Nova Scotia Examinations
Mathematics 12

Web Sample 3

General Instructions to Students

This examination is composed of two sections with the following suggested time allotment:

Selected Response (Multiple Choice) Questions   Value 35 pts (approx. 1 hour)
Constructed Response Questions   Value 63 pts (approx. 2 hours)

Total time: 3 hours

Use these suggested times to guide you in the completion of the examination; however, you may not find it necessary to spend the suggested time on each section. Plan your time to enable you to complete the examination.

Your teacher must clear the memory of your own graphing calculator prior to this examination. The only graphing calculators permitted are: TI-82, TI-83, TI-83 Plus, TI-84, or TI-84 Plus.

When a question indicates that you may not use a graphing calculator, you are not permitted to use the graphing or regression functions, but you are still permitted to use the calculator to perform arithmetic operations.

Calculators are not to be shared.

Graph paper, scrap paper, and formula sheets are provided in a separate booklet. Please place this booklet along with your student response sheet inside the front cover of this examination booklet before handing it in.

Note: Diagrams are not necessarily drawn to scale.

Selected Response Questions
(Total Value: 35 points)

In this part of the examination, there are 35 selected response questions, each with a value of 1 point. Read each question carefully, and decide which one of the responses best answers the question being asked.

You are provided a separate student answer sheet. In the selected response section of the student answer sheet, fill in the bubble that corresponds to your choice, as shown in the example below. Use an HB pencil only.

Example:

1.   What are the roots of $x^2 + 3x - 4 = 0$?

   A.   4 and 1   B.   –4 and 3
   C.   –4 and 1   D.   4 and 3

(On student answer sheet)

1. | C | (A)   (B)   ●   (D)

If you wish to change an answer, please ensure that you erase your first answer completely on the student answer sheet. Calculations or rough work on the selected response pages of the examination booklet will not be scored.

1. Which of the following is the transformational form of the function $y = 2(x-3)^2 + 5$?

   A. $\dfrac{1}{2}y - 5 = (x-3)^2$ **B.** $2(y-5) = (x-3)^2$

   C. $\dfrac{1}{2}(y-5) = (x-3)^2$ **D.** $2y - 5 = (x-3)^2$

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2. Which one of the following represents the range of the function $-2(y-5) = (x-3)^2$?

   A. $\{y \in \mathbb{R} \mid y \geq 5\}$ **B.** $\{y \in \mathbb{R} \mid y < 5\}$
   C. $\{y \in \mathbb{R} \mid y \leq 5\}$ **D.** $\{y \in \mathbb{R} \mid y > 5\}$

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3. The function $y = x^2 - 4x + 5$ has a minimum value of

   A. 1   **B.** 2

   C. 5   **D.** –5

---

4. Celeste changed the function $\dfrac{1}{2}(y+3) = (x-2)^2$ from transformational form to general form. What should she have obtained?

   A. $y = 2x^2 - 8x + 5$ **B.** $y = 2x^2 + 5$
   C. $y = 2x^2 + 8x + 11$ **D.** $y = 4x^2 - 8x + 11$

---

5. Which quadratic function has x-intercepts at –2 and 8 and a maximum value?

   A. $y = (x+2)(x-8)$ **B.** $y = -(x+2)(x-8)$
   C. $y = (x-2)(x+8)$ **D.** $y = -(x-2)(x+8)$

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6. Given $y = ax^2 + bx + c$, $a \neq 0$, what does the value of $-\dfrac{b}{2a}$ represent?

   A. the minimum or maximum value   **B.** the x coordinate of the vertex

   C. an x-intercept   **D.** the y-intercept

7. If a quadratic function has a y-intercept at $(0, -11)$, and a vertex at $(4, -3)$, which one of the following is the transformational form of the function?

A. $-\dfrac{1}{2}(y+3)=(x-4)^2$ **B.** $-2(y+3)=(x-4)^2$

C. $-\dfrac{1}{2}(y-3)=(x+4)^2$ **D.** $-2(y-3)=(x+4)^2$

8. Which of the following is true about the graph of any quadratic function?

A. The graph always has a minimum point. **B.** The graph always crosses the x-axis.

C. The graph always crosses the y-axis. **D.** The graph always has a maximum point.

9. What is the axis of symmetry for the parabola defined by $\dfrac{1}{4}(y+2)=(x-8)^2$?

A. $x=-8$ **B.** $y=-2$

C. $x=8$ **D.** $y=-\dfrac{1}{2}$

10. Which graph could represent a quadratic function where $f(x)=0$ has no real roots?

A.

B.

C.

D.
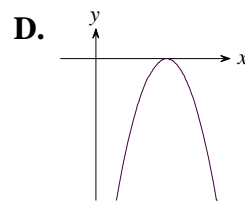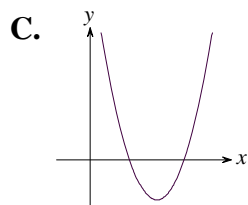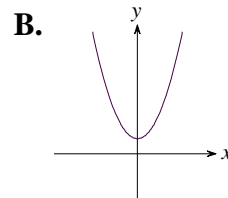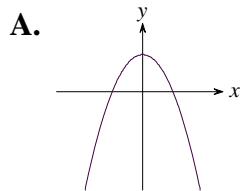
11. The function $y = (x+1)^2 - 7$ is the image of $y = x^2$ after

