



**Nova Scotia Examinations
Advanced 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 75 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.

1. If in a sequence the second difference is constant, then the sequence is

- A. arithmetic
B. linear
C. quadratic
D. cubic

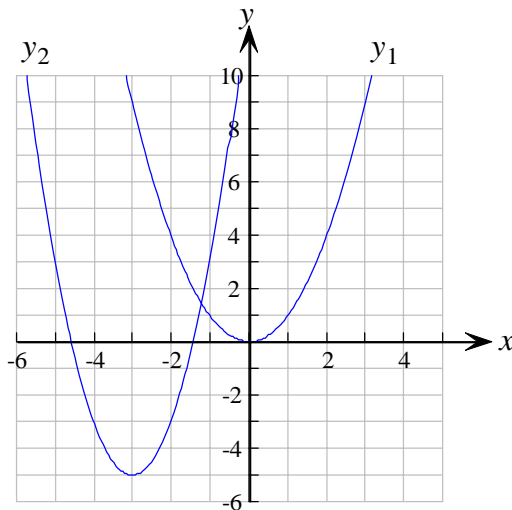
2. The equation of the axis of symmetry of the parabola represented by the function $y = x^2 - 2$ is

- A. $x = 2$
B. $x = -2$
C. $y = 2$
D. $x = 0$

3. Given the equation $x^2 + 48 = 0$, then x is equal to

- A. $\pm 4\sqrt{3}$
B. $\pm 4\sqrt{3}i$
C. 6.9
D. no possible value

4. Which mapping rule describes how to map function y_1 onto the function y_2 ?



- A. $(x, y) \rightarrow (x-3, 2y-5)$
B. $(x, y) \rightarrow (2x-3, y+5)$
C. $(x, y) \rightarrow (2x-3, y-5)$
D. $(x, y) \rightarrow (x-3, \frac{1}{2}y+5)$

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

- A. $-\frac{b}{2a}$
B. c
C. $\frac{c}{a}$
D. $\frac{4ac - b^2}{4a}$

13. Which of the following expressions is equivalent to $2x^{-\frac{3}{2}}$?

A. $\frac{1}{2x^{\frac{3}{2}}}$

B. $\left(\frac{1}{2x}\right)^{\frac{2}{3}}$

C. $\frac{2}{x^{\frac{3}{2}}}$

D. $\frac{2}{\sqrt[3]{x^2}}$

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

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

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

C. $\log 16 - \log 2x$

D. $(\log 4 - \log x)^2$

15. The table given shows how two dollars invested over a period of years grows in value when interest is compounded annually. What is the approximate annual interest rate?

x (years)	1	2	3	4
y (\$)	2.06	2.12	2.18	2.25

A. 1.03%

B. 3%

C. 6%

D. 9.7%

16. If $\log_x\left(\frac{1}{64}\right) = -\frac{3}{2}$ then x is equal to

A. 16

B. 8

C. $\frac{1}{8}$

D. $\frac{1}{16}$

17. Which of the following relationships cannot be modelled using an exponential function?

A. growth of a population

B. compound interest

C. half-life of radioactive elements

D. tidal cycles

18. The Alaska quake of 1964 measured 9.2 on the Richter scale, and the Sri Lanka quake of 2004 measured 9.0. How many times more intense was the Alaska quake? (rounded to the nearest hundredth)

A. 0.20

B. 1.01

C. 1.02

D. 1.58

23. 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. $1 - f$

24. Two dice are thrown. Given that the sum of the two numbers on the pair of dice is greater than 7, what is the probability that these two numbers are the same?

A. $\frac{1}{5}$

B. $\frac{5}{12}$

C. $\frac{1}{12}$

D. $\frac{1}{2}$

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

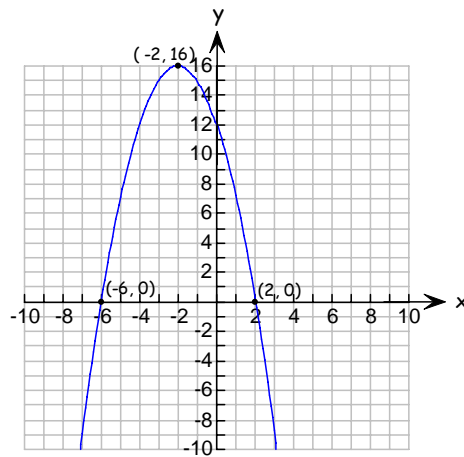
Constructed-Response Questions
(Total Value: 75 points)

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



(a) Determine the general form of the function represented by the above graph.

