



**Nova Scotia Examinations
Mathematics 12
Web Sample 1**

Student Booklet

General Instructions - WEB SAMPLE*

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

Selected-Response (Multiple-Choice) Questions	Value 25 pts	(approx. 40 min)*
Constructed-Response Questions	Value 80.5 pts	(approx. 120 min)

*note: there are 35 constructed response questions on the Math NSEs as of January 2008

Total time: 3 hours (revision time included)

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

You are not permitted to use your own graphing calculator unless your teacher has cleared the memory immediately prior to this examination. The only graphing calculators permitted are TI-82, TI-83, TI-83 Plus, TI-84, or TI-84 Plus.

If the question indicates that you are not to use a graphing calculator, you are still permitted to use a calculator to perform arithmetic operations.

Calculators are not to be shared.

Graph paper, scrap paper, and formula sheets are provided at the end of this booklet. These pages can be removed from the booklet for your use during the examination.

Note: Diagrams are not necessarily drawn to scale.

Selected-Response Questions - WEB SAMPLE
(Total Value: 25 points)

In this part of the examination, there are 25 selected-response questions*, each with a value of 1 point. Read each question carefully, and decide which 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 |

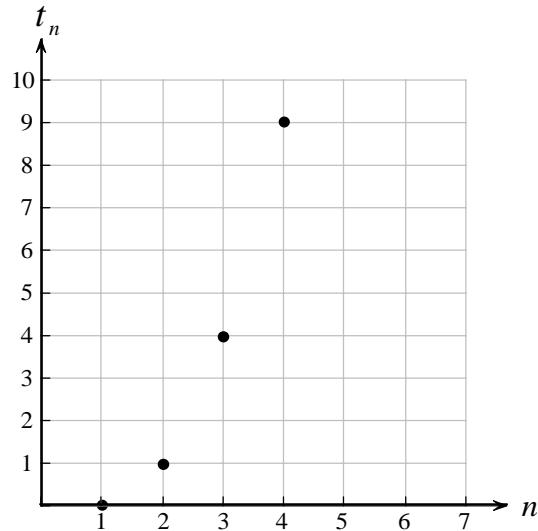
(On student answer sheet)

1. A B C 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.

*Note: As of January 2008 there are 35 selected response questions on the NSE Math exams.

1. Which formula generates the sequence represented by the graph below?



A. $t_n = n^2 + n - 2$

B. $t_n = 2n^2 - 2n + 1$

C. $t_n = n^2 - 2n + 1$

D. $t_n = 2n^2 - 4n + 1$

2. The equation of the axis of symmetry of the parabola represented by the function $y = (x - 2)^2$ is

A. $x = -2$

B. $x = 2$

C. $x = 0$

D. $y = 2$

3. What is the nature of the roots of a quadratic equation having a discriminant equal to 0?

A. two equal real roots

B. two unequal real roots

C. two imaginary roots

D. no real roots

4. Given the equation $x^2 + 25 = 0$, then x is equal to

A. ± 5

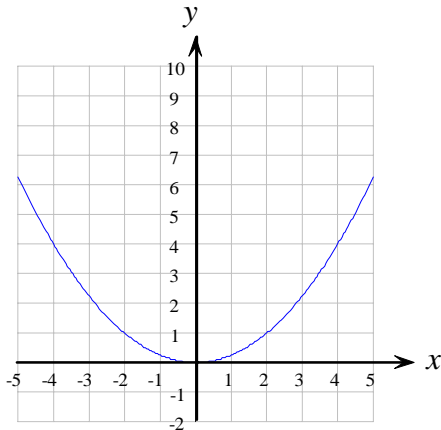
B. 5

C. $\pm 5i$

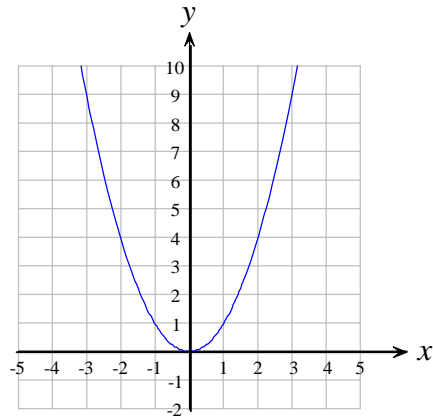
D. $5 \pm i$

5. Which graph has a vertical stretch factor of $\frac{1}{2}$ when compared to the graph of $y = x^2$?

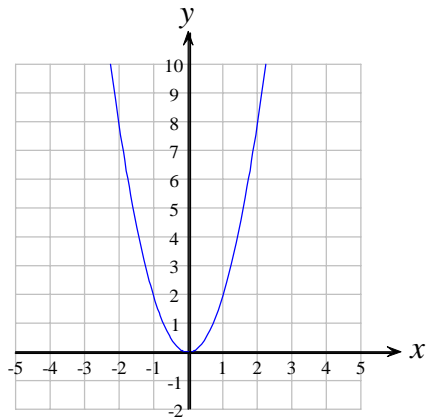
A.



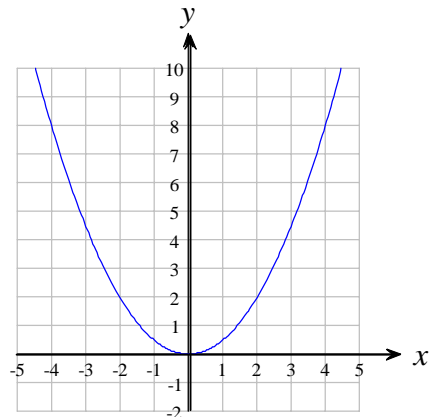
B.



