5$



11. What is the vertical stretch factor for  $-\frac{1}{3}(y + 1) = (x - 5)^2$ ?

(A)  $-3$

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

(C)  $\frac{1}{3}$

(D)  $3$

12. What is the mapping rule that will transform  $y = x^2$  into the

equation  $\frac{1}{4}(y + 8) = (x - 6)^2$ ?

(A)  $(x, y) \rightarrow (x - 6, \frac{1}{4}y + 8)$

(B)  $(x, y) \rightarrow (x - 6, 4y + 8)$

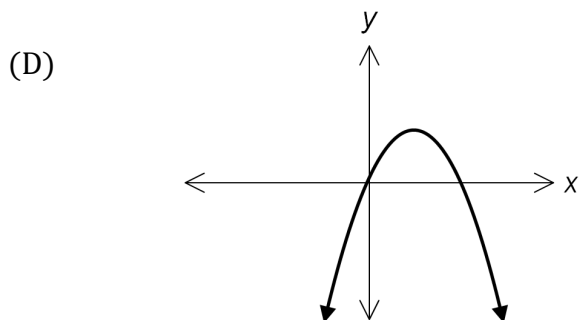
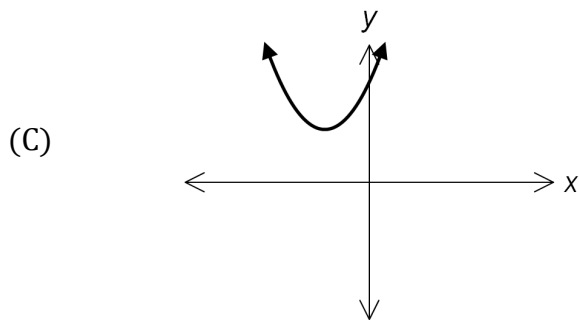
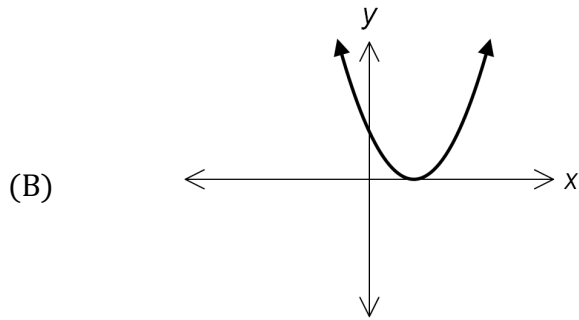
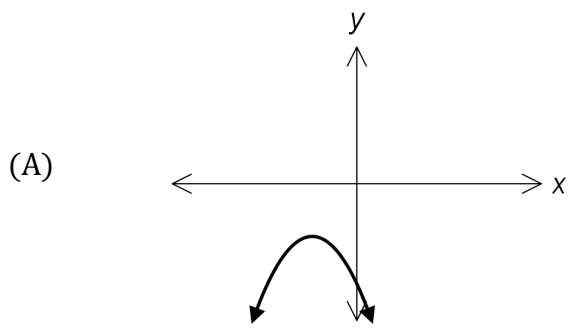
(C)  $(x, y) \rightarrow (x + 6, \frac{1}{4}y - 8)$

(D)  $(x, y) \rightarrow (x + 6, 4y - 8)$

13. What is the general form of  $y = 4(x + 1)^2 + 2$ ?
- (A)  $-4(y - 2) = (x + 1)^2$
- (B)  $\frac{1}{4}(y - 2) = (x + 1)^2$
- (C)  $y = 4x^2 + 4x + 6$
- (D)  $y = 4x^2 + 8x + 6$
14. What is the y-intercept of the graph of  $y = 5(x - 3)^2 + 10$ ?
- (A) 10
- (B) 15
- (C) 19
- (D) 55
15. What value of  $c$  makes the expression  $x^2 - 8x + c$  a perfect square trinomial?
- (A) -16
- (B) -4
- (C) 16
- (D) 64
16. What is the horizontal translation if  $y = x^2$  is transformed to  $y = (x + 9)^2 + 12$ ?
- (A) 12 units left
- (B) 9 units left
- (C) 9 units right
- (D) 12 units right
17. What is the transformational form of  $y = 3(x - 5)^2 + 7$ ?
- (A)  $\frac{1}{3}(y - 7) = (x - 5)^2$
- (B)  $3(y - 7) = (x - 5)^2$
- (C)  $y = 3x^2 - 30x + 82$
- (D)  $y = 3x^2 - 68$