(2 points)

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

(b) On the same grid as above, trace a parabola that has the same x -intercepts as the given parabola and a maximum value of 8. Indicate the coordinates of the vertex and 2 other points on the curve. (1.5 points)

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

(a) $3x^2 = -6x$

(1.5 points)

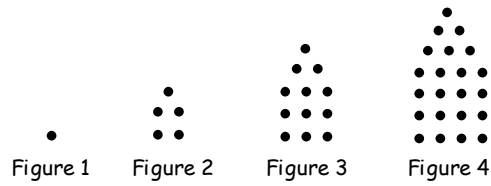
Show your work above and write your conclusion or final answer in the box below.

(b) $\frac{3}{3-x} + \frac{4}{x+2} = 4$

(3 points)

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

28. The number of dots in each of the following figures forms a sequence.



(a) Algebraically determine the function that generates the sequence.

(3 points)

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

(b) If the figures continue to follow the same pattern, which figure would contain exactly 590 dots?

(1 point)

Final Answer

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.

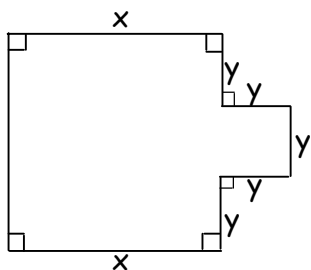
(a) Algebraically determine the maximum height the snowball reaches. (3 points)

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

(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.

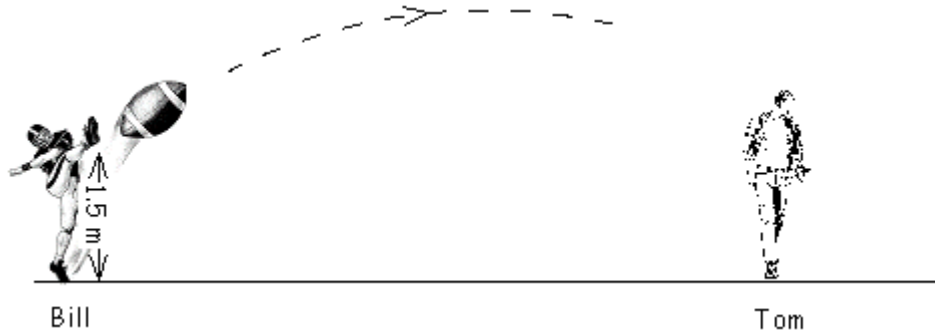
30. A piece of land in the shape below has to be fenced. If 600 m of fencing are to be used, find the values of x and y that will produce a maximum area. (5 points)



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 is unaware that he 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 1 metre from the spot where the football should hit the ground? Solve this problem algebraically.

(5 points)



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

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) $4^{2x} - 17(4^x) + 16 = 0$

(2 points)

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

33. (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)

34. 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)

35. When Drug 1 enters the bloodstream, it gradually dilutes, decreasing by 20% every 5 days. A second drug, after entering the bloodstream, also decreases but by 10% every 7 days. If Billy takes 200 mg of Drug 1 and Maria takes 150 mg of Drug 2 at the same time, when will the amount of the drug remaining in their bloodstreams be the same? (5 points)

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

36. An accident at a nuclear reactor released 20 g/km^2 of a radioactive material in the area around the reactor. After 5 months the contamination had dropped to 10 g/km^2 and scientists agree that the level must drop below 2 g/km^2 before it is safe for human habitation. How long before the workers can safely return to work? (3.5 points)

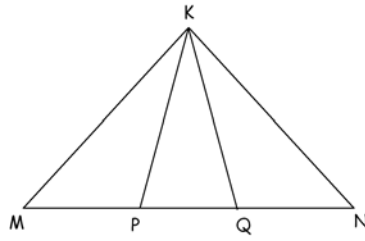
Show your work above and write your conclusion or final answer in the box below.

37. Given: $\angle KPQ \cong \angle KQP$

$$\overline{MQ} \cong \overline{NP}$$

Prove: $\overline{MK} \cong \overline{NK}$.

(4 points)

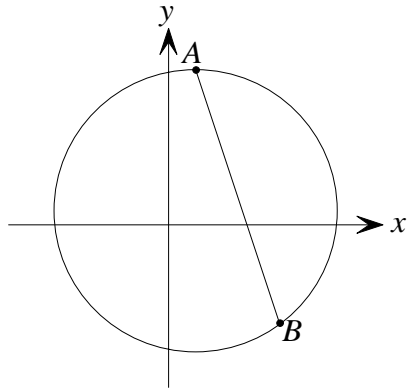


38. A circle has a diameter with endpoints A $(-3, 5)$ and B $(15, -3)$. Determine whether the point $(7, 8)$ is located inside, outside, or on the circumference of the circle.