C.



D.



6. For the function $y = ax^2 + bx + c$, the y-intercept is always

A. $-\frac{b}{2a}$

B. c

C. $\frac{c}{a}$

D. $\frac{4ac - b^2}{4a}$

7. The function representing a parabola with vertex at $(3, 2)$ and passing through the point $(4, 4)$ is

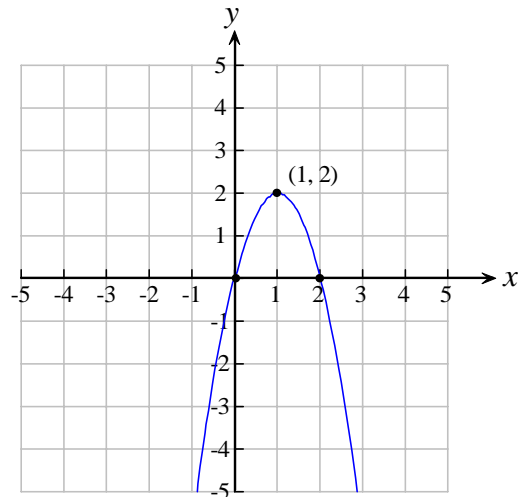
A. $y = 2(x - 3)^2 + 2$

B. $y = 2(x + 3)^2 - 2$

C. $y = \frac{1}{2}(x - 3)^2 + 2$

D. $y = \frac{1}{2}(x + 3)^2 - 2$

8. The domain and range of the function represented by the graph below are:



- A. $\{x \in R\}$ and $\{y \in R\}$ B. $\{x \in R\}$ and $\{y \in R \mid y \leq 2\}$
C. $\{x \in R\}$ and $\{y \in R \mid y \geq 2\}$ D. $\{x \in R \mid x \leq 1\}$ and $\{y \in R \mid y \leq 2\}$

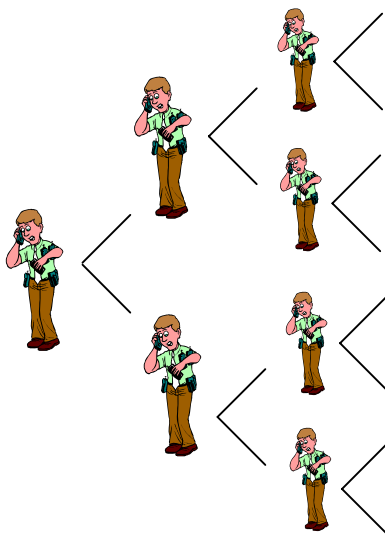
9. An olympic diver dives from the high diving board. The distance, d , in metres, from the surface of the water varies with the time, t , in seconds, that have passed since she left the board, according to the equation $d = -2t^2 + 3t + 10$. What is her maximum elevation above the water during the dive? (rounded to the nearest unit)

- A. 3 metres B. 10 metres
C. 11 metres D. 12 metres

10. Which of the following is NOT a geometric sequence?

- A. $\{\frac{1}{10}, \frac{3}{20}, \frac{9}{40}, \dots\}$ B. $\{24, 18, 13.5, \dots\}$
C. $\{0.8, 0.08, 0.008, \dots\}$ D. $\{\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \dots\}$

11. The students at East High School are planning a surprise party for the principal. One student tells two other students who in turn each tell two other people and so on as indicated in the following diagram:



What type of sequence is depicted by this situation?

- | | |
|--------------|---------------|
| A. cubic | B. geometric |
| C. quadratic | D. arithmetic |

12. $\sqrt[3]{y^{-5}}$ can also be expressed as

- | | |
|---|---|
| A. y^{-15} | B. $\left(\frac{1}{y}\right)^{\frac{5}{3}}$ |
| C. $\left(\frac{1}{y}\right)^{\frac{5}{3}}$ | D. $-y^{\frac{5}{3}}$ |

13. Which of the following expressions is equivalent to $2\log B - \log C + \log D$?

- | | |
|-------------------------------------|--------------------------------------|
| A. $2\log\left(\frac{BD}{C}\right)$ | B. $\log\left(\frac{B^2D}{C}\right)$ |
| C. $\log\left(\frac{2BD}{C}\right)$ | D. $\log\left(\frac{B^2}{CD}\right)$ |

23. A bag contains 12 green marbles, 10 red marbles and 18 white marbles. Bill removes 1 marble from the bag. The probability that Bill removes a red marble from the bag is

A. $\frac{1}{4}$

B. $\frac{1}{10}$

C. $\frac{1}{3}$

D. $\frac{1}{40}$

24. If an event can succeed in s ways and fail in f ways, then the probability of success is

A. $\frac{s}{f}$

B. $\frac{s}{f + s}$

C. $s \times f$

D. $1 - f$

25. In a school of 200 students, 80 have blood type O. If 5 students are chosen at random, what is the probability of selecting five students with type O blood?

A. $\frac{1}{80} \times \frac{1}{79} \times \frac{1}{78} \times \frac{1}{77} \times \frac{1}{76}$

B. $\frac{5}{{}_{80}C_5}$

C. $\frac{5}{{}_{80}P_5}$

D. $\frac{{}_{80}C_5}{{}_{200}C_5}$

Constructed-Response Questions
(Total Value: 80.5 points)

Read each question carefully, and be sure to write your response in the box and space provided. If 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.

When working with decimal values, you may round off 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.

With the exception of the probability unit, all answers must be given in simplified form.