18. Which equation represents the transformation of  $y = x^2$ , under the mapping rule  $(x, y) \rightarrow (x + 8, 3y)$ ?
- (A)  $\frac{1}{3}y = (x - 8)^2$
- (B)  $\frac{1}{3}y = (x + 8)^2$
- (C)  $3y = (x - 8)^2$
- (D)  $3y = (x + 8)^2$
19. What are the roots of  $x^2 + 12 = 0$ ?
- (A)  $x = \pm 2\sqrt{3}$
- (B)  $x = \pm 3\sqrt{2}$
- (C)  $x = \pm 2i\sqrt{3}$
- (D)  $x = \pm 3i\sqrt{2}$
20. What are the zeros of  $y = x^2 - 3x - 18$ ?
- (A)  $x = -3, x = -6$
- (B)  $x = -3, x = 6$
- (C)  $x = 3, x = -6$
- (D)  $x = 3, x = 6$
21. What are the x-intercepts of the graph of  $y = 2(x - 15)(x + 3)$ ?
- (A)  $x = -15, x = 3$
- (B)  $x = -3, x = 15$
- (C)  $x = -2, x = -3, x = 15$
- (D)  $x = 2, x = -15, x = 3$

22. The discriminant of a quadratic function is greater than zero. Which is the correct graph for the function?

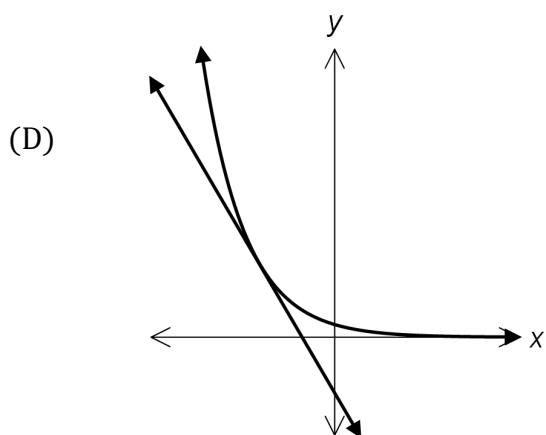
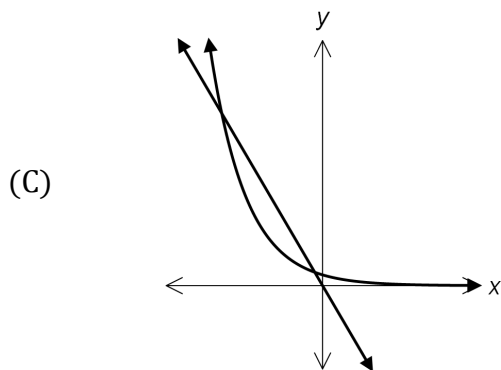
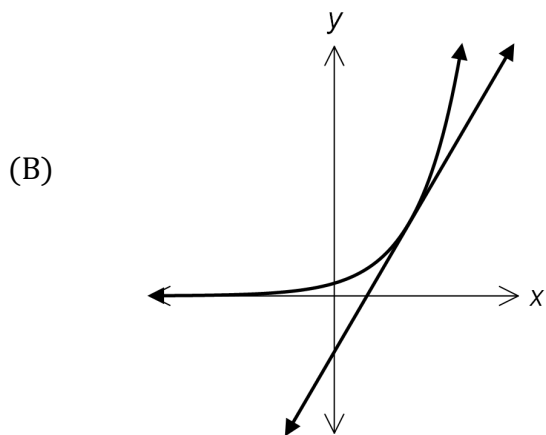
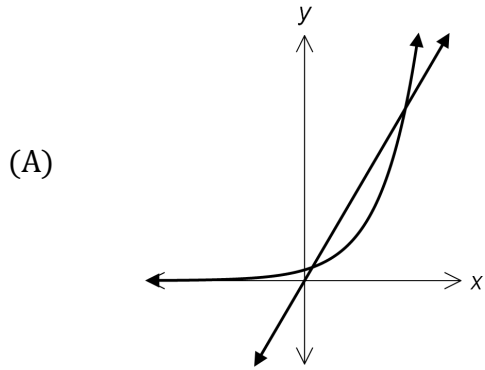