(3 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} . (3 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. Rewrite each equation in transformational form. State whether the equation represents a circle or an ellipse. If it is a circle, state the centre and radius. If it is an ellipse, state the centre and the lengths of the two axes.

(a) $x^2 + y^2 - 8y = 1$

(2 points)

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

(b) $4x^2 + y^2 - 8x + 4y - 8 = 0$

(3 points)

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

41. Refer to the following chart.

(3 points)

	Event A	Event \bar{A}
Event B	10	20
Event \bar{B}	15	25

Calculate

(a) $P(A \text{ or } B)$

<i>Final Answer</i>	<input type="text"/>
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(b) $P(A|B)$

<i>Final Answer</i>	<input type="text"/>
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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.

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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 ADVANCED WEB SAMPLE 1 Examination.
Please check your work to ensure you have completed all questions.**

Formula Sheet – Advanced Mathematics 12

Quadratic 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

$$y = ab^x$$

$$A(y - C) = b^{B(x-D)}$$

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

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

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

Circle Geometry Unit

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

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

$$\text{General form: } Ax^2 + Ay^2 + Dx + Ey + F = 0$$

$$Ax^2 + By^2 + Dx + Ey + F = 0$$

$$\text{Standard form: } (x - h)^2 + (y - k)^2 = r^2$$

$$\text{Transformational form: } \left[\frac{1}{r}(x - h) \right]^2 + \left[\frac{1}{r}(y - k) \right]^2 = 1$$
$$\left[\frac{1}{a}(x - h) \right]^2 + \left[\frac{1}{b}(y - k) \right]^2 = 1$$

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

Probability Unit

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

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

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

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

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



**Nova Scotia Examinations
Advanced Mathematics 12
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Marking Guide

Selected Response Answers

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

Question 26 (a)

(2 points)

$-(y-16) = (x+2)^2$ 0.5 pt 0.5 pt 0.5 pt

$y = -(x+2)^2 + 16$

$y = -(x^2 + 4x + 4) + 16$

$y = -x^2 - 4x + 12$ 0.5 pt

OR

$y = a(x+6)(x-2)$ 0.5 pt 0.5 pt

$12 = a(0+6)(0-2)$ 0.5 pt

$12 = -12a$

$-1 = a$

$y = -(x+6)(x-2)$ 0.5 pt

$y = -x^2 - 4x + 12$ 0.5 pt

Question 26 (b)

(1.5 points)

One example:

0.5 pt each for:

- ✓ Vertex correctly placed and labeled.
- ✓ 2 correct coordinates placed and labeled
- ✓ General parabolic shape and opens downwards

Question 27 (a)

(1.5 points)

$3x^2 + 6x = 0$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $3x(x+2) = 0$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> <hr style="border-top: 1px dotted black;"/> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px; vertical-align: top;"> $3x = 0$ $x = 0$ </td> <td style="width: 50%; padding: 5px; vertical-align: top;"> $x + 2 = 0$ $x = -2$ </td> </tr> </table> <div style="text-align: center; margin-top: 10px;"> 0.5 pt both answers must be correct </div>	$3x = 0$ $x = 0$	$x + 2 = 0$ $x = -2$	$3x^2 + 6x = 0$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $x = \frac{-6 \pm \sqrt{6^2 - (4)(3)(0)}}{(2)(3)}$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $= \frac{-6 \pm \sqrt{36}}{6}$ <hr style="border-top: 1px dotted black;"/> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px; vertical-align: top;"> $x = \frac{-6 - 6}{6}$ $= -2$ </td> <td style="width: 50%; padding: 5px; vertical-align: top;"> $x = \frac{-6 + 6}{6}$ $= 0$ </td> </tr> </table> <div style="text-align: center; margin-top: 10px;"> 0.5 pt both answers must be correct </div>	$x = \frac{-6 - 6}{6}$ $= -2$	$x = \frac{-6 + 6}{6}$ $= 0$
$3x = 0$ $x = 0$	$x + 2 = 0$ $x = -2$				
$x = \frac{-6 - 6}{6}$ $= -2$	$x = \frac{-6 + 6}{6}$ $= 0$				

OR

$3x^2 + 6x = 0$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $x^2 + 2x = 0$ $x^2 + 2x + 1 = 1$ <div style="text-align: right; margin-right: 20px;">0.5 pt</div> $(x+1)^2 = 1$ $x+1 = \pm 1$ $x = -1 \pm 1$ <hr style="border-top: 1px dotted black;"/> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px; vertical-align: top;"> $x = -1 - 1$ $= -2$ </td> <td style="width: 50%; padding: 5px; vertical-align: top;"> $x = -1 + 1$ $= 0$ </td> </tr> </table> <div style="text-align: center; margin-top: 10px;"> 0.5 pt both answers must be correct </div>	$x = -1 - 1$ $= -2$	$x = -1 + 1$ $= 0$
$x = -1 - 1$ $= -2$	$x = -1 + 1$ $= 0$	