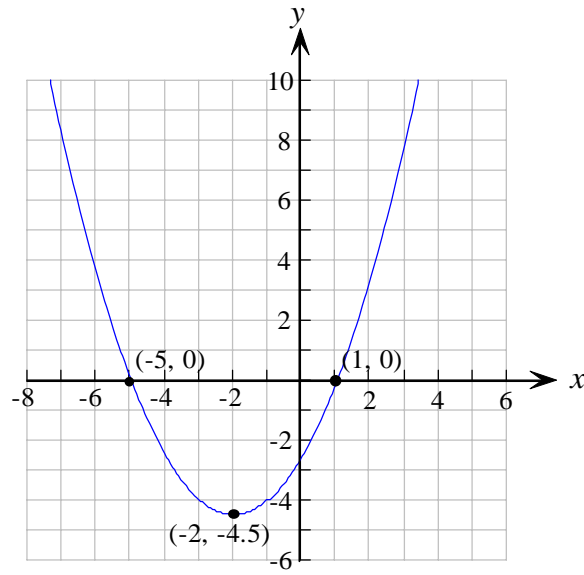
26. Given the quadratic function $y = -3x^2 + 12x + 6$.

- (a) Algebraically determine the coordinates of the vertex of the parabola represented by the function above. (3 points)

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

- (b) State whether the vertex in (a) is a maximum point or a minimum point. Explain how you know. (1 point)

27. Given the graph below, do the following tasks without using the regression feature on your graphing calculator.



- (a) Determine the transformational form of the function represented by the above graph. (3 points)

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

- (b) On the same grid above, trace a parabola that has the same x-intercepts as the given parabola and a maximum value of 9. Write the coordinates of the vertex and 3 other points on this parabola. (2.5 points)

28. Solve algebraically to find the exact roots of the following equations. Simplify where possible.

(a) $5x^2 + 3x - 7 = 0$

(3 points)

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

(b) $2x(3x+1) - 3x = 3 - 4x(-3+x)$

(3.5 points)

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

29. A snowball is thrown into the air. The function $h = -4.9t^2 + 20t + 1.8$ expresses the relationship between height, h , in metres and time, t , in seconds.

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

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

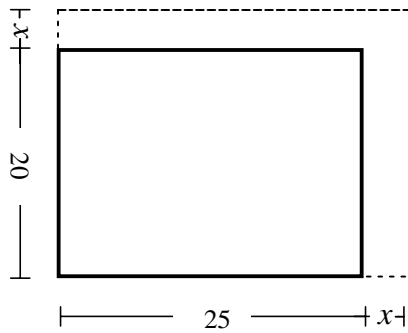
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(b) How long is the snowball in the air? (2 points)

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

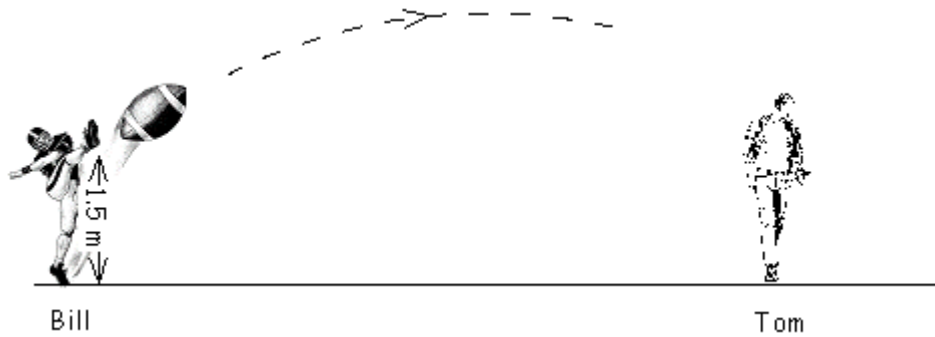
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30. A rectangular rink with dimensions of 25 m by 20 m is to be expanded by adding a rectangular strip of uniform width as shown below. If the new rink is to have an area of 644 m^2 , what will be the width of the strip? (4 points)



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

31. Bill kicks a football in Tom's direction. The football follows a parabolic path. Tom, who does not know it has been kicked, may be standing in the football's path. After having travelled a horizontal distance of 10 metres, the football reaches a maximum height of 18 metres. Will Tom, who is 1.8 metres tall, get hit by the football if he's standing 19.8 metres from the where the football was kicked? Solve this problem algebraically. (5 points)



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

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32. Algebraically solve for x :

(a) $25^{x+2} = 125^{2x}$

(2 points)

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

(b) $8(2)^{x+3} = 120$

(2 points)

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

(c) $\log_2(3x) + \log_2 10 = \log_3 81$

(2 points)

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

33. Michael was running a Biology experiment where he was determining and recording the approximate number of bacteria over time. The following is a partial record of some of the readings.

No. of hours	0	2	4	6	8	10	12
No. of bacteria			100			800	1600

(a) What was the initial number of bacteria in the culture? (1 point)

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

(b) Determine an equation to calculate the number of bacteria at any time. (1.5 points)

Final Answer

(c) What is the bacteria count after 20 hours? (1 point)

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

34. 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? Clearly define the variable(s) you use. (4 points)

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

35. (a) Describe in words how the graphs of $y=b^x$ and $y=b^{-x}$ for $b>0$, and $b\neq 1$ are related.

You must state a total of 3 similarities and/or differences.

(3 points)

(b) Given the function $y = ab^x$, for what values of 'a' and 'b' will the graph of the function be an exponential growth curve?