23. What is the value of the discriminant of  $y = 4x^2 - 6x + 2$ ?
- (A) 2  
(B) 4  
(C) 8  
(D) 16



24. For what value of  $k$  does  $-5x^2 + 4x + k = 0$  have real and equal roots?
- (A)  $k < -\frac{4}{5}$
  - (B)  $k = -\frac{4}{5}$
  - (C)  $k = \frac{4}{5}$
  - (D)  $k > \frac{4}{5}$
25. The vertex of a quadratic function is  $(-5, 2)$  and its graph opens upward. What is the nature of the roots?
- (A) imaginary and equal
  - (B) imaginary and unequal
  - (C) real and equal
  - (D) real and unequal
26. What is the vertex of the function  $y = 3x^2 + 12x + 19$ ?
- (A)  $(-4, 19)$
  - (B)  $(-2, 7)$
  - (C)  $(2, 55)$
  - (D)  $(4, 115)$
27. What is the simplest form of  $\frac{24 \pm \sqrt{-32}}{4}$ ?
- (A)  $6 \pm i$
  - (B)  $6 \pm 2i$
  - (C)  $6 \pm i\sqrt{2}$
  - (D)  $6 \pm 2i\sqrt{2}$

28. Which illustrates a positive average rate of change?

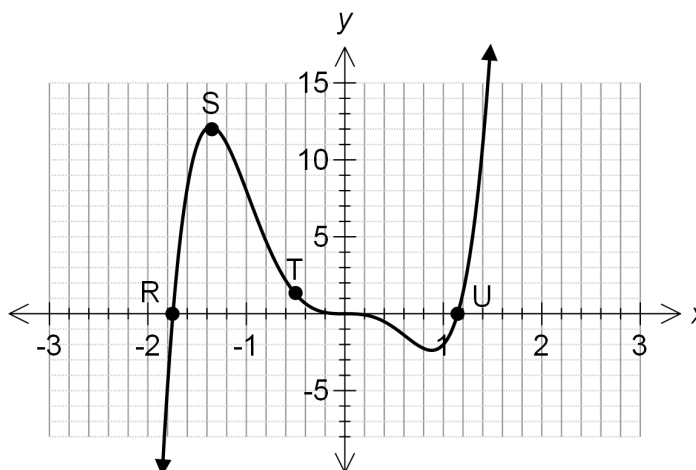


29. For the first five months of 2007, Environment Canada recorded the total accumulation of snowfall in St. Anthony.

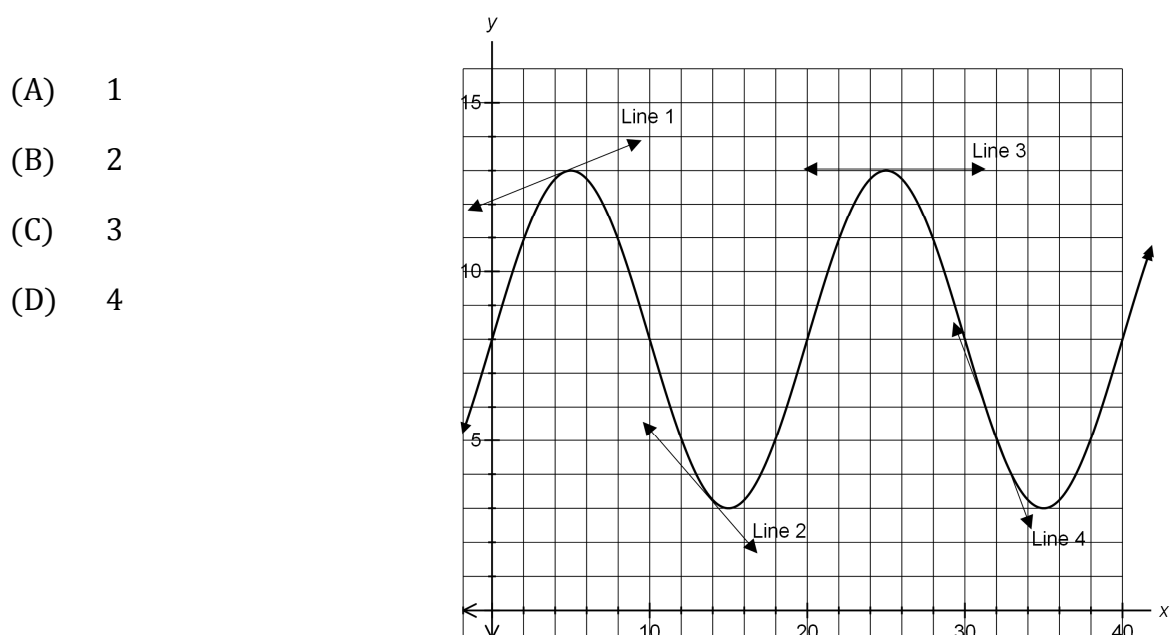
Month	1	2	3	4	5
Amount of Snow ( <i>cm</i> )	138.5	93.9	61.0	15.4	12.6

Calculate the average rate of change in snowfall amounts, in *cm/month*, between the 1<sup>st</sup> and 5<sup>th</sup> months.

- (A)  $-31.475$   
 (B)  $-25.18$   