Question 27 (b)

(3 points)

$$3(x+2)+4(3-x)=4(x+2)(3-x) \quad \text{0.5 pt}$$

$$3x+6+12-4x=4(-x^2+x+6)$$

$$-x+18=-4x^2+25-8x$$

$$4x^2-5x-6=0 \quad \text{1 pt}$$

$$4x^2-8x+3x-6=0$$

$$4x(x-2)+3(x-2)=0$$

$$(4x+3)(x-2)=0 \quad \text{1 pt}$$

$$4x+3=0$$

$$4x=-3$$

$$x=-\frac{3}{4}$$

$$x-2=0$$

$$x=2$$

0.5 pt

both answers must be correct

$$x = \frac{5 \pm \sqrt{(-5)^2 - (4)(4)(-6)}}{(2)(4)} \quad \text{0.5 pt}$$

$$= \frac{5 \pm \sqrt{121}}{8} \quad \text{0.5 pt}$$

$$x = \frac{5-11}{8}$$

$$= -\frac{3}{4}$$

$$x = \frac{5+11}{8}$$

$$= 2$$

0.5 pt

both answers must be correct

OR

$$4x^2-5x=6$$

$$x^2 - \frac{5}{4}x = \frac{3}{2}$$

$$x^2 - \frac{5}{4}x + \frac{25}{64} = \frac{3}{2} + \frac{25}{64} \quad \text{0.5 pt}$$

$$\left(x - \frac{5}{8}\right)^2 = \frac{121}{64}$$

$$x - \frac{5}{8} = \pm \frac{11}{8} \quad \text{0.5 pt}$$

$$x = \frac{5}{8} \pm \frac{11}{8}$$

$$x = \frac{5}{8} - \frac{11}{8}$$

$$= -\frac{3}{4}$$

$$x = \frac{5}{8} + \frac{11}{8}$$

$$= 2$$

0.5 pt

both answers must be correct

Question 28 (a)

(3 points)

\therefore quadratic

$2a = 3$ Using $y = ax^2 + bx + c$
 $a = \frac{3}{2}$

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

$b + c = -\frac{1}{2}$
 $b = -\frac{1}{2}$

$\therefore 1 = \frac{3}{2} - \frac{1}{2} + c$
 $c = 0$

$y = \frac{3x^2}{2} - \frac{x}{2}$

OR Solving algebraically

$(1, 1) \Rightarrow a + b + c = 1$
 $(2, 5) \Rightarrow 4a + 2b + c = 5$
 $(3, 12) \Rightarrow 9a + 3b + c = 12$

$a = 1.5, b = -0.5, c = 0$
 $y = 1.5x^2 - 0.5x$

Question 28 (b)

(1 point)

$1.5x^2 - 0.5x = 590$
 $1.5x^2 - 0.5x - 590 = 0$

(any method)

~~$x = -59$~~ $x = 20$

The 20th figure contains 590 dots.

Note: deduct 0.5 pt if -59 not discarded.

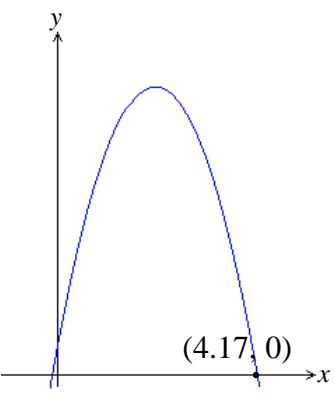
Question 29 (a)

(3 points)

$h = -4.9t^2 + 20t + 1.8$ $h - 1.8 = -4.9(t^2 - 4.0816t) \quad \text{0.5 pt}$ $h - 1.8 - 20.4082 = -4.9(t - 2.0408)^2 \quad \text{1 pt}$ $-\frac{1}{4.9}(h - 22.2082) = (t - 2.0408)^2 \quad \text{0.5 pt}$ <p>The maximum height is 22.21 m. 1 pt</p>	OR	$t = -\frac{b}{2a}$ $= -\frac{20}{2(4.9)}$ $\doteq 2.0408 \quad \text{1 pt}$ $h(t) = -4.9t^2 + 20t + 1.8$ $h(2.0408) = -4.9(2.0408)^2 + 20(2.0408) + 1.8$ $\doteq 22.2081 \quad \text{1 pt}$ <p>The maximum height is 22.21 m. 1 pt</p>
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Question 29 (b)