(2 points)

36. Susan tried to solve the equation $x = \log_2(-3)$. She got the error message 'NONREAL ANS' on her TI-83 calculator when trying to evaluate $\log_2(-3)$. Explain why.

(2 points)

37. When Drug 1 enters the bloodstream, it gradually dilutes, decreasing exponentially, by 20% every 5 days. A second drug, after entering the bloodstream, also decreases exponentially, but by 10% every 7 days. If the initial amount of Drug 1 is 200 mg and the initial amount of Drug 2 is 150 mg, create and use functions to determine which drug has the greater amount remaining after 12 days. (5 points)

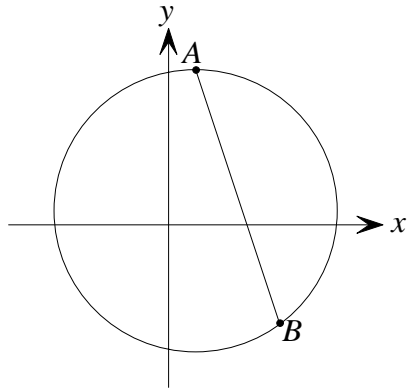
Show your work above and write your conclusion or final answer in the box below.

38. A chord \overline{AB} is 9 cm from the centre of the circle whose radius is 15 cm. What is the length of \overline{AB} ? Points will be awarded for a relevant labelled diagram.

(4 points)

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

39. In the following diagram the points A(2, 11) and B(8, -7) are on the circumference of the circle.



(a) Determine the equation of the perpendicular bisector of chord \overline{AB} . (5 points)

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

(b) Determine algebraically if the perpendicular bisector of chord \overline{AB} passes through the point $(-4, -2)$. (1 point)

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

40. Prove that $\triangle XYZ$ with vertices $X(3, 4)$, $Y(4, -1)$, and $Z(-1, -2)$ is an isosceles triangle and not an equilateral triangle. (4 points)

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

41. One card is selected from a standard deck of 52 playing cards. What is the probability that the card selected is a diamond or an ace? (2.5 points)

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

42. From a group of 5 men and 6 women, what is the probability that a committee formed at random will consist of 3 men and 3 women? (3.5 points)

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

43. Joe, Mary, and George are among the seven finalists for a random draw to win three different prizes. What is the probability that Joe will win 1st prize, Mary will win 2nd prize, and George will win 3rd prize? Express your answer in fraction form. (2 points)

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

44. John, Amy, and Fred tried to solve the following problem:

In a certain city, during a person's lifetime the probability of having diabetes is 0.10 and the probability of having cancer is 0.05. What is the probability of a person having either diabetes or cancer in his/her lifetime ?

Suppose that event C is 'person having cancer' and event D is 'person having diabetes'.

Their proposed solutions are as follows:

John's solution: $P(C \text{ and } D) = 0.10 \times 0.05 = 0.005$

Amy's solution: $P(C \text{ or } D) = 0.10 + 0.05 = 0.15$

Fred's solution: $P(C \text{ or } D) = 0.10 + 0.05 - 0.005 = 0.145$

(a) Which student has the correct answer? (1 point)

<i>Final Answer</i>	
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(b) Explain why the other two solutions are NOT correct. (2 points)

**You have reached the end of the SAMPLE Mathematics 12 Examination.
Please check your work to ensure you have completed all questions.**

Formula Sheet – Mathematics 12

Quadratics Unit

General form: $y = ax^2 + bx + c$

Standard form: $y = a(x - h)^2 + k$

Transformational form: $\frac{1}{a}(y - k) = (x - h)^2$

If $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Exponential Growth Unit

$$y = ab^x$$

$$\log_a(xy) = \log_a x + \log_a y$$

$$\log_a(x \div y) = \log_a x - \log_a y \quad \text{or} \quad \log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$$

$$\log_a x^b = b(\log_a x)$$

Circle Geometry Unit

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$\text{The coordinates of M are: } \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

$$m = \frac{\Delta y}{\Delta x}$$

Probability Unit

$$P(\text{A and B}) = P(\text{A}) \times P(\text{B})$$

$$P(\text{A or B}) = P(\text{A}) + P(\text{B}) - P(\text{A and B})$$

$${}_n P_r = \frac{n!}{(n-r)!}$$

$${}_n C_r = \frac{n!}{r!(n-r)!}$$



**Nova Scotia Examinations
Mathematics 12
Web Sample 1**

Marking Guide

Selected Response Answers

- | | |
|-------|-------|
| 1. C | 14. D |
| 2. B | 15. A |
| 3. A | 16. C |
| 4. C | 17. A |
| 5. D | 18. B |
| 6. B | 19. C |
| 7. A | 20. D |
| 8. B | 21. D |
| 9. C | 22. A |
| 10. D | 23. A |
| 11. B | 24. B |
| 12. C | 25. D |
| 13. B | |

Question 26 (a)

(3 points)

$y = -3x^2 + 12x + 6$ $x = \frac{-b}{2a}$ $= \frac{-12}{(2)(-3)}$ $= \frac{-12}{-6}$ $= 2$ <p style="text-align: right;">$f(2) = -3x^2 + 12x + 6$ 0.5 pt</p> $= -3(2)^2 + 12(2) + 6$ $= -12 + 24 + 6$ $= 18$ <p style="text-align: right;">0.5 pt</p>	$y = -3x^2 + 12x + 6$ $y = -3(x^2 - 4x - 2)$ $y = -3(x^2 - 4x - 2 + 6 - 6)$ $y = -3(x - 2)^2 + 18$ $-\frac{1}{3}(y - 18) = (x - 2)^2$ <p style="text-align: center;">OR</p> <p>Note: Last step may be omitted and then the final answer gets a 1 pt value.</p>
<p>The coordinates of the vertex are (2, 18).</p>	