 (C)  $25.18$   
 (D)  $31.475$
30. At what point could a tangent be drawn to best indicate an instantaneous rate of change of zero?



- (A)  $R$   
 (B)  $S$   
 (C)  $T$   
 (D)  $U$
31. Which tangent line illustrates the greatest instantaneous rate of change?



- (A) 1  
 (B) 2  
 (C) 3  
 (D) 4

32. Which situation is best modelled by an exponential equation?

- (A) Shooting an arrow at a target
- (B) Riding the waves in a wave pool
- (C) A population of bacteria doubling over time
- (D) Adding \$2 each week to your piggybank

33. If  $f(x) = \left(\frac{1}{64}\right)^{-\frac{x}{2}}$ , what is the value of  $f(3)$ ?

- (A)  $\frac{1}{512}$
- (B)  $\frac{1}{16}$
- (C) 16
- (D) 512

34. What is the range of  $y = 3(2)^x + 4$ ?

- (A)  $\{y|y < 4, y \in R\}$
- (B)  $\{y|y \leq 4, y \in R\}$
- (C)  $\{y|y > 4, y \in R\}$
- (D)  $\{y|y \geq 4, y \in R\}$

35. What type of function is represented by the table?

$x$	1	2	3	4	5
$y$	6	18	54	162	486

- (A) cubic
- (B) exponential
- (C) linear
- (D) quadratic

36. Which describes the function  $= 2\left(\frac{1}{3}\right)^x - 4$ ?

- (A) exponential decay, horizontal asymptote  $-4$
- (B) exponential decay, horizontal asymptote 4
- (C) exponential growth, horizontal asymptote  $-4$
- (D) exponential growth, horizontal asymptote 4