    A. a horizontal translation of 1 and a vertical translation of 7

    B. a horizontal translation of –1 and a vertical translation of 7

    C. a horizontal translation of 1 and a vertical translation of –7

    D. a horizontal translation of –1 and a vertical translation of –7

---

12. $-27^{-\frac{2}{3}} =$

    A. $-\dfrac{1}{9}$ **B.** $\dfrac{1}{9}$

    C. -9 **D.** 9

---

13. What type of function would best model the data in the table below?

x	-15	-12	-9	-6	-3
y	64	32	16	8	4

    A. linear   **B.** quadratic

    C. exponential   **D.** logarithmic

---

14. What is the simplified form of $\dfrac{b(b^n)}{(b^3)^n}$, $b \neq 0$?

    A. $\dfrac{1}{b^{2n}}$ **B.** $\dfrac{1}{b^2}$

    C. b^{-2n+1} **D.** b^{2n+1}

---

15. At which point do the functions $y = 4$ and $y = 3(2)^x + 1$ intersect?

    A. $(4, 0)$ **B.** $(0, 4)$

    C. $(1, 4)$ **D.** $(4, 1)$

---

16. Which of the following best approximates $\log_5 7 + \log_7 5$?

    A. 0.96   **B.** 1

    C. 2.04   **D.** 2.2

17. Given $\log_x y = 1.25$, what is the value of $\log_y x$?

A. -1.25 B. 0.80

C. -17.78 D. 17.78

---

18. What is one half of 2^{20}?

A. 2^{10} B. 1^{20}

C. 2^{19} D. 1^{10}

---

19. Which expression is equivalent to $2\log\left(\dfrac{4}{x}\right), x \neq 0$ for all possible values of x?

A. $\log 16 - 2\log x$ B. $\log 8 - 2\log x$

C. $\log 16 - \log 2x$ D. $\left(\log 4 - \log x\right)^2$

---

20. What is the value of x in $\log_x 32 = \dfrac{5}{3}$?

A. 4 B. $\dfrac{3}{5}$

C. 8 D. 16

---

21. $-\left(-3\right)^0 =$

A. 0 B. 3

C. 1 D. -1

---

22. What is the exponential form of $\log_b a = c$?

A. $b^a = c$ B. $c = a^b$

C. $b^c = a$ D. $a = b^c$

23. If log $10^x = 5$, what is the value of x?

    A. 1   **B.** 0.5

    C. 5   **D.** no solution

---

24. Given points $A(4, -6)$, $B(7, -1)$, and $C(p, q)$ such that B is the midpoint of $\overline{AC}$, what are the coordinates of C?

    A. $\left(\dfrac{11}{2}, -\dfrac{7}{2}\right)$ **B.** $(10, 4)$

    C. $(10, -4)$ **D.** $\left(\dfrac{3}{2}, \dfrac{5}{2}\right)$

---

25. Which of the following is always true of the perpendicular bisectors of non-parallel chords in the same circle?

    A. The perpendicular bisectors never intersect.   **B.** The perpendicular bisectors are always parallel.

    C. The perpendicular bisectors are always perpendicular to each other.   **D.** The perpendicular bisectors always intersect at the centre of the circle.

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26. Given $A(-4, -3)$, $B(0, 0)$ and $C(a, b)$, such that B is the midpoint of $\overline{AC}$, what is the length of $\overline{BC}$?

    A. 5   **B.** $\sqrt{7}$

    C. 25   **D.** 10

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27. To prove that quadrilateral ABCD is a rectangle, Meghan showed that both pairs of opposite sides are congruent.
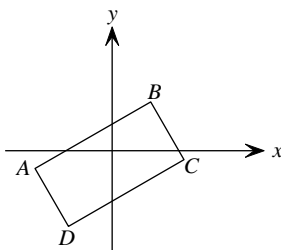
Which of the following conditions would be sufficient to complete her proof?

    A. Opposite sides are parallel.   **B.** The diagonals bisect each other.

    C. $\overline{AB}$ and $\overline{BC}$ are perpendicular.   **D.** $\angle ABC \cong \angle ADC$

28. Given the statement:

"If two chords of a circle are congruent, then they are equidistant from the centre of the circle."
Which of the following is the converse statement?

A. Two chords of a circle that are equidistant from the centre of the circle must also be equidistant from the circle.

B. If two chords of a circle are equidistant from the centre of the circle, then they are congruent.

C. Two chords of a circle are equidistant from the centre iff they are congruent.

D. If two chords of a circle are congruent, then they are not equidistant from the centre of the circle.

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29. What is the value of $\dfrac{500!}{498!}$?

A. $2!$

B. $\dfrac{250}{249}$

C. $249\ 500$

D. 1.004

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30. An electronic lock on a door has 6 buttons numbered 1–6. The door will open only when a certain 4-digit sequence is entered. The digits in the sequence must all be different. What is the probability that a random sequence of 4 digits will open the door?

A. $6 \times 5 \times 4 \times 3$

B. $\dfrac{1}{{}_6C_4}$

C. $\dfrac{1}{{}_6P_4}$

D. $\dfrac{4}{6!}$

---

31. If a letter, from the English alphabet, is picked at random, what is the probability that the letter is in the word MATH and in the word EXAM?

A. $\dfrac{1}{2}$

B. $\dfrac{1}{13}$

C. $\dfrac{2}{13}$

D. $\dfrac{3}{13}$

32. Suppose event '*X*' is "obtaining a six" when rolling a fair six-sided die. Which of the following statements is false?