Question 26 (b)

(1 point)

0.5 pt

The vertex is a maximum point because:

- the 'a' value is negative
- graphing the function $y = -3x^2 + 12x + 6$ shows it is a maximum. (with accompanying sketch)
- values for 'y' decrease for 'x' values on either side of the vertex.
- any other correct explanation

0.5 pt

Question 27 (a)

(3 points)

<div style="display: flex; justify-content: space-between; margin-bottom: 10px;"> <div style="border: 1px solid gray; padding: 2px 5px; font-size: 0.8em;">0.5 pt</div> <div style="border: 1px solid gray; padding: 2px 5px; font-size: 0.8em;">0.5 pt</div> </div> $\frac{1}{a}(y + 4.5) = (x + 2)^2$ $\frac{1}{a}(0 + 4.5) = (1 + 2)^2$ <div style="text-align: right; margin-right: 20px;">1 pt</div> $\frac{4.5}{a} = 9$ $a = \frac{4.5}{9}$ $a = \frac{1}{2}$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 20px;"> <div style="text-align: center;"> $\therefore \left. \begin{aligned} 2(y + 4.5) &= (x + 2)^2 \\ \text{OR} \\ \frac{1}{\frac{1}{2}}(y + 4.5) &= (x + 2)^2 \end{aligned} \right\}$ </div> <div style="border: 1px solid gray; padding: 2px 5px; font-size: 0.8em;">0.5 pt</div> </div>	<p>To go from $(-2, -4.4)$ there is a horizontal translation is 3 and a vertical translation of 4.5. If there was no vertical stretch the vertical translation should be 9, therefore the vertical stretch must be $\frac{1}{2}$.</p> <div style="text-align: center; margin-top: 20px;"> $\therefore \left. \begin{aligned} 2(y + 4.5) &= (x + 2)^2 \\ \text{OR} \\ \frac{1}{\frac{1}{2}}(y + 4.5) &= (x + 2)^2 \end{aligned} \right\}$ </div> <div style="text-align: right; margin-right: 20px;">1.5 pt</div>
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Question 27 (b)

(2.5 points)

<div style="display: flex; justify-content: space-between; margin-bottom: 10px;"> <div style="border: 1px solid gray; padding: 2px 5px; font-size: 0.8em;">0.5 pt</div> </div>	<p>Award 0.5 pt for a correctly drawn parabola passing through the vertex and the correct x-intercepts.</p> <p>Award 0.5 pt for each of the 3 other points labeled on the parabola.</p>
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Question 28 (a)

(3 points)

$$x = \frac{-3 \pm \sqrt{(3)^2 - (4)(5)(-7)}}{2(5)} \quad \text{1 pt}$$
$$= \frac{-3 \pm \sqrt{149}}{10} \quad \text{1 pt}$$

$$x = \frac{3 + \sqrt{149}}{10} \quad \text{0.5 pt}$$
$$x = \frac{3 - \sqrt{149}}{10} \quad \text{0.5 pt}$$

Question 28 (b)

(3.5 points)

$$6x^2 + 2x - 3x = 3 + 12x - 4x^2$$
$$10x^2 - 13x - 3 = 0 \quad \text{0.5 pt}$$

$$x = \frac{13 \pm \sqrt{(13)^2 - (4)(10)(-3)}}{2(10)} \quad \text{1 pt}$$
$$= \frac{13 \pm \sqrt{289}}{20} \quad \text{1 pt}$$

$$x = \frac{13+17}{20} = \frac{3}{2} \quad \text{0.5 pt}$$
$$x = \frac{13-17}{20} = -\frac{1}{5} \quad \text{0.5 pt}$$

OR

$$10x^2 - 15x - 3 = 0$$
$$5x(2x-3) + 1(2x-3) = 0$$
$$(5x+1)(2x-3) = 0 \quad \text{1 pt}$$

$$5x+1 = 0 \quad \text{0.5 pt}$$
$$x = -\frac{1}{5} \quad \text{0.5 pt}$$
$$2x-3 = 0 \quad \text{0.5 pt}$$
$$x = \frac{3}{2} \quad \text{0.5 pt}$$

Question 29(a)

(3 points)

$$\begin{aligned}
 h &= -4.9t^2 + 20t + 1.8 && \text{0.5 pt} \\
 &= -4.9(t^2 - 4.0816t) + 1.8 && \text{0.5 pt} \quad \text{1 pt} \\
 &= -4.9(t^2 - 4.0816t + 4.1649) + 1.8 + 20.4078 \\
 &= -4.9(t - 2.0408)^2 + 22.2078
 \end{aligned}$$

The maximum height is 22.21 metres. 1 pt

OR

$$\begin{aligned}
 -\frac{1}{4.9}h &= t^2 - 4.0816t - 0.3673 && \text{0.5 pt} \\
 -\frac{1}{4.9}h + 0.3673 + 4.1649 &= t^2 - 4.0816t + 4.1649 && \text{1 pt} \\
 -\frac{1}{4.9}h + 4.5322 &= (t - 2.0408)^2 \\
 -\frac{1}{4.9}(h - 22.2078) &= (t - 2.0408)^2
 \end{aligned}$$

0.5 pt

The maximum height is 22.21 metres. 1 pt

OR

$$\left. \begin{aligned}
 t &= -\frac{b}{2a} \\
 &= -\frac{20}{2(-4.9)} \\
 &\doteq 2.0408
 \end{aligned} \right\} \text{1 pt}$$

$$\begin{aligned}
 h &\doteq -4.9(2.0408)^2 + 20(2.0408) + 1.8 \\
 &\doteq 22.21
 \end{aligned}$$

1 pt

1 pt

The maximum height is 22.21 metres.

$$\left. \begin{aligned}
 h &= \frac{4ac - b^2}{4a} \\
 &= \frac{4(-4.9)(1.8) - (20)^2}{4(-4.9)} \\
 &\doteq 22.21
 \end{aligned} \right\} \text{2 pt}$$

The maximum height is 22.21 metres.