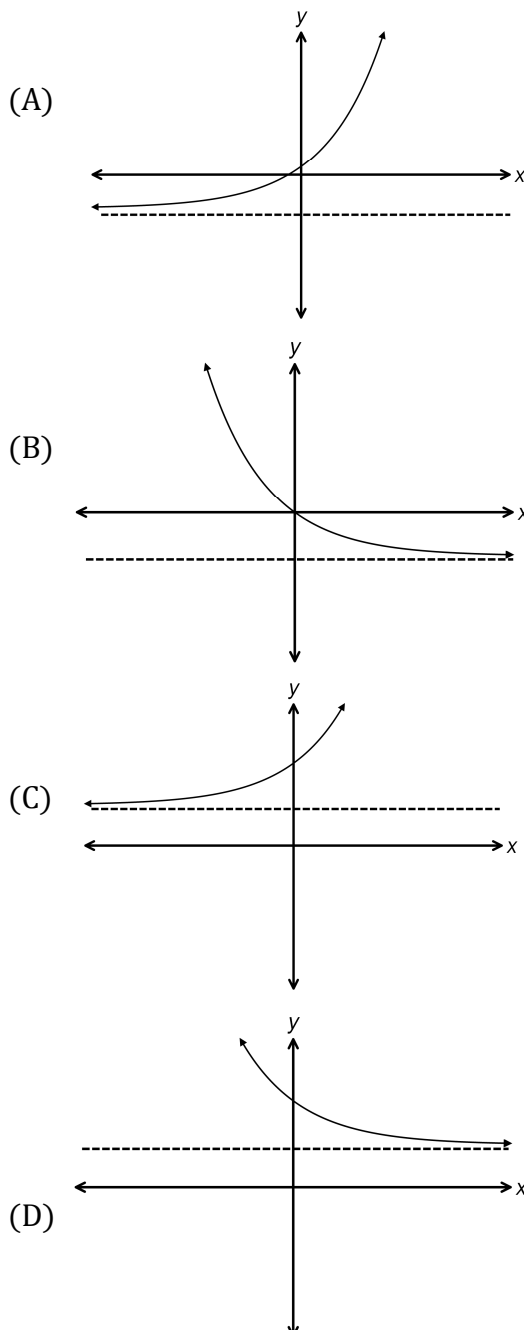
37. The function  $T = 125(0.8)^m + 12$  represents a car engine cooling once it has been shut off. If  $T$  is the engine's temperature in degrees Celsius after  $m$  minutes, what is the initial temperature of the car engine?

- (A) 112
- (B) 113
- (C) 125
- (D) 137

38. Which represents a geometric sequence?

- (A)  $\{2, 2 + 3, 2 + 3 + 3, 2 + 3 + 3 + 3, \dots\}$
- (B)  $\{2(1), 2(2), 2(3), 2(4), \dots\}$
- (C)  $\{2 + 2^1, 2 + 2^2, 2 + 2^3, 2 + 2^4, \dots\}$
- (D)  $\{2(3)^1, 2(3)^2, 2(3)^3, 2(3)^4, \dots\}$

39. Which represents  $y = 3^x + k$ , where  $k > 0$ ?



40. Evaluate:  $\left[\left(\frac{1}{9}\right)^{-1} - \left(\frac{1}{3}\right)^0\right]^{-2}$

(A)  $-\frac{80}{81}$

(B)  $-\frac{17}{18}$

(C)  $\frac{1}{81}$

(D)  $\frac{1}{64}$

41. What is the equation of the horizontal asymptote of  $y = 4(2)^x - 3$ ?

(A)  $x = -3$

(B)  $x = 3$

(C)  $y = -3$

(D)  $y = 3$

42. Which function models the table of values?

$x$	0	1	2	3
$y$	3	6	12	24

(A)  $y = 2(3)^x$

(B)  $y = 3(2)^x$

(C)  $y = 2(3)^{\frac{x}{3}}$

(D)  $y = 3(2)^{\frac{x}{3}}$

43. A population of dragonflies quadruples every 3 days. If there are 200 initially, which equation models this situation?