A. $P(\overline{X}) = \dfrac{5}{6}$

B. $P(X) + P(\overline{X}) = 1$

C. $\overline{X} = 1 - X$

D. X and $\overline{X}$ are mutually exclusive events

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33. Two six-sided dice are to be rolled. On any roll, what is the probability of getting two different numbers?

A. $\dfrac{30}{36}$

B. $\dfrac{6}{36}$

C. $\dfrac{5}{36}$

D. $\dfrac{2}{36}$

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34. A fair 8-sided die is rolled. The faces of the die are numbered 1 through 8. On any given roll, what is the probability of rolling a 1 or a number larger than 6?

A. $\dfrac{3}{8}$

B. $\dfrac{2}{64}$

C. $\dfrac{2}{8}$

D. $\dfrac{3}{16}$

---

35. There are 10 red marbles and 20 blue marbles in a bag. Two marbles are randomly removed from the bag at the same time. What is the probability that both are blue?

A. $\dfrac{{}_2C_2}{{}_{20}C_2}$

B. $\dfrac{2}{20}$

C. $\dfrac{{}_{20}C_2}{{}_{30}C_2}$

D. $\dfrac{20}{30}$

Constructed Response Questions
(Total Value: 63 points)

Read each question carefully. Be sure to write your response in the box and space provided. When the answer box indicates that you are to show your work, then points will be awarded for your correct work and your correct final answer. The method used to solve a problem must clearly be shown even when using a graphing calculator. If the answer box requires that just a final answer be provided, then points will be awarded for the correct answer only.

You may round off decimal values to the hundredths place in your final answer only. If any decimal values are rounded prior to the final step of the solution, at least 4 decimal places must be kept.

All answers must be given in simplest form.

36. (a) Solve the following equation for x. Express your answer(s) in exact simplest form.

(3 points)

$$x^2 = 2x + 7$$

Show your work above and write your conclusion or final answer in the box below.

(b) Solve the following equation for x using a **different** method than that used in part (a). Express your answer(s) in exact simplest form.

(3 points)

$$3x^2 - 5x - 2 = 0$$

Show your work above and write your conclusion or final answer in the box below.

12

37. During a high school baseball tournament, Nellie hits a pitch and the baseball stays in the air for 4.423 seconds. The function $h = -5t^2 + 22t + 0.5$ describes the height over time, where h is its height, in meters, and t is the time, in seconds, from the instant the ball is hit.

(a) Algebraically determine the maximum height the ball reaches. (3 points)

Show your work above and write your conclusion or final answer in the box below.

(b) By the method of your choice, determine how long the ball will be at a height of less than __20 meters__ while it is in the air. (4 points)

Show your work above and write your conclusion or final answer in the box below.

38. A newly finished rectangular painting is to be framed. The frame is of uniform width and will increase the coverage area of the painting by 20%. If the original painting was 25 cm by 40 cm, determine the width of the frame. (5 points)
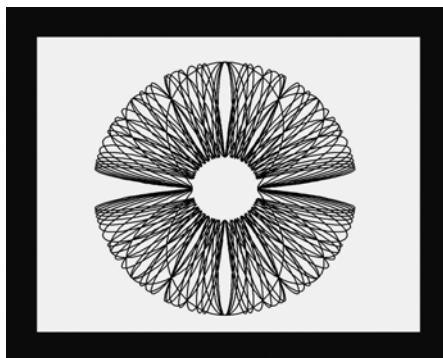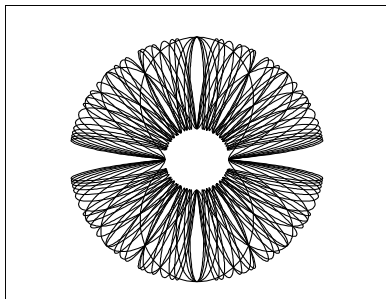
Show your work above and write your conclusion or final answer in the box below.

14

39. A ball was released and rolled down an inclined plane. Its distance travelled, with respect to time since release, is recorded in the following scatter plot.
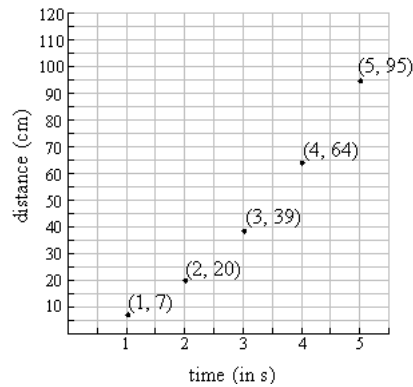
It was determined that a quadratic function would best represent the data.

(a) Using your graphing calculator, find the function that best fits the data. Fill in values for a, b, c, and R^2 that you obtain from your graphing calculator. (2 points)

(b) Write the complete quadratic function. (1 point)

Final Answer	

(c) How far had the ball rolled by the 4.7 second mark? (1 point)

Show your work above and write your conclusion or final answer in the box below.