(2 points)

$x = \frac{-20 \pm \sqrt{20^2 - 4(-4.9)(1.8)}}{2(-4.9)} \quad \text{1 pt}$ $= \frac{-20 \pm \sqrt{435.28}}{-9.8}$ <p>$x = 0.09$ $x = 4.17$ 1 pt</p> <p>The snowball is in the air for 4.17 seconds.</p>	OR	$-\frac{1}{4.9}(0 - 22.2082) = (t - 2.0408)^2 \quad \text{1 pt}$ $4.5323 = (t - 2.0408)^2$ $\pm 2.1289 = t - 2.0408$ $t = 2.0408 \pm 2.1289$ <p>$t = 4.17$ $t = 0.09$ 1 pt</p> <p>The snowball is in the air for 4.17 seconds.</p>
OR		
$y = -4.9x^2 + 20x + 1.8$  <p style="text-align: right;">1 pt</p> <p style="text-align: right;">1 pt</p> <p>The snowball is in the air for 4.17 seconds.</p>		

Question 30

(5 points)

$$2x + 8y = 600$$

$$x = 300 - 4y \quad \text{1 pt}$$

$$A = 3xy + y^2 \quad \text{0.5 pt}$$

$$= 3y(300 - 4y) + y^2 \quad \text{0.5 pt}$$

$$= 900y - 12y^2 + y^2$$

$$= -11y^2 + 900y \quad \text{0.5 pt}$$

Maximum occurs at $y = -\frac{b}{2a}$

$$y = -\frac{900}{2(-11)}$$

$$\doteq 40.9091 \quad \text{1 pt}$$

$$\therefore x \doteq 300 - 4(40.9091)$$

$$\doteq 136.3636 \quad \text{0.5 pt}$$

OR

$$A = -11\left(y^2 - \frac{900}{11}y\right)$$

$$A - \frac{202500}{11} = -11\left(y^2 - \frac{900}{11}y + \frac{202500}{121}\right)$$

$$-\frac{1}{11}\left(A - \frac{202500}{11}\right) = \left(y - \frac{900}{22}\right)^2 \quad \text{0.5 pt}$$

$$y = \frac{900}{22}$$

$$\doteq 40.9091 \quad \text{0.5 pt}$$

$$\therefore x \doteq 300 - 4(40.9091)$$

$$\doteq 136.3636 \quad \text{0.5 pt}$$

A maximum area is produced when $x = 136.36$ m and $y = 40.91$ m.

Question 31

(5 points)

$$\frac{1}{a}(y-18) = (x+10)^2 \quad \text{0.5 pt}$$

$$(0, 1.5) \Rightarrow \frac{1}{a}(1.5-18) = (0-10)^2 \quad \text{0.5 pt}$$

$$\frac{-16.5}{a} = 100$$

$$a = \frac{-16.5}{100}$$

$$a = -0.165 \quad \text{0.5 pt}$$

$$-\frac{1}{0.165}(y-18) = (x-10)^2$$

$$-\frac{1}{0.165}(0-18) = (x-10)^2 \quad \text{0.5 pt}$$

$$-\frac{-18}{0.165} = (x-10)^2$$

$$109.0909 \doteq (x-10)^2$$

$$\pm 10.4447 \doteq x-10$$

$$10 \pm 10.4447 \doteq x$$

$$x \doteq 20.44$$

~~$$x \doteq -0.44$$~~

0.5 pt

At $x = 19.44$

$$-\frac{1}{0.165}(y-18) = (19.44-10)^2 \quad \text{1 pt}$$

$$-\frac{1}{0.165}(y-18) = 89.1136$$

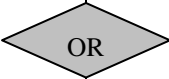
$$y-18 = -14.7037 \quad \text{0.5 pt}$$

$$y \doteq 3.30$$

The ball will not hit Tom. 1 pt

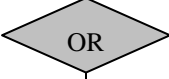
Question 32 (a)

(2 points)

$(5^2)^{x+2} = (5^3)^{2x} \quad \text{0.5 pt}$ $5^{2x+4} = 5^{6x} \quad \text{0.5 pt}$ $\therefore 2x+4 = 6x \quad \text{0.5 pt}$ $-4x = -4$ $x = 1 \quad \text{0.5 pt}$		$\log 25^{x+2} = \log 125^{2x} \quad \text{0.5 pt}$ $(x+2)\log 25 = (2x)\log 125 \quad \text{0.5 pt}$ $x+2 = 2x \frac{\log 125}{\log 25} \quad \left. \begin{array}{l} \text{0.5 pt} \\ \text{0.5 pt} \end{array} \right\}$ $x+2 = 2x(1.5)$ $x+2 = 3x$ $-2x = -2$ $x = 1 \quad \text{0.5 pt}$
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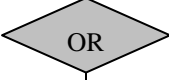
Question 32 (b)