(A)  $y = 200(4)^{\frac{x}{3}}$

(B)  $y = 200(4)^{\frac{3}{x}}$

(C)  $y = 200(3)^{\frac{x}{4}}$

(D)  $y = 200(3)^{\frac{4}{x}}$

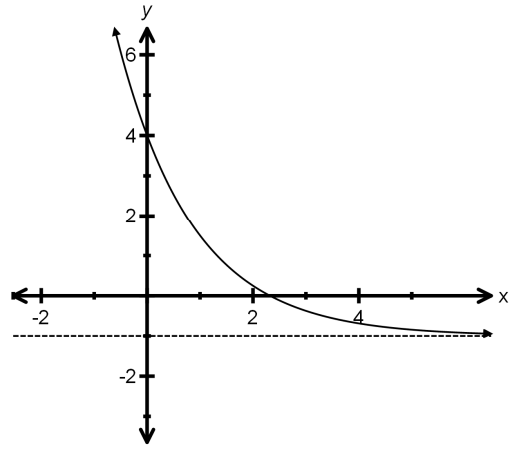
44. Which equation represents the graph?

(A)  $y = 5\left(\frac{1}{2}\right)^x - 1$

(B)  $y = 5\left(\frac{1}{2}\right)^x + 1$

(C)  $y = 5(2)^x - 1$

(D)  $y = 5(2)^x + 1$



45. Which function models a situation where a car valued at \$20 000 depreciates by 3% annually?

(A)  $y = 20000(0.03)^x$

(B)  $y = 20000(0.7)^x$

(C)  $y = 20000(0.97)^x$

(D)  $y = 20000(1.03)^x$

46. Simplify:  $\frac{(8x^3)^2}{8x^{-4}}$

(A)  $x^2$

(B)  $x^{10}$

(C)  $8x^2$

(D)  $8x^{10}$

47. Which function produces a decay curve?

(A)  $y = -\frac{1}{2}(3)^x$

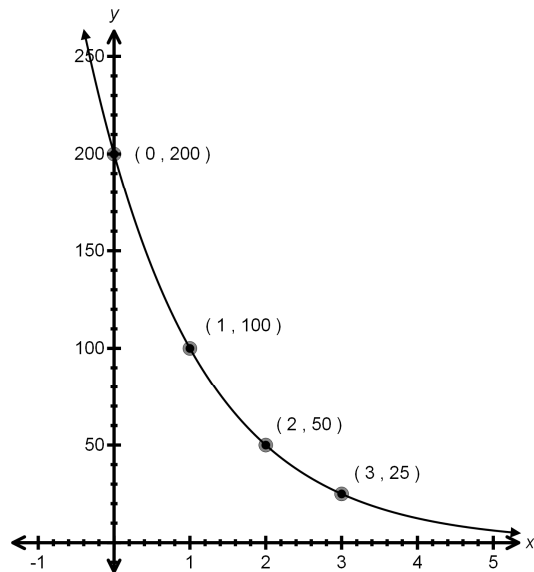
(B)  $y = \frac{1}{2}(-2)^x$

(C)  $y = 2\left(\frac{1}{2}\right)^x$

(D)  $y = 2\left(\frac{3}{2}\right)^x$

48. What is the common ratio for the graph?

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



49. What is the y-intercept of  $y = 3(2)^{\frac{x}{4}}$ ?

- (A) (0,1)
- (B) (0,3)
- (C) (1,0)
- (D) (3,0)

50. Which exponential function grows the fastest?

- (A)  $y = \frac{1}{2}(3)^x$
- (B)  $y = 2\left(\frac{1}{3}\right)^x$
- (C)  $y = 5\left(\frac{7}{2}\right)^x$
- (D)  $y = 7(2)^x$



## PART II

Total Value 50%

Answer **ALL** items in the space provided. Show **ALL** workings.

*Value*

- 4      51.      Algebraically determine the EXACT roots, in simplest form, of  
 $2x^2 + 22 = -8x$ .

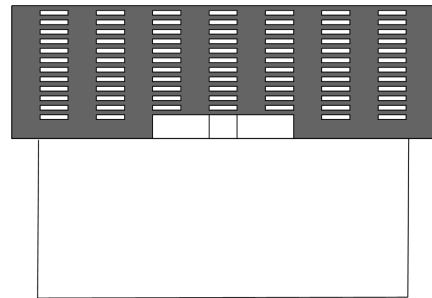
- 4      52.      Change the equation  $y = 2x^2 - 32x + 125$  into transformational form.