(a) Write the function, in transformational form, that represents the following parabola. (3 points)
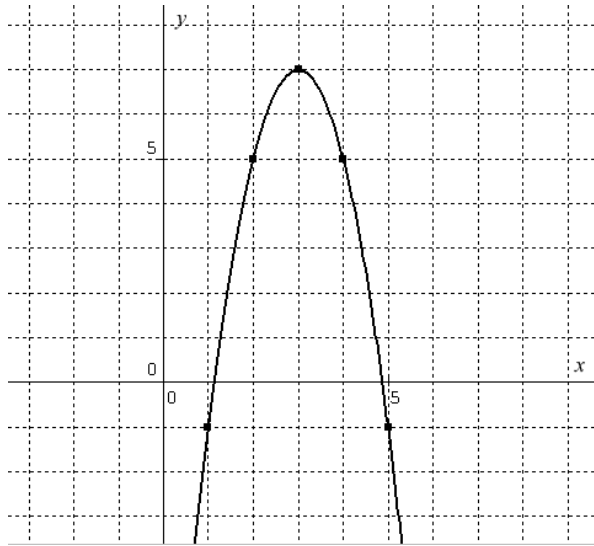
Show your work above and write your conclusion or final answer in the box below.

(b) State the domain and the range of the function. (2 points)

Domain: | **Final Answer** | |
| --- | --- |

Range: | **Final Answer** | |
| --- | --- |

16

41. Given: $y = 2.5(0.9)^x + 1$

(a) Write the equation of the horizontal asymptote. (1 point)

Final Answer	

(b) Write the coordinates of the *y*-intercept. (1 point)

Final Answer	

(c) Is the graph of the function a growth curve? Justify your answer. (2 points)

42. A recently discovered bacteria doubles in number every 15 minutes. A biologist determined that the initial number of bacteria in the sample was 500.

(a) Determine an equation representing this situation. Let *t* represent time, in minutes, and *N* represent the number of bacteria. (2 points)

Final Answer	

(b) How many bacteria will there be at the one hour mark if the growth of the bacteria is not interrupted? (1 point)

Final Answer	

43. Suppose the cost of a parking permit increases by 4% annually. If the cost of parking is now $300 per year, how long will it take for the price to triple? (4 points)

44. The number of cell phone users in a city has increased by 10% every year for the past several years. With this constant rate, if there are 800 000 cell phone users today, how many years ago were there only 500 000 users? Set up and solve an equation(s) that represents this situation. (4 points)

45. Algebraically solve for *n*. (3 points)

$$\left(\sqrt{2}\right)^{2n-4} = \left(\frac{1}{8}\right)^{-n+4}$$

Show your work above and write your conclusion or final answer in the box below.

46. If $\log_x 16 = 7$ calculate $\log_{16}(2x)$. (3 points)

Show your work above and write your conclusion or final answer in the box below.

47. Given $\triangle ABC$ with $A(-3, 11)$, $B(5, 9)$, and $C(1, -3)$. Show, using relevant calculations, that the segment connecting the midpoints of $\overline{AB}$ and $\overline{BC}$ is parallel to $\overline{AC}$. (5 points)

Show your work above and write your conclusion or final answer in the box below.

48. The radius of a circle measures 5 cm. How far from the centre is a chord that measures 9 cm? Please complete the diagram below to aid in your solution   (3 points)
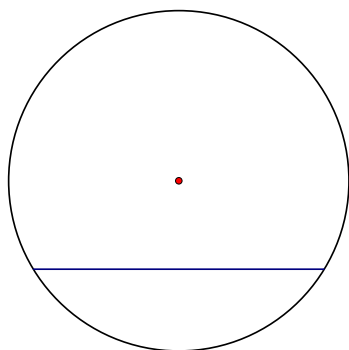
Show your work above and write your conclusion or final answer in the box below.

49. (a) Four students are selected from the student council to form a committee. If there are 20 students on the student council, how many different committees of four students are possible?   (1.5 points)

(b) A meeting will be held to randomly select a four-member executive from the 20 student council members. What is the exact probability that council members LeBlanc, Smith, Brown, and Legere will be assigned the positions of president, vice-president, secretary, and treasurer respectively.

(2 points)

50. Jamie has 12 different coloured shirts and 7 different coloured pants.

   (a) What is the probability that Jamie chooses a yellow shirt and tan pants.   (1.5 points)

Show your work above and write your conclusion or final answer in the box below.

   (b) What is the probability that Jamie chooses a pink shirt or green pants?   (2 points)

Show your work above and write your conclusion or final answer in the box below.

Nova Scotia Examinations
Mathematics 12

Solutions - Web Sample 3

Selected Response Answer Key

1.	C	19.	A
2.	C	20.	C
3.	A	21.	D
4.	A	22.	C
5.	B	23.	C
6.	B	24.	B
7.	B	25.	D
8.	C	26.	A
9.	C	27.	C
10.	B	28.	B
11.	D	29.	C
12.	A	30.	C
13.	C	31.	B
14.	C	32.	C
15.	B	33.	A
16.	C	34.	A
17.	B	35.	C
18.	C		

Question 36 (a)   (3 points)

$$x^2 - 2x - 7 = 0$$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-7)}}{2(1)}$$ `1 pt`

$$= \frac{2 \pm \sqrt{32}}{2}$$ `1 pt`

$$x = 1 + 2\sqrt{2} \qquad\qquad x = 1 - 2\sqrt{2}$$

`0.5 pt`   `0.5 pt`

Note: Deduct 0.5 pt if decimal approximations are given.

$$x^2 - 2x = 7$$

$$x^2 - 2x + 1 = 7 + 1$$ `1 pt`

$$(x - 1)^2 = 8$$ `0.5 pt`

$$x - 1 = \pm\sqrt{8}$$ `0.5 pt`

$$x = 1 + 2\sqrt{2} \qquad\qquad x = 1 - 2\sqrt{2}$$

`0.5 pt`   `0.5 pt`

Note: Deduct 0.5 pt if decimal approximations are given.