(2 points)

$2^{x+3} = 15 \quad \text{0.5 pt}$ $\log 2^{x+3} = \log 15 \quad \text{0.5 pt}$ $(x+3)\log 2 = \log 15 \quad \text{0.5 pt}$ $x+3 = \frac{\log 15}{\log 2}$ $x+3 \doteq 3.9069$ $x \doteq 0.91 \quad \text{0.5 pt}$		$2^{x+3} = 15 \quad \text{0.5 pt}$ $\log_2 15 = x+3 \quad \text{0.5 pt}$ $3.9069 \doteq x+3 \quad \text{0.5 pt}$ $3.91 \doteq x \quad \text{0.5 pt}$
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Question 32 (c)

(2 points)

<p>let $n = 4^x$</p> $n^2 - 17n + 16 = 0 \quad \text{0.5 pt}$ $(n-16)(n-1) = 0 \quad \text{0.5 pt}$ <table style="width: 100%;"> <tr> <td style="width: 50%;">$n = 16$</td> <td style="width: 50%;">$n = 1$</td> </tr> <tr> <td>$\therefore 4^x = 16$</td> <td>$4^x = 1$</td> </tr> <tr> <td>$x = 2$</td> <td>$x = 0$</td> </tr> <tr> <td style="text-align: center;">0.5 pt</td> <td style="text-align: center;">0.5 pt</td> </tr> </table>	$n = 16$	$n = 1$	$\therefore 4^x = 16$	$4^x = 1$	$x = 2$	$x = 0$	0.5 pt	0.5 pt		$(4^x - 16)(4^x - 1) = 0 \quad \text{1 pt}$ <table style="width: 100%;"> <tr> <td style="width: 50%;">$4^x - 16 = 0$</td> <td style="width: 50%;">$4^x - 1 = 0$</td> </tr> <tr> <td>$4^x = 16$</td> <td>$4^x = 1$</td> </tr> <tr> <td>$x = 2$</td> <td>$x = 0$</td> </tr> <tr> <td style="text-align: center;">0.5 pt</td> <td style="text-align: center;">0.5 pt</td> </tr> </table>	$4^x - 16 = 0$	$4^x - 1 = 0$	$4^x = 16$	$4^x = 1$	$x = 2$	$x = 0$	0.5 pt	0.5 pt
$n = 16$	$n = 1$																	
$\therefore 4^x = 16$	$4^x = 1$																	
$x = 2$	$x = 0$																	
0.5 pt	0.5 pt																	
$4^x - 16 = 0$	$4^x - 1 = 0$																	
$4^x = 16$	$4^x = 1$																	
$x = 2$	$x = 0$																	
0.5 pt	0.5 pt																	

Question 33 (a)

(3 points)

Note: The similarities and differences must refer to the graphs and not the equations.

Examples of acceptable answers (1 pt each):

- ✓ They share the same y-intercept.
- ✓ When $y = b^x$ is increasing, $y = b^{-x}$ is decreasing.
- ✓ Each is a reflection of the other in $x = 0$ (y axis).
- ✓ Same horizontal asymptote.
- ✓ Neither have x-intercepts.

Question 33 (b)

(2 points)

$$a > 0$$

1 pt

$$b > 1$$

1 pt

Question 34

(2 points)

Examples of acceptable answers (2 pts each):

$$\begin{array}{l} \log_2(-3) = x \\ 2^x = -3 \end{array} \quad \begin{array}{l} 2^x \text{ is always positive } \therefore \text{ cannot equal } -3 \end{array}$$

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 35

(5 points)

Billy

$$A_B = 200(0.80)^{\frac{t}{5}} \quad \text{1 pt}$$

$$200(0.80)^{\frac{t}{5}} = 150(0.90)^{\frac{t}{7}} \quad \text{0.5 pt}$$

$$\frac{200}{150}(0.80)^{\frac{t}{5}} = (0.90)^{\frac{t}{7}}$$

$$\log\left[\frac{200}{150}(0.80)^{\frac{t}{5}}\right] = \log(0.90)^{\frac{t}{7}} \quad \text{0.5 pt}$$

$$\log\left(\frac{200}{150}\right) + \frac{t}{5}\log 0.80 = \frac{t}{7}\log 0.90 \quad \text{0.5 pt}$$

$$\frac{t}{5}\log 0.80 - \frac{t}{7}\log 0.90 = \log\left(\frac{200}{150}\right)$$

