The graph of $y = f(x)$ is shown below.

Mylana transforms $y = f(x)$ such that the equation of the new graph is $g(x) + 3 = f(x + 4)$.

1. The graph of $y = g(x)$ lies in Quadrant

   A. I
   B. II
   C. III
   D. IV

The graph of $y = f(x)$ is transformed to produce the graph of $\frac{1}{4}g(x) = f\left(\frac{1}{9}x\right)$.

2. *The graph of $y = f(x)$ was horizontally stretched about the y-axis by a factor of ___i___ and vertically stretched about the x-axis by a factor of ___ii___ .*

   The statement above is completed by the information in row

Row	i	ii
A.	$\frac{1}{9}$	$\frac{1}{4}$
B.	$\frac{1}{9}$	4
C.	9	$\frac{1}{4}$
D.	9	4

The range of the graph of $y = f(x)$ is $y \geq 4$. The graph of the function $y = f(x)$ is stretched vertically about the x-axis by a factor of 2 and then translated 9 units down to become the graph of $y = g(x)$.

3. The range of the graph of $y = g(x)$ is

   A. $[-1, \infty)$
   B. $[-5, \infty)$
   C. $[-7, \infty)$
   D. $[-10, \infty)$

4. If the graph of $y = (x + 6)^2 - 5$ is reflected in the x-axis, then the equation of the new graph is

   A. $y = -(x + 6)^2 + 5$
   B. $y = -(x + 6)^2 - 5$
   C. $y = (-x + 6)^2 + 5$
   D. $y = (-x + 6)^2 - 5$

A student made the following statements about the graph of the exponential function $f(x) = ab^x - 4$, where $a > 1$, $b > 1$.

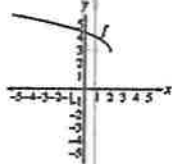|	
1	The y-intercept is at -4.
2	The y-intercept is at $(a - 4)$.
3	The domain is the set of all real numbers.
4	The range is $\{y \mid y > 4, y \in R\}$.
5	The graph has one x-intercept.
6	There is no x-intercept.

Numerical Response

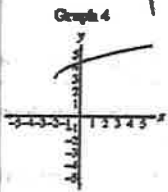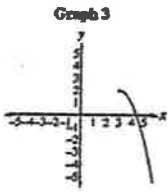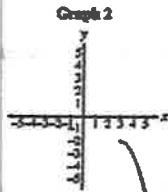**1.** The three statements above that are true for the graph of $y = f(x)$ are numbered _____, _____, and _____.
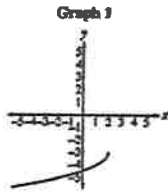
(Record all three digits of your answer in any order below.)

The partial graph of $y = f(x)$ is shown below.

Below are the partial graphs of four transformations of $y = f(x)$.
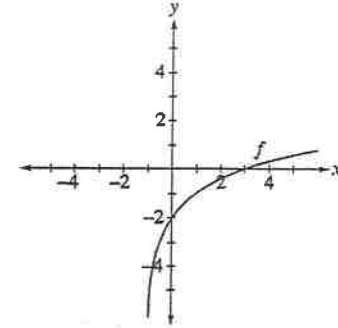
Graph 1   Graph 2

Graph 3   Graph 4

5. The partial graph that represents $y = f(-x)$ is ___ i ___ and the partial graph that represents $y = f^{-1}(x)$ is ___ ii ___.

The statement above is completed by the information in row

Row	i	ii
A.	Graph 1	Graph 3
B.	Graph 1	Graph 2
C.	Graph 4	Graph 3
D.	Graph 4	Graph 2

The partial graph of $f(x) = \log_2(x + 1) - 2$ is shown below.