OR

$$y_1 = x^2 - 2x - 7$$ `1 pt`

(-1.83, 0)   (3.83, 0)   `1 pt`

$$x = -1.83 \qquad x = 3.83$$

`0.5 pt`
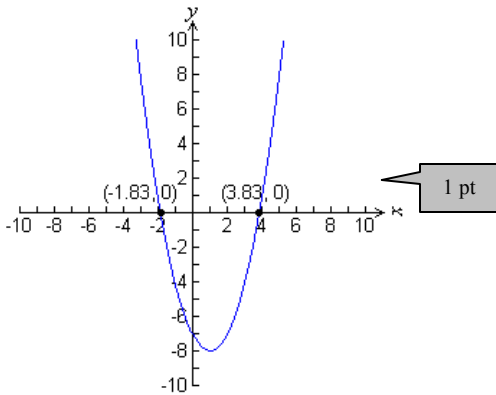
Note: If solving graphically max value of question is 2.5 due to decimal approximation.
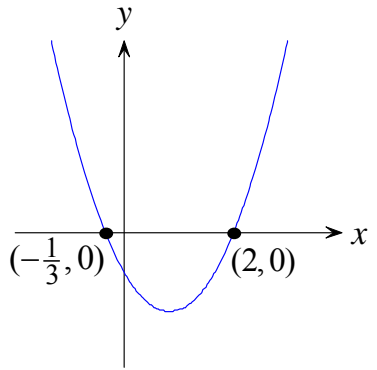
Note

Throughout this exam, where a graph is used to obtain a solution, if the point(s) used to obtain that solution is not indicated on the representation of the graph, then no points will be awarded for the graph. The graph below would be worth nothing.

Question 36(b)   (3 points)

$$3x^2 - 5x - 2 = 0$$

$$(3x+1)(x-2) = 0$$ $\Big\}$ s1 pt

$$3x+1=0 \qquad\qquad x-2=0$$

0.5 pt   0.5 pt

$$x = -\frac{1}{3} \qquad\qquad x = 2$$

0.5 pt   0.5 pt

$$3x^2 - 5x - 2 = 0$$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(3)(-2)}}{2(3)}$$ $\Big\}$ 1 pt

$$x = \frac{5 \pm \sqrt{49}}{6}$$ $\Big\}$ 1 pt

$$x = \frac{5-7}{6} \qquad\qquad x = \frac{5+7}{6}$$

$$x = -\frac{1}{3} \qquad\qquad x = 2$$

0.5 pt   0.5 pt

OR

$$3x^2 - 5x - 2 = 0$$

$$x^2 - \frac{5x}{3} = \frac{2}{3}$$ $\Big\}$ 0.5 pt

$$x^2 - \frac{5x}{3} + \frac{25}{36} = \frac{2}{3} + \frac{25}{36}$$ $\Big\}$ 0.5 pt

$$\left(x - \frac{5}{6}\right)^2 = \frac{49}{36}$$ $\Big\}$ 0.5 pt

$$x - \frac{5}{6} = \pm\frac{7}{6}$$ $\Big\}$ 0.5 pt

$$x = -\frac{1}{3}$$ 0.5 pt $$x = 2$$ 0.5 pt

$$y_1 = 3x^2 - 5x - 2$$

$(-\frac{1}{3}, 0)$ $(2, 0)$

2 pts

$$x = -\frac{1}{3}$$ $\Big\}$ 0.5 pt

$$x = 2$$ $\Big\}$ 0.5 pt

4

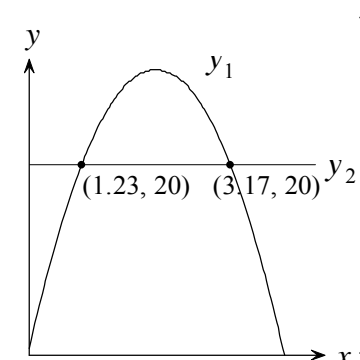# Question 37(a)　　　　　　　(3 points)

Note: Concluding that the maximum occurs at $\dfrac{4.423}{2} = 2.2115$ seconds is to be considered a conceptual error.

$h = -5t^2 + 22t + 0.5$

The vertex is $\left(-\dfrac{b}{2a},\ f\left(-\dfrac{b}{2a}\right) \right)$

$-\dfrac{b}{2a} = -\dfrac{22}{2(-5)} = 2.2$ 　　1 pt

$f(2.2) = -5(2.2)^2 + 22(2.2) + 0.5 = 24.7$ 　　1 pt

$\therefore$ The maximum height is 24.7m. 　　1 pt

OR

$h = -5t^2 + 22t + 0.5$

$h - 0.5 = -5t^2 + 22t$ 　　0.5 pt

$h - 0.5 = -5(t^2 - 4.4t)$ 　　0.5 pt

$h - 0.5 - 24.2 = -5(t^2 - 4.4t + 4.84)$ 　　1 pt

$h - 24.7 = -5(t^2 - 4.4t + 4.84)$

$\therefore$ The maximum height is 24.7 m. 　　1 pt

Note: There are several variations of this method. Use your professional judgment.
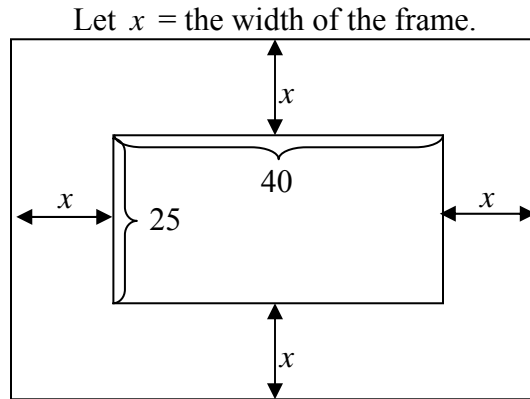
Question 37(b)　　　　　　　(4 points)