Value

- 4 53. Clayton has a square shed. In order to accommodate a new snowmobile, the length of the floor must be increased by 2m and the width increased by 1m. If the new floor area is  $42\text{m}^2$ , algebraically determine the original dimensions of the floor.



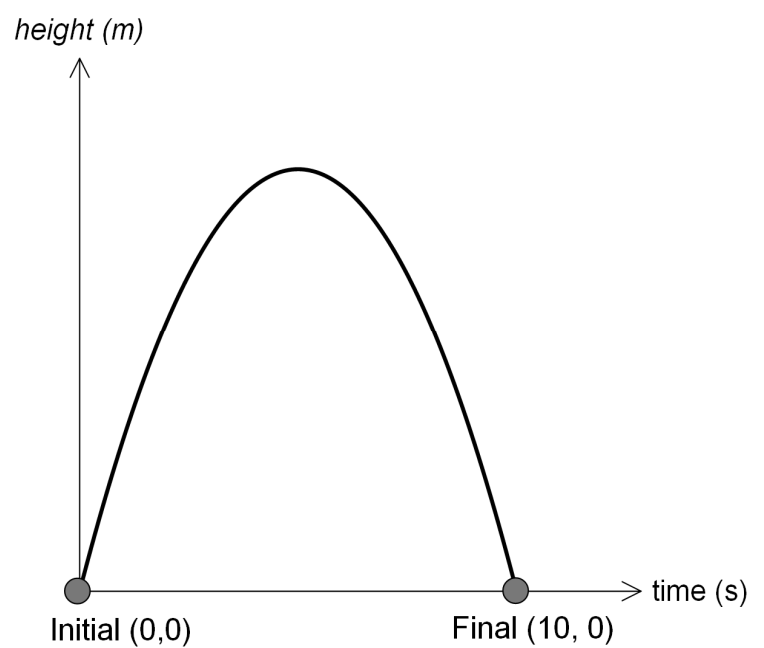
- 4 54. The school administration has 80 metres of fencing to construct a rectangular playground. If they use a wall of the school as a fourth side, what dimensions will yield a maximum area?



Value

- 4 55. A person throws a snowball and the snowball follows a parabolic path that is described by the function  $h(t) = -\frac{1}{2}t^2 + 4t + 2$  where  $t$  is time in seconds and  $h(t)$  is height in metres. Algebraically, determine the maximum height of the snowball and the time at which the maximum height occurs.

- 4 56. A golfer hits a ball and it reaches a maximum height of 30m. The ball hits the ground in 10 seconds. Algebraically determine the quadratic function that models the situation.



Value

- 4      57.    A blue jay swoops down from the top of a 10m tree to chase away some house sparrows. The blue jay's path follows a parabolic path given by the function  $h(t) = 2t^2 - 8t + 10$  where  $t$  is time in seconds and  $h(t)$  is height in metres. Algebraically, determine the time(s) when the blue jay reaches a height of 4m.
- 4      58.    Jim enjoys snowboarding at Marble Mountain. He attempts a jump and his height  $h(t)$ , in metres, is recorded as  $h(t) = -5t^2 + 12t + 15$ . Calculate Jim's approximate instantaneous rate of change at  $t = 3$  seconds.

*Value*

- 4      59.      A sugar cube is placed in a cup of hot coffee. As it dissolves, its volume is given by  $V = (15 - 2t)^3$ , where  $t$  is time in minutes and  $V$  is volume in  $\text{mm}^3$ . Calculate the average rate of change in the volume between 5 and 6 minutes.

- 4      60.      Sean likes to spend money. He currently has \$1000 in his bank account but unfortunately, due to his spending habits, his account has a half-life of 3 years.

Andrew likes to save money. He invests \$100 in a fund that doubles every three years.