6. On the graph of the inverse of $y = f(x)$, the y-intercept is

A. −2

B. 2

C. −3

D. 3

7. The equation $a = 3b^{(2y)}$ can also be expressed in the logarithmic form

A. $y = 2\log_{3b}(a)$

B. $y = 2\log_b\left(\dfrac{a}{3}\right)$

C. $y = \dfrac{1}{2}\log_{3b}(a)$

D. $y = \dfrac{1}{2}\log_b\left(\dfrac{a}{3}\right)$

8. An equivalent expression for $2\log_3 a - \log_3 c + \log_3\sqrt{b}$ is

A. $\log_3\left(\dfrac{a^2\sqrt{b}}{c^2}\right)$

B. $\log_3\left(\dfrac{a^2\sqrt{b}}{c}\right)$

C. $\log_3\left(\dfrac{a^2}{c\sqrt{b}}\right)$

D. $\log_3\left(\dfrac{a^2}{c^2\sqrt{b}}\right)$

9. Given that $\log_b a = c$, where $a, b > 0$, and $b \neq 1$, a simplified expression

for $\log_b\left(\dfrac{\sqrt{b}}{a}\right)$ is

A. $\dfrac{1}{2}b - c$

B. $\dfrac{1}{2} - c$

C. $\dfrac{b}{2c}$

D. $\dfrac{1}{2c}$

The equations of two functions, where $a > 1$, are given below. Function g is a transformation of function f.

$$f(x) = \log_a x$$
$$g(x) = \log_a x + \log_a a$$

10. The graph of $y = g(x)$ is the graph of $y = f(x)$ translated

A. 1 unit up

B. a units up

C. 1 unit left

D. a units left

A student is solving the equation $\log_a(a - 2) + \log_a(2a + 1) = 2$, where $a > 2$, by using an algebraic process.

11. By correctly simplifying the equation above, the student could obtain the equation

A. $2a^2 - 5a - 2 = 0$

B. $2a^2 - 3a - 4 = 0$

C. $a^2 - 3a - 2 = 0$

D. $a^2 - 3a + 1 = 0$

Numerical Response

2. The radioactive isotope oxygen-22 has a half-life of 2.25 seconds. The time it will take for a sample of oxygen-22 to decay to 35% of its original amount, to the nearest hundredth of a second, is _____ s.

(Record your answer below.)

An 18 in. by 16 in. rectangular piece of cardboard is used to make an open-top box with a volume of 336 in.^{3} by cutting identical squares, of side length x inches, from each corner. A diagram is shown below.
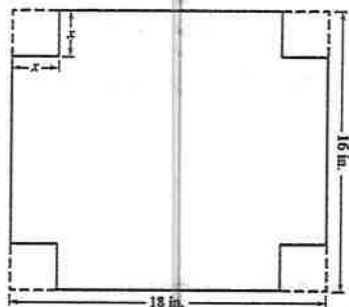
12. A polynomial equation that can be used to determine the dimensions of the box is

    A. $x(18 - 2x)(16 - 2x) + 336 = 0$
    B. $x(18 - 2x)(16 - 2x) - 336 = 0$
    C. $2x(18 - x)(16 - x) + 336 = 0$
    D. $2x(18 - x)(16 - x) - 336 = 0$

One factor of the polynomial $2x^3 + 7x^2 - 2x - 15$ is $x + 3$. The remaining factor can be expressed in the form $ax^2 + bx - c$.

Numerical Response

3. The values of a, b, and c are, respectively, _____, _____, and _____.

(Record all three digits of your answer below.)

A student constructed the following table of values for a third-degree polynomial.

x	−6	−4	−2	0	1	4	5	6
y	33	0	−7	0	5	8	0	−15

13. The equation of the polynomial described by the table of values is
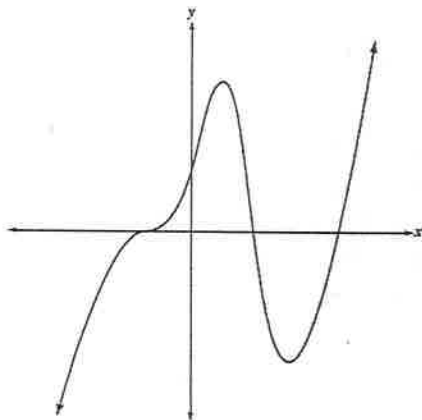
    A. $y = -x(x + 5)(x - 4)$

    B. $y = -\dfrac{1}{4}x(x + 5)(x - 4)$

    C. $y = -x(x - 5)(x + 4)$

    D. $y = -\dfrac{1}{4}x(x - 5)(x + 4)$

Numerical Response

4. If the domain of the radical function $f(x) = \sqrt{23 - 5x} + 7.1$ is $x \le k$, then the value of k, to the nearest tenth, is _____.

The graph of a polynomial function is shown below. Five statements regarding the function are provided.