$h = -5t^2 + 22t + 0.5$

Let $h = 20$

$-5t^2 + 22t + 0.5 = 20$ 　　1 pt

$-5t^2 + 22t - 19.5 = 0$

$t = \dfrac{-(22) \pm \sqrt{(22)^2 - 4(-5)(-19.5)}}{2(-5)}$ 　　0.5

$t = \dfrac{-22 \pm \sqrt{94}}{-10}$ 　　0.5 pt

$t \doteq 1.2305$ and $t \doteq 3.1695$

The ball was at a height of more than 20 m during the interval between 1.2305 seconds and 3.1695 seconds.

$\therefore$ Duration above 20 m was: 　　1 pt

$3.1695 - 1.2305 \doteq 1.939$ seconds.

$\therefore$ the time at no more than 20 m was: 　　1 pt

$4.423 - 1.939 \doteq 2.48$ seconds

OR

$y_1 = -5x^2 + 22x + 0.5$ 　　1 pt

$y_2 = 20$

(1.23, 20)　(3.17, 20)　　1 pt

The ball was at a height of more than 20 m during the interval between 1.2305 seconds and 3.1695 seconds.

$\therefore$ Duration above 20 m was: 　　1 pt

$3.1695 - 1.2305 \doteq 1.939$ seconds.

$\therefore$ the time at no more than 20 m was: 　　1 pt

$4.423 - 1.939 \doteq 2.48$ seconds

Let x = the width of the frame.

x

40

x

25

x

x

1 pt

1 pt

$$\therefore (25+2x)(40+2x) = 1000 + 0.2 \times 1000$$

$$4x^2 + 130x + 1000 = 1200$$

0.5 pt

$$4x^2 + 130x - 200 = 0$$
or
$$2x^2 + 65x - 100 = 0$$

0.5 pt

$$x = \frac{-(65) \pm \sqrt{(65)^2 - 4(2)(-100)}}{2(2)}$$

1 pt

$$x = \frac{-65 \pm \sqrt{5025}}{4}$$

$x \doteq 1.47$ and $x \doteq -33.97$ (Discard)

1 pt

Therefore the width is 1.47 cm
Note: If the negative value is given as a solution and not discarded, deduct 0.5 pt.

$y_1 = 2x^2 + 65x - 100$

(1.47, 0)

1 pt

OR

1 pt

Therefore the width is 1.47 cm.
Note: If the negative value is given as a solution and not discarded deduct 0.5 pt.

Question 39(a)   (2 points)

QuadReg
y=ax²+bx+c
a=3   0.5 pt
b=4   0.5 pt
c=0   0.5 pt
R²=1   0.5 pt

Question 39(b)   (1 point)

$y = 3x^2 + 4x + 0$ 1 pt

Question 39(c)   (1 point)

$f(4.7) = 3(4.7)^2 + 4(4.7)$ 0.5 pt

$f(4.7) = 85.07$ cm   0.5 pt

7

Question 40(a)   (3 points)

The vertex is (3, 7).

0.5 pt   0.5 pt

$$\frac{1}{a}(y-7)=(x-3)^2$$

Since, from the vertex, it is over 1 and down 2×1 there is a vertical stretch of 2 and a reflection.

1 pt

$\therefore\ a=-2$ and transformational form is:

$$-\frac{1}{2}(y-7)=(x-3)^2$$

1 pt

OR

The vertex is (3, 7).

0.5 pt   0.5 pt

$$\frac{1}{a}(y-7)=(x-3)^2$$

Since the parabola passes through (2, 5) we know that:

$$\frac{1}{a}(5-7)=(2-3)^2$$ 0.5 pt

$$\frac{1}{a}(-2)=1$$
$$a=-2$$ 0.5 pt

The transformational form is:

$$-\frac{1}{2}(y-7)=(x-3)^2$$ 1 pt

Question 40(b)   (2 points)

Domain is $\{x \mid x \in \mathbb{R}\}$ or $(-\infty, \infty)$ 1 pt

Range is $\{y \mid y \in \mathbb{R},\ y \le 7\}$ or $(-\infty, 7]$ 1 pt

Question 41(a)   (1 point)

$$y = 1$$

1 pt

Question 41(b)   (1 point)

$(0, 3.5)$

1 pt

Question 41(c)   (2 points)

Knows it is not a growth curve	Reason shows complete understanding	2 points
Knows it is not a growth curve	Reason shows some understanding	1.5 point
Knows it is not a growth curve	Reason not correct	1 point

Question 42(a)   (2 points)

$$N = 500 (2)^{\frac{t}{15}}$$

0.5 pt

0.5 pt

1 pt

Question 42(b)   (1 point)

8000 bacteria.