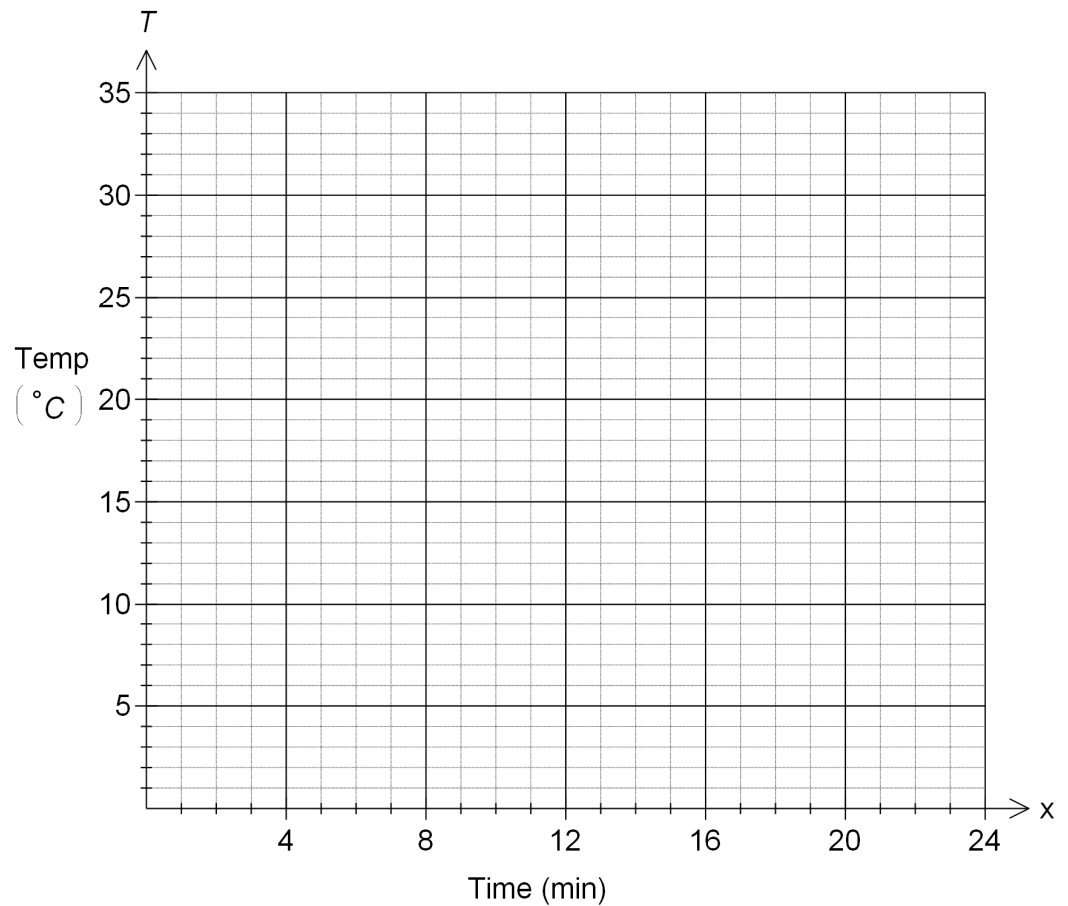
Write the exponential functions that model their situations and use them to determine who will have more money in 5 years.

Value

- 3 61. Your computer registers the temperature of its motherboard as 32°C. During a power outage, the cooling of the motherboard is modeled by

$T = 12(0.6)^{\frac{x}{4}} + 20$ , where  $T$  is the temperature in degrees Celsius and  $x$  is time in minutes. Complete the table of values for the first 20 minutes, then sketch the graph including the asymptote.

$x$ in minutes	$T$ in Celsius
0	
4	
8	
12	
16	
20	



- 3 62. Karen purchased a house in 1995. In 2012, it is worth \$285 000. If the house has appreciated by 11% every 2 years, what was the original cost of the house?

Value

- 4 63. The graph shows the decrease in the population of Woodland Caribou in Newfoundland over the past 12 years. Algebraically, determine an equation that models the population of caribou,  $P$ , over time,  $t$ . Use the equation to predict the caribou population in year 25.