Statement 1	The polynomial function is of odd degree.
Statement 2	The least possible degree of the polynomial function is 3.
Statement 3	The leading coefficient is positive.
Statement 4	The polynomial function has an absolute maximum point.
Statement 5	At least one of the roots has an odd multiplicity.

14. The number of true statements that describe the polynomial function above is

A. 2
B. 3
C. 4
D. 5

The graph of the function $y = f(x)$ is shown below.
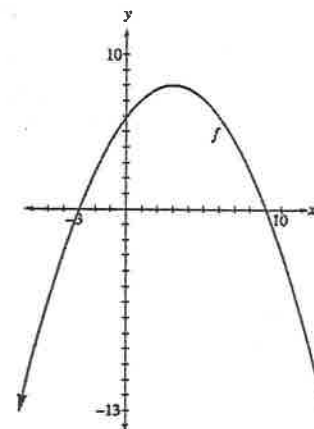
15. When the graph of $y = f(x)$ is transformed to the graph of $y = \sqrt{f(x)}$, the number of invariant points is

A. 1
B. 2
C. 3
D. 4

Two rational functions are given below.

$$f(x) = \frac{x-7}{3x^2 - 15x} \qquad\qquad g(x) = \frac{x-1}{x^2 - 6x + 8}$$

The equations of the vertical asymptotes for the function $y = f(x)$ are $x = a$ and $x = b$.

The equations of the vertical asymptotes for the function $y = g(x)$ are $x = c$ and $x = d$.

Numerical Response

5. In the functions above, the value of

a is _____ (Record in the first box)

b is _____ (Record in the second box)

c is _____ (Record in the third box)

d is _____ (Record in the fourth box)

16. If $f(x) = \sqrt{3x}$ and $g(x) = x^2 + 2x + 1$, then an expression for $g(f(x))$ is
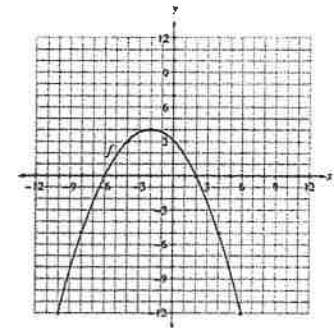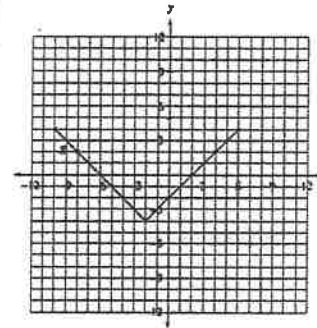
   A. $3x + 2\sqrt{3x} + 1$

   B. $9x^2 + 2\sqrt{3x} + 1$

   C. $3x + \sqrt{6x} + 1$

   D. $9x^2 + \sqrt{6x} + 1$

The graphs of $y = g(x)$ and $y = f(x)$, and a list of possible points on the graph of $h(x) = g(x) - f(x)$, are given below.

Possible points on the graph of $y = h(x)$

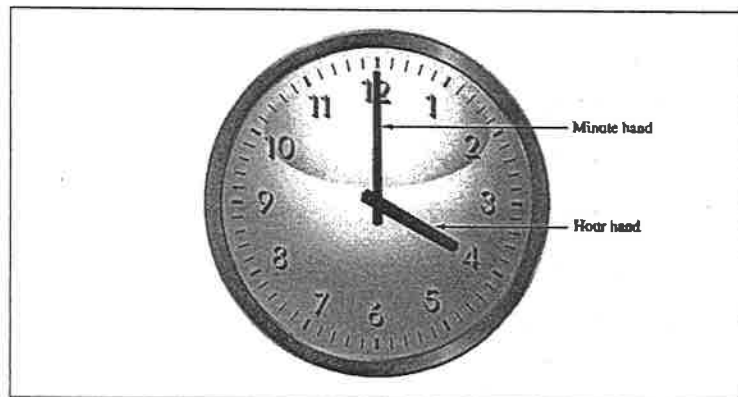| Point 1 | (2, 0) | Point 2 | (0, -5) | Point 3 | (-2, 8) | Point 4 | (-4, -5) |

Numerical Response

6. The three points listed above that exist on the graph of $y = h(x)$ are numbered _____, _____, and _____.

(Record all three digits of your answer in any order)