1pt

Question 43   (4 points)

Let n represent the time in years

1 pt   1 pt

$$900 = 300(1.04)^n$$

or

1 pt   1 pt

$$3 = (1.04)^n$$

$\log 3 = \log(1.04)^n$ 0.5 pt

$\log 3 = n\log(1.04)$ 0.5 pt

$n = \dfrac{\log 3}{\log(1.04)}$ 0.5 pt

$n \doteq 28.01$ years   0.5 pt

$n = \log_{1.04} 3$ 1 pt

$n = \dfrac{\log 3}{\log 1.04}$ 0.5 pt

$n \doteq 28.01$ years   0.5 pt

OR

11

Question 44 (4 points)

Let T represent the number of users today, F represent the number of users in n years.

$$F = T(1.1)^n$$ `0.5 pt`

$$\underbrace{800\ 000}_{} = \underbrace{500\ 000}(1.1)^n$$ `0.5 pt` `0.5 pt`

`0.5 pt`

$$1.6 = 1.1^n$$ `0.5 pt`

$$\log 1.6 = n\log 1.1$$ `1 pt`

$$n = \frac{\log 1.6}{\log 1.1}$$ `0.5 pt`

$$n \doteq 4.93$$ `0.5 pt`

⬦ OR ⬦

$$y_1 = 1.6$$
$$y_2 = 1.1^n$$ `0.5 pt`

$$y = 1.1^x - 1.6$$ `0.5 pt`

(4.93, 1.6) `1 pt`

(4.93, 0) `1 pt`
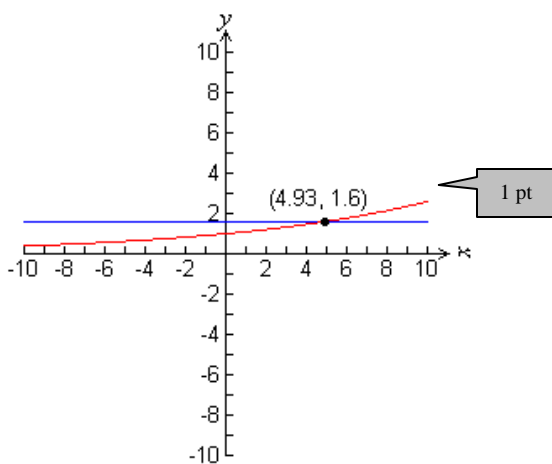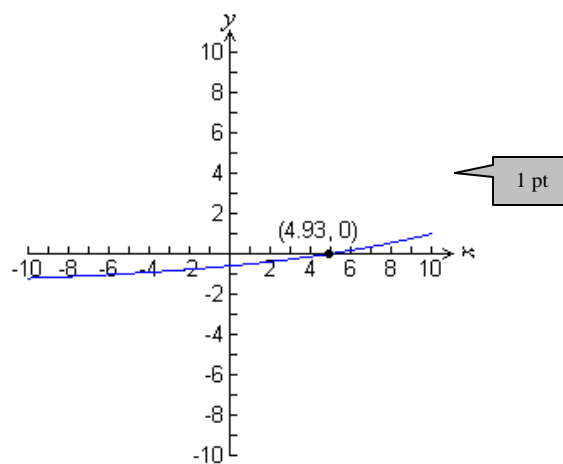
$$x \doteq 4.93$$ `0.5 pt`

$$x \doteq 4.93$$ `0.5 pt`

Question 45 (3 points)

$$\left(\sqrt{2}\right)^{2n-4} = \left(\frac{1}{8}\right)^{-n+4}$$

0.5 pt   0.5 pt

$$\left(2^{\frac{1}{2}}\right)^{2n-4} = \left(2^{-3}\right)^{-n+4}$$

$$2^{n-2} = 2^{3n-12}$$ 0.5 pt

$$\therefore n-2 = 3n-12$$ 1 pt

$$-2n = -10$$

$$n = 5$$

0.5 pt

$$\left(\sqrt{2}\right)^{2n-4} = \left(\frac{1}{8}\right)^{-n+4}$$

$$\log\left(\sqrt{2}\right)^{2n-4} = \log\left(\frac{1}{8}\right)^{-n+4}$$ 0.5 pt

$$(2n-4)\log\left(\sqrt{2}\right) = (-n+4)\log\left(\frac{1}{8}\right)$$ 0.5 pt

$$2n\log\left(\sqrt{2}\right) - 4\log\left(\sqrt{2}\right) = -n\log\left(\frac{1}{8}\right) + 4\log\left(\frac{1}{8}\right)$$ 0.5 pt

$$2n\log\left(\sqrt{2}\right) + n\log\left(\frac{1}{8}\right) = 4\log\left(\frac{1}{8}\right) + 4\log\left(\sqrt{2}\right)$$ 0.5 pt

$$n\left(2\log\left(\sqrt{2}\right) + \log\left(\frac{1}{8}\right)\right) = 4\log\left(\frac{1}{8}\right) + 4\log\left(\sqrt{2}\right)$$ 0.5 pt