$$t\left(\frac{\log 0.80}{5} - \frac{\log 0.90}{7}\right) = \log\left(\frac{200}{150}\right) \quad \text{0.5 pt}$$

$$t = \frac{\log\left(\frac{200}{150}\right)}{\left(\frac{\log 0.80}{5} - \frac{\log 0.90}{7}\right)}$$

$$t \doteq 9.73 \quad \text{1 pt}$$

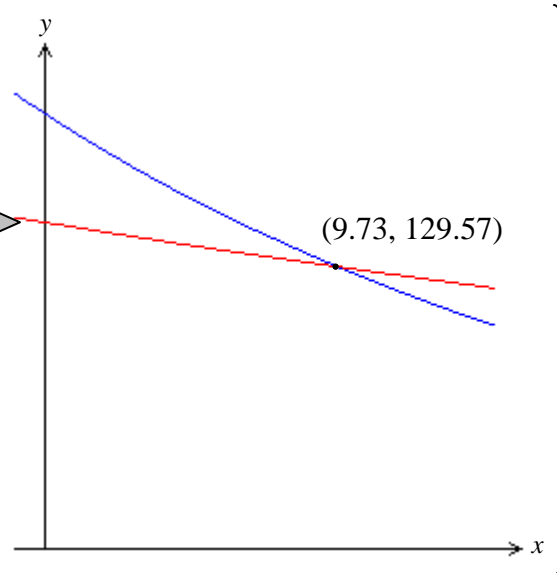
Maria

$$A_M = 150(0.90)^{\frac{t}{7}} \quad \text{1 pt}$$

$$y_1 = 200(0.80)^{\frac{x}{5}}$$

$$y_2 = 150(0.90)^{\frac{x}{7}}$$

OR



2 pts

The amount of drug remaining will be the same after 9.73 days. 1 pt

Note: student could also find the x -intercept of $y = 200(0.80)^{\frac{x}{5}} - 150(0.90)^{\frac{x}{7}}$

Question 36

(3.5 points)

$$2 = 20 \left(\frac{1}{2}\right)^{\frac{t}{5}}$$

0.5 pt (points to 2), 0.5 pt (points to 20), 0.5 pt (points to $\frac{1}{2}$), 0.5 pt (points to $\frac{t}{5}$)

$$\frac{2}{20} = \left(\frac{1}{2}\right)^{\frac{t}{5}}$$

$$\log\left(\frac{1}{10}\right) = \frac{t}{5} \log\left(\frac{1}{2}\right)$$

1 pt (points to $\log\left(\frac{1}{2}\right)$)

$$\frac{\log\left(\frac{1}{10}\right)}{\log\left(\frac{1}{2}\right)} = \frac{t}{5}$$

$$\frac{5 \log\left(\frac{1}{10}\right)}{\log\left(\frac{1}{2}\right)} = t$$

$$16.61 \doteq t$$

0.5 pt (points to 16.61)

OR

$$\frac{t}{5} = \log_{\left(\frac{1}{2}\right)}\left(\frac{1}{10}\right)$$

1 pt (points to $\log_{\left(\frac{1}{2}\right)}\left(\frac{1}{10}\right)$)

$$t = 5 \log_{\left(\frac{1}{2}\right)}\left(\frac{1}{10}\right)$$

$$t \doteq 16.61$$

0.5 pt (points to 16.61)

Question 37

(4 points)

Statement(s)	Reason(s)
$\overline{MQ} \cong \overline{NP}$	Given
$\angle KPQ \cong \angle KQP$	Given
$\triangle KPQ$ is isosceles	Definition of an isosceles triangle
$\overline{PK} \cong \overline{KQ}$	$\triangle KPQ$ is an isosceles triangle
$\triangle MQK \cong \triangle NPK$	SAS
$\overline{MK} \cong \overline{NK}$	CPCTC

1 pt

1 pt

1 pt

1 pt

OR

Statement(s)	Reason(s)
$\overline{MQ} \cong \overline{NP}$	Given
$\angle KPQ \cong \angle KQP$	Given
$\triangle KPQ$ is isosceles	Definition of an isosceles triangle
$\overline{PK} \cong \overline{KQ}$	$\triangle KPQ$ is an isosceles triangle
$\angle KPM \cong \angle KQN$	Supplementary angles
$\overline{MP} \cong \overline{NQ}$	Segment subtraction
$\triangle MPK \cong \triangle NQK$	SAS
$\overline{MK} \cong \overline{NK}$	CPCTC

1 pt

1 pt

1 pt

1 pt

Question 38

(3 points)