17. In 40 minutes, the number of radians the minute hand of a clock will travel through is

A. $\frac{\pi}{10}$

B. $\frac{\pi}{20}$

C. $\frac{2\pi}{3}$

D. $\frac{4\pi}{3}$

To prevent car thefts in a parking lot, security cameras are installed on the outer walls of several buildings, as represented in the diagram below. Camera A is programmed to have a recognition range of 400 m and covers an arc length of 780 m.
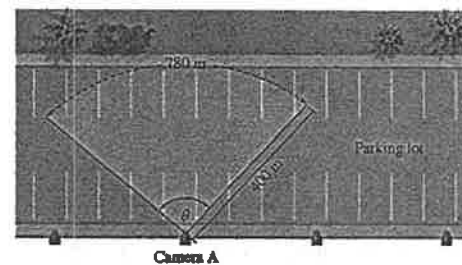
Camera A

Note: This diagram is not drawn to scale.

18. The value of the angle, θ, to the nearest degree, that Camera A turns through is

A. 290°

B. 112°

C. 92°

D. 29°

The following statements are made with reference to the unit circle.

Statement I   The point $A\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$ lies on the unit circle.

Statement II   The point $B\left(\frac{1}{\sqrt{2}}, \frac{1}{2}\right)$ lies on the unit circle.

Statement III   For any point on the unit circle, $x^2 + y^2 = 1$.

Statement IV   Any point that lies on the unit circle can be described as $(\sin\theta, \cos\theta)$.

19. The statements that are true are numbered

A. I and III

B. I and IV

C. II and III

D. III and IV

Point $P(x, y)$ lies on the terminal arm of an angle, θ, in standard position.

20. Given that $\sin\theta = \dfrac{5}{\sqrt{29}}$ and $\dfrac{\pi}{2} \leq \theta \leq \pi$, the coordinates of Point P could be

    A. $(-2, 5)$

    B. $(-5, 2)$

    C. $\left(-2, \sqrt{29}\right)$

    D. $\left(-5, \sqrt{29}\right)$

If $\cot\theta = \dfrac{-1}{\sqrt{3}}$ and $\csc\theta < 0$, where $0 \leq \theta < 2\pi$, then the value of θ can be expressed as $\dfrac{a\pi}{b}$.

21. Possible values of a and b are, respectively,

    A.   2 and 3

    B.   5 and 3

    C.   5 and 6

    D.   11 and 6

Below are five statements about the graph of $f(x) = -6\sin\left(\dfrac{1}{2}x + \pi\right) + 10$.

1   The period of the graph of $f(x)$ is 4π.

2   The y-intercept of the graph of $f(x)$ is 4.

3   The amplitude of the graph of $f(x)$ is -6.

4   The graph of $g(x) = 4\cos(2x - \pi) + 12$ has the same maximum value as $f(x)$.

5   The graph of $f(x)$ is the same as the graph of $h(x) = -6\sin\left(\dfrac{1}{2}x\right) + 10$ if $h(x)$ is translated horizontally 2π units left.

Numerical Response

7. The three statements above that are correct are numbered _____, _____, and _____.

(Record all three digits of your answer in any order.)

The paddlewheel on a ferry boat has a radius of 4.2 m and rotates at a constant rate. The height, h, in metres, above the surface of the water of a particular point on the edge of the wheel at time t, in seconds, can be modelled by the function $h = a\sin[b(t-1.2)] + d$. The graph of the function is shown below.
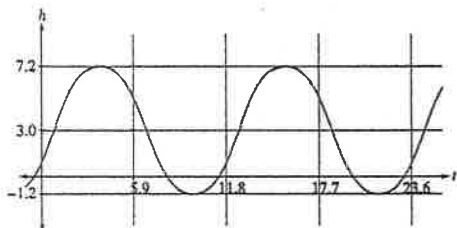
22. The values of b and d in the equation above are, respectively,

A. $\frac{\pi}{11.8}$ and 3.0

B. $\frac{\pi}{11.8}$ and 4.2

C. $\frac{\pi}{5.9}$ and 3.0

D. $\frac{\pi}{5.9}$ and 4.2

A student decides to graphically solve the equation $\sec^2 x + 1 = 3\tan x$ by graphing two functions. A list of possible functions that the student could use is provided below.