1 pt

Question 29(b)

(2 points)

Note: $2 \times 2.04 = 4.08$ is not an acceptable answer.

$$t = \frac{-20 \pm \sqrt{(20)^2 - 4(-4.9)(1.8)}}{2(-4.9)}$$

$$= \frac{-20 \pm \sqrt{435.28}}{-9.8}$$

1 pt

$$t = \cancel{-0.09} \quad t = 4.17$$

1 pt

The snowball is in the air for 4.17 seconds.

$$-\frac{1}{4.9}(0 - 22.2078) = (t - 2.0408)^2$$

$$4.5322 = (t - 2.0408)^2$$

$$\pm 2.1289 = t - 2.0408$$

$$t = 2.0408 \pm 2.1289$$

$$t = 4.17 \quad t = \cancel{-0.09}$$

1 pt

The snowball is in the air for 4.17 seconds.

1 pt

Note: Deduct 0.5 pt if -0.09 is not discarded.

OR

$$-4.9(t - 2.0408)^2 + 22.2078 = 0$$

$$-4.9(t - 2.0408)^2 = -22.2078$$

$$(t - 2.0408)^2 = 4.5322$$

$$t - 2.0408 = \pm 2.1289$$

$$t = \pm 2.1289 + 2.0408$$

$$t = 4.17 \quad t = \cancel{-0.09}$$

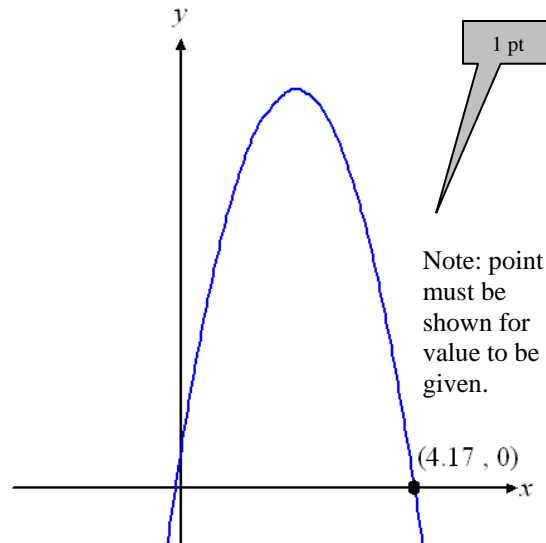
1 pt

1 pt

The snowball is in the air for 4.17 seconds.

Note: Deduct 0.5 pt if -0.09 is not discarded.

$$y_1 = -4.9x^2 + 20x + 1.8$$



1 pt

1 pt

The snowball is in the air for 4.17 seconds.

Question 30

(4 points)

$(x + 20)(x + 25) = 644$ (0.5 pt) (0.5 pt) (0.5 pt)

$x^2 + 45x + 500 = 644$

$x^2 + 45x - 144 = 0$ (1 pt)

$(x + 48)(x - 3) = 0$ (1 pt)

$x + 48 = 0$
 $x = \cancel{-48}$

$x - 3 = 0$
 $x = 3$ (0.5 pt)

OR

$x = \frac{-45 \pm \sqrt{(45)^2 - 4(1)(-144)}}{2(1)}$

$= \frac{-45 \pm \sqrt{2601}}{2}$

$= \frac{-45 \pm 51}{2}$

$x = 3$ (0.5 pt) $x = \cancel{-48}$ (0.5 pt)

(1 pt)

The width of the strip is 3 m.

Note: Deduct 0.5 pt if -48 is not discarded.

Question 31

(5 points)

$y = a(x - 10)^2 + 18$ (1 pt)

$(0, 1.5) \Rightarrow 1.5 = a(0 - 10)^2 + 18$ (0.5 pt)

$-16.5 = 100a$

$-0.165 = a$ (0.5 pt)

$y = -0.165(x - 10)^2 + 18$

$= -0.165(19.8 - 10)^2 + 18$ (1 pt)

$= 2.15$ (1 pt)

2.15 m > 1.8 m therefore the football will not hit Tom. (1 pt)

Question 32 (a)

(2 points)

$(5^2)^{x+2} = (5^3)^{2x} \quad \text{0.5 pt}$ $5^{2x+4} = 5^{6x} \quad \text{0.5 pt}$ $\therefore 2x+4 = 6x \quad \text{0.5 pt}$ $4 = 4x$ $1 = x \quad \text{0.5 pt}$	OR	$\log 25^{x+2} = \log 125^{2x} \quad \text{0.5 pt}$ $(x+2)\log 25 = 2x\log 125 \quad \text{0.5 pt}$ $x+2 = 2x \frac{\log 125}{25}$ $x+2 = 2x(1.5) \quad \text{0.5 pt}$ $x+2 = 3x$ $2 = 2x$ $1 = x$
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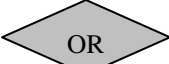
Question 32 (b)