Centre of circle is midpoint of $\overline{AB} \Rightarrow \left(\frac{-3+15}{2}, \frac{5-3}{2} \right) \left. \vphantom{\left(\frac{-3+15}{2}, \frac{5-3}{2} \right)} \right\} \begin{matrix} 1 \text{ pt} \\ (6, 1) \end{matrix}$

Circle's radius $\Rightarrow \left. \begin{matrix} D = \sqrt{(6+3)^2 + (1-5)^2} \\ = \sqrt{97} \end{matrix} \right\} \begin{matrix} \text{OR} \\ D = \sqrt{(6-15)^2 + (1+3)^2} \\ = \sqrt{97} \end{matrix} \left. \vphantom{\left. \begin{matrix} D = \sqrt{(6+3)^2 + (1-5)^2} \\ = \sqrt{97} \end{matrix} \right\}} \right\} \begin{matrix} 1 \text{ pt} \end{matrix}$

Distance from centre to (7, 8) $\Rightarrow D = \sqrt{(6-7)^2 + (1-8)^2}$
 $= \sqrt{50} \left. \vphantom{= \sqrt{50}} \right\} \begin{matrix} 0.5 \text{ pt} \\ = 5\sqrt{2} \end{matrix}$

$\therefore (7, 8)$ is inside the circle $\left. \vphantom{\therefore (7, 8) \text{ is inside the circle}} \right\} \begin{matrix} 0.5 \text{ pt} \end{matrix}$

Question 39 (a)

(3 points)

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

Slope of $\overline{AB} \Rightarrow m = \frac{11-7}{2-8}$
 $= -3$ 0.5 pt

Slope of \perp bisector is $\frac{1}{3}$ 0.5 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

$y = \frac{x}{3} + \frac{1}{3}$ 0.5 pt

Question 39 (b)

(1 point)





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

$(-4, -2) \Rightarrow -2 \stackrel{?}{=} \frac{-4}{3} + \frac{1}{3}$
 $-2 \neq -1$ 0.5 pt

Therefore the perpendicular bisector does not pass through the point $(-4, -2)$. 0.5 pt




Question 40 (a)

(2 points)

$x^2 + y^2 - 8y = 1$	
$x^2 + y^2 - 8y + 16 = 1 + 16$	
$x^2 + (y - 4)^2 = 17$ 	
Circle 	
Centre (0, 4) 	
Radius is $\sqrt{17}$ 	

Question 40 (b)

(3 points)

$4x^2 - 8x + y^2 + 4y = 8$	
$4(x^2 - 2x) + y^2 + 4y = 8$	
$4(x^2 - 2x + 1) + y^2 + 4y + 4 = 8 + 4 + 4$	
$4(x - 1)^2 + (y + 2)^2 = 16$	
$\left[\frac{(x - 1)}{2}\right]^2 + \left[\frac{(y + 2)}{4}\right]^2 = 1$	
Ellipse 	
Minor axis measures 4 units.	} 
Major axis measures 8 units.	
Centre (1, -2) 	

Question 41 (a)

(1.5 points)

$$P(A \text{ or } B) = \frac{25}{70} + \frac{30}{70} - \frac{10}{70} \quad \text{1 pt}$$
$$= \frac{45}{70} \text{ or } \frac{9}{14} \text{ or } 0.64 \quad \text{0.5 pt}$$

Question 41 (b)

(1.5 points)

$$P(A | B) = \frac{\frac{10}{70}}{\frac{30}{70}} \quad \text{1 pt}$$
$$= \frac{1}{3} \quad \text{0.5 pt}$$

Question 42

(3.5 points)

$$\frac{{}_5C_3 \times {}_6C_3}{{}_{11}C_6} \quad \text{1 pt} \quad \text{1 pt}$$
$$= \frac{10 \times 20}{462} \quad \text{1 pt}$$
$$= \frac{200}{462} \text{ or } \frac{100}{231} \text{ or } 0.43 \quad \text{0.5 pt}$$

Question 43

(2 points)

$\frac{1}{{}_7P_3} = \frac{1}{210}$	OR	$\frac{1}{7} \times \frac{1}{6} \times \frac{1}{5} = \frac{1}{210}$
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0.5 pt (pointing to the first fraction in the second equation)
0.5 pt (pointing to the second fraction in the second equation)
0.5 pt (pointing to the third fraction in the second equation)
0.5 pt (pointing to the denominator 210 in the second equation)

Question 44 (a)

(1 point)

Fred's solution is correct. 1 pt

Question 44 (b)

(2 points)

Note: Responses should show understanding of the following:

- ✓ John's solution is not correct because he calculated the probability of C and D not C or D. 1 pt
- ✓ Amy's solution considers C or D but includes cases where a person gets both. 1 pt