1 $y = 2$	3 $y = 3\tan x$	5 $y = 2 - 3\tan x$
2 $y = -\tan^2 x$	4 $y = 2 + \tan^2 x$	6 $y = 3\tan x - \tan^2 x$

Numerical Response

8. To solve the equation correctly, the student could graph the functions numbered _____ and _____. (There is more than one possible answer.)

(Record both digits of your answer in any order.)

Carol is asked to solve the equation $3\sin x + \sqrt{8} = -\sin x$ algebraically, where $0° \le x < 360°$. Carol simplified the equation to the form $\sin x = a$.

23. The value of a is

A. $-\sqrt{2}$

B. $-\frac{\sqrt{2}}{2}$

C. $\sqrt{2}$

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

24. Given that $\tan x = \frac{3}{4}$, where $180° < x < 270°$, the exact value of $\cos(x - 30°)$ is

A. $\frac{3\sqrt{3} + 4}{10}$

B. $\frac{-3\sqrt{3} - 4}{10}$

C. $\frac{3 + 4\sqrt{3}}{10}$

D. $\frac{-3 - 4\sqrt{3}}{10}$

Bob simplifies the left-hand side of the identity $\dfrac{\tan x - \sin x}{\tan x \sin x} = \dfrac{1 - \cos x}{\sin x}$ as shown below.

Step 1 $\dfrac{\tan x - \sin x}{\left(\dfrac{\sin x}{\cos x}\right)\sin x}$

Step 2 $\left(\dfrac{\sin x}{\cos x} - \sin x\right) \div \dfrac{\sin^2 x}{\cos x}$

Step 3 $\left(\dfrac{\sin x - \sin x \cos x}{\cos x}\right) \cdot \dfrac{\cos x}{\sin^2 x}$

Step 4 $\dfrac{\sin x - \sin x \cos x}{\sin^2 x}$

Step 5 $\dfrac{-\sin x \cos x}{\sin x}$

Step 6 $-\cos x$

Numerical Response

9. The first recorded error in Bob's simplification is in Step _____.

(Record your answer.)

In 2008, the province of Alberta had three area codes: 780, 403, and 587. Telephone numbers in Alberta consist of the area code followed by a 7-digit number that cannot begin with the digits 0 or 1, and the digits can be repeated.

25. How many different phone numbers were available in the province of Alberta in 2008?

- A. 24 000 000
- B. 30 000 000
- C. 216 000 000
- D. 270 000 000

Each switch on a panel can be set in 2 positions, "on" or "off," as shown below.
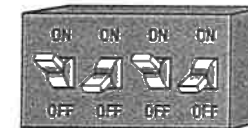
26. How many different setting arrangements are possible if 2 switches must be on and 2 switches must be off?

- A. 4
- B. 6
- C. 8
- D. 12

In a particular family of 8 children, there are 5 boys and 3 girls. A photographer is hired to take a series of family pictures of the children only. For one of the pictures, the photographer selects 2 boys and 1 girl and arranges them in a row.

27. The number of different ways of arranging the three children for this picture is

- A. 30
- B. 60
- C. 180
- D. 360

Numerical Response

10. The number of ways of arranging all the letters of the town name ENILDA if the vowels must be together and in alphabetical order is _____.

(Record your answer.)

A student is asked to identify which of the following problems can be solved using $\binom{n}{r}$.

1 The number of different arrangements using all the letters of the word POSITIVE.

2 The number of different 5-player teams that can be selected from 7 boys and 6 girls.

3 The number of line segments that can be drawn using the vertices of an 8-sided polygon that are marked on a circle.

4 The number of different ways to choose 3 cupcakes from a display of 8 different cupcakes at a coffee shop.

5 The number of different ways to assign the job of stage manager and costume director in a school play, if 5 students apply.

Numerical Response

11. The three problems above that can be solved using $\binom{n}{r}$ are numbered
_____, _____, and _____.

(Record all three digits of your answer in any order.)

28. In the expansion of the binomial $\left(x - \dfrac{3}{x}\right)^6$, written in descending powers of x, the term that contains x^2 is term number

A. 5
B. 4
C. 3
D. 2

In the expansion of the binomial $\left(2x + \dfrac{1}{2}\right)^8$, written in descending powers of x, the fifth term can be expressed in the form ax^b, where $a, b \in N$.

Numerical Response

12. The value of the coefficient a is _____.

(Record your answer.)