OR

$$n = \frac{4\log\left(\frac{1}{8}\right) + 4\log\left(\sqrt{2}\right)}{2\log\left(\sqrt{2}\right) + \log\left(\frac{1}{8}\right)}$$ 0.5 pt
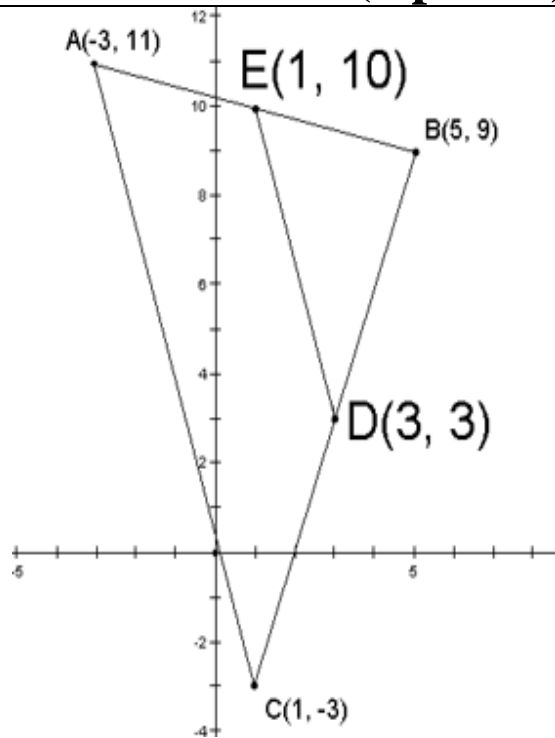
or

$$n = 5$$

Question 46 (3 points)

$$\log_x 16 = 7$$

$$\therefore x^7 = 16$$
$$x = \sqrt[7]{16}$$ 1 pt
$$x = 1.4860$$

$$\therefore \log_{16}(2x) = \log_{16}(2 \times 1.4860)$$ 0.5 pt

$$= \log_{16} 2.9720$$ 0.5 pt

$$= \frac{\log 2.9720}{\log 16}$$ 0.5 pt

$$\therefore \log_{16}(2x) \doteq 0.39$$ 0.5 pt

OR

If $\log_x 16 = 7$ then $\log_{16} x = \frac{1}{7}$ 1 pt

$$\log_{16}(2x) = \log_{16} 2 + \log_{16} x$$ 1 pt

$$\therefore \log_{16}(2x) = \frac{1}{4} + \frac{1}{7}$$ 0.5 pt

$$\therefore \log_{16}(2x) = \frac{11}{28} \ or \doteq 0.39$$ 0.5 pt

Question 47   (5 points)

A(-3, 11)

E(1, 10)

B(5, 9)

D(3, 3)

C(1, -3)

Let D be the midpoint of $\overline{BC}$ and   E be the midpoint of $\overline{AB}$.

$$D\left(\frac{5+1}{2},\ \frac{9-3}{2}\right)=D(3,\ 3)$$ } [1 pt]

$$E\left(\frac{-3+5}{2},\ \frac{11+9}{2}\right)=E(1,\ 10)$$ } [1 pt]

$$m_{\overline{AC}}=\frac{11+3}{-3-1}=-\frac{14}{4}=-\frac{7}{2}$$ } [1 pt]

$$m_{\overline{ED}}=\frac{10-3}{1-3}=-\frac{7}{2}$$ } [1 pt]

$\therefore$ The segment joining the midpoints of $\overline{AB}$ and $\overline{BC}$ is parallel to $\overline{AC}$ because } [1 pt]
$m_{\overline{AC}}=m_{\overline{ED}}$.

Question 48
(3 points)

0.5 pt

5   5

x

4.5   4.5
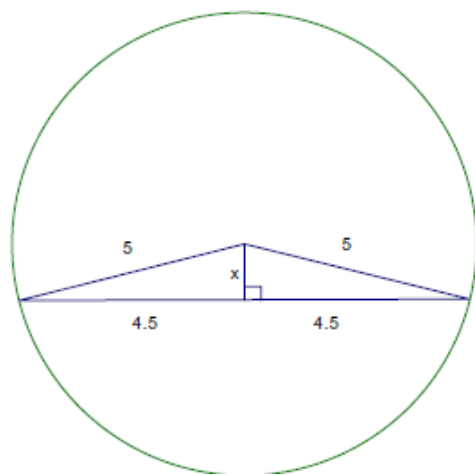
0.5 pt

0.5 pt

0.5 pt

$$x^2 + 4.5^2 = 5^2$$

$$x^2 = 5^2 - 4.5^2$$

0.5 pt

$$x^2 = 4.75$$

$$x \doteq 2.18$$

0.5 pt

Question 49(a)   (1.5 points)

0.5 pt   0.5 pt   0.5 pt

$$_{20}C_4 = 4845$$

Note: $_{20}P_4 = 116280$ worth 0.5 point total.

Question 49(b)   (2 points)

0.5 pt

$$\frac{1}{_{20}P_4} = \frac{1}{116280}$$

0.5 pt

0.5 pt   0.5 pt

Note: $\dfrac{1}{_{20}C_4} = \dfrac{1}{4845}$ worth 1 point total.

Question 50(a)   (1.5 points)

$$\frac{1}{12} \times \frac{1}{7} = \frac{1}{84}$$

0.5 pt

0.5 pt

0.5 pt

Question 50(b)   (2 points)

$$\frac{1}{12} + \frac{1}{7} - \frac{1}{84} = \frac{18}{84} \text{ or } \frac{3}{14}$$

0.5 pt

0.5 pt

0.5 pt

0.5 pt