(2 points)

$2^{x+3} = 15 \quad \text{0.5 pt}$ $\log 2^{x+3} = \log 15 \quad \text{0.5 pt}$ $(x+3)\log 2 = \log 15 \quad \text{0.5 pt}$ $x+3 = \frac{\log 15}{\log 2}$ $x \doteq -3 + 3.9069$ $x \doteq 0.91 \quad \text{0.5 pt}$	OR	$2^{x+3} = 15 \quad \text{0.5 pt}$ $\log_2 15 = x+3 \quad \text{0.5 pt}$ $3.9069 \doteq x+3 \quad \text{0.5 pt}$ $0.91 \doteq x \quad \text{0.5 pt}$
$(2^3)(2^{x+3}) = 120 \quad \text{0.5 pt}$ $2^{x+6} = 120 \quad \text{0.5 pt}$ $(x+6)\log 2 = \log 120 \quad \text{0.5 pt}$ $x+6 = \frac{\log 120}{\log 2}$ $x \doteq -6 + 6.9069$ $x \doteq 0.91 \quad \text{0.5 pt}$		$(2^3)(2^{x+3}) = 120$ $2^{x+6} = 120 \quad \text{0.5 pt}$ $\log_2 120 = x+6 \quad \text{0.5 pt}$ $6.9069 \doteq x+6 \quad \text{0.5 pt}$ $0.91 \doteq x \quad \text{0.5 pt}$

Question 32 (c)

(2 points)

$\log_2 30x = \log_3 81$ 0.5 pt $\log_2 30x = 4$ 0.5 pt $2^4 = 30x$ 0.5 pt $16 = 30x$ $\frac{8}{15} = x$ 0.5 pt		$\log_2 30x = \log_3 81$ 0.5 pt $\log_2 30x = 4$ 0.5 pt $\log_2 30x = \log_2 16$ 0.5 pt $30x = 16$ $x = \frac{8}{15}$ 0.5 pt
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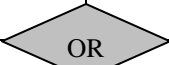
Question 33 (a)

(1 point)

$P = P_0 (2)^{\frac{t}{2}}$ $100 = P_0 (2)^{\frac{4}{2}}$ $100 = 4P_0$ $25 = P_0$	<p>Note: answer only is worth full value.</p>
<p>The initial number of bacteria in the culture was 25.</p>	

Question 33 (b)

(1.5 points)

$P = 25(2)^{\frac{t}{2}}$ <div style="display: flex; justify-content: space-around; margin-top: 5px;"> 0.5 pt 0.5 pt </div>		$y = 25(1.41)^x$ 1 pt Exp Reg on TI-83 0.5 pt
$y = a(b)^x$ $a = 25$	$(4, 100) \Rightarrow 100 = 25(b)^4$ 0.5 pt $4 = b^4$ $\sqrt[4]{4} = b$ $1.41 \doteq b$ 0.5 pt	$y = 25(1.41)^x$ 0.5 pt

Question 33 (c)

(1 point)

$y = 25(1.41)^x$ $= 25(1.41)^{20}$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $\doteq 24117$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <p>There are approximately 24117 bacteria after 20 hours.</p>		$y = 25(2)^{\frac{x}{2}}$ $y = 25(2)^{\frac{20}{2}}$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $y = 25(2)^{10}$ $y = 25600$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <p>There are approximately 25600 bacteria after 20 hours.</p>
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Question 34

(4 points)

<div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $900 = 300(1.04)^t$ $3 = 1.04^t$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $\log_{1.04} 3 = t$ <div style="text-align: right; margin-right: 20px;">1 pt</div> $28.01 \doteq t$ <div style="text-align: right; margin-right: 20px;">1 pt</div> <p>It will take 28.01 yrs for the price to triple.</p>		<div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $900 = 300(1.04)^t$ $3 = 1.04^t$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $\log 3 = t \log 1.04$ <div style="text-align: right; margin-right: 20px;">1 pt</div> $\frac{\log 3}{\log 1.04} = t$ $28.01 \doteq t$ <div style="text-align: right; margin-right: 20px;">1 pt</div> <p>It will take 28.01 yrs for the price to triple.</p>
<div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $3C = C(1.04)^t$ $3 = 1.04^t$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $\log_{1.04} 3 = t$ <div style="text-align: right; margin-right: 20px;">1 pt</div> $28.01 \doteq t$ <div style="text-align: right; margin-right: 20px;">1 pt</div> <p>It will take 28.01 yrs for the price to triple.</p>		<div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $3C = C(1.04)^t$ $3 = 1.04^t$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $\log 3 = t \log 1.04$ <div style="text-align: right; margin-right: 20px;">1 pt</div> $\frac{\log 3}{\log 1.04} = t$ $28.01 \doteq t$ <div style="text-align: right; margin-right: 20px;">1 pt</div> <p>It will take 28.01 yrs for the price to triple.</p>

Question 35 (a)

(3 points)

Note: The answers must refer to the graphs and NOT the equations.

Here are some examples:

- same y-intercept
- when $y = b^x$ is increasing, $y = b^{-x}$ is decreasing
- each is a reflection of the other in $x = 0$
- same horizontal asymptotes
- neither have x -intercepts

Question 35 (b)

(2 points)

$$\underbrace{a > 0}_{1 \text{ pt}} \quad \text{and} \quad \underbrace{b > 1}_{1 \text{ pt}}$$

Question 36

(2 points)

$$\log_2(-3) = x \quad 2^x \text{ is always positive therefore it cannot equal } -3.$$

$$2^x = -3$$

OR

The domain of $y = \log_a x$ is $x > 0, x \in \mathbb{R}$.

OR

Susan has her calculator set to give only real number answers.

Question 37

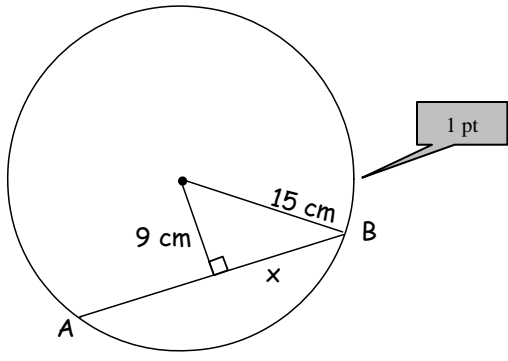
(5 points)

<p>Drug 1</p> $M = 200(0.8)^{\frac{d}{5}}$ $= 200(0.8)^{\frac{12}{5}}$ $= 117.07$	<p>Drug 2</p> $M = 150(0.9)^{\frac{d}{7}}$ $= 150(0.9)^{\frac{12}{7}}$ $= 125.21$
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Drug 2 has a greater amount remaining after 12 days.

Question 38

(4 points)



1 pt

$$15^2 = 9^2 + x^2$$
$$15^2 - 9^2 = x^2$$
$$144 = x^2$$
$$12 = x$$

1 pt

The length of the chord is 24 cm.

1 pt

Question 39(a)

(5 points)

Midpoint of $\overline{AB} = \left(\frac{2+8}{2}, \frac{11+(-7)}{2}\right)$ 0.5 pt
 $= (5, 2)$ 0.5 pt

$m_{\overline{AB}} = \frac{11 - (-7)}{2 - 8}$ 0.5 pt
 $= \frac{18}{-6}$
 $= -3$ 0.5 pt

\therefore slope of \perp bisector is $\frac{1}{3}$ 1 pt

$y = \frac{1}{3}x + b$

$(5, 2) \Rightarrow 2 = \frac{1}{3}(5) + b$ 0.5 pt
 $6 = 5 + 3b$
 $1 = 3b$
 $\frac{1}{3} = b$ 0.5 pt

The equation of the perpendicular bisector
is $y = \frac{1}{3}x + \frac{1}{3}$. 1 pt

Question 39(b)

(1 point)

$(-4, -2) \Rightarrow \left. \begin{aligned} -2 &\stackrel{?}{=} \frac{1}{3}(-4) + \frac{1}{3} \\ -2 &\stackrel{?}{=} \frac{-4}{3} + \frac{1}{3} \\ -2 &\neq 1 \end{aligned} \right\}$ 0.5 pt

The point is not on the line since it does not satisfy the equation of the perpendicular bisector. 0.5 pt

Question 40

(4 points)

$d_{\overline{XY}} = \sqrt{(4-3)^2 + (-1-4)^2}$ <p style="text-align: right; margin-right: 20px;">0.5 pt</p> $= \sqrt{1+25}$ $= \sqrt{26}$ <p style="text-align: right; margin-right: 20px;">0.5 pt</p>	$d_{\overline{XZ}} = \sqrt{(3+1)^2 + (4+2)^2}$ <p style="text-align: right; margin-right: 20px;">0.5 pt</p> $= \sqrt{16+36}$ $= \sqrt{52}$ <p style="text-align: right; margin-right: 20px;">0.5 pt</p>
$d_{\overline{YZ}} = \sqrt{(4+1)^2 + (-1+2)^2}$ <p style="text-align: right; margin-right: 20px;">0.5 pt</p> $= \sqrt{25+1}$ $= \sqrt{26}$ <p style="text-align: right; margin-right: 20px;">0.5 pt</p>	<p>$\triangle XYZ$ has only 2 equal sides \therefore it is isosceles and not equilateral.</p> <p style="text-align: right; margin-right: 20px;">1 pt</p>

Question 41

(2.5 points)

$$P(D \text{ or } A) = P(D) + P(A) - P(D \text{ and } A)$$

0.5 pt 0.5 pt 1 pt

$$= \frac{13}{52} + \frac{4}{52} - \frac{1}{52}$$
$$= \frac{16}{52} \text{ or } \doteq 0.31$$

0.5 pt

Question 42

(3.5 points)

$$= \frac{{}_5C_3 \times {}_6C_3}{{}_{11}C_6}$$

1 pt 1 pt 1 pt

$$= \frac{10 \times 20}{462}$$
$$= \frac{200}{462} \text{ or } \doteq 0.43$$

0.5 pt

Question 43

(2 points)

<p>1 pt $\rightarrow \frac{1}{{}_7P_3} = \frac{1}{210} \leftarrow$ 1 pt</p>	<p>OR</p>	<p>0.5 pt $\frac{1}{7} \times \frac{1}{6} \times \frac{1}{5} = \frac{1}{210}$ 0.5 pt</p> <p>0.5 pt \leftarrow 0.5 pt</p>
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Question 44(a)

(1 point)

<p>1 pt \rightarrow</p>	<p>Fred has the correct answer.</p>
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Question 44(b)

(2 points)

Student's answers should address the following:

<p>1 pt \rightarrow</p>	<p>John's solution is not correct because he calculated the probability of C and D, not C or D.</p>
<p>1 pt \rightarrow</p>	<p>- Amy's solution does not discard the probability of C and D occurring.</p>