The possession or use of any communications device is strictly prohibited when taking this examination. If you have or use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

Print your name and the name of your school on the lines above.

A separate answer sheet for Part I has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet.

This examination has four parts, with a total of 39 questions. You must answer all questions in this examination. Record your answers to the Part I multiple-choice questions on the separate answer sheet. Write your answers to the questions in Parts II, III, and IV directly in this booklet. All work should be written in pen, except graphs and drawings, which should be done in pencil. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. The formulas that you may need to answer some questions in this examination are found at the end of the examination. This sheet is perforated so you may remove it from this booklet.

Scrap paper is not permitted for any part of this examination, but you may use the blank spaces in this booklet as scrap paper. A perforated sheet of scrap graph paper is provided at the end of this booklet for any question for which graphing may be helpful but is not required. You may remove this sheet from this booklet. Any work done on this sheet of scrap graph paper will not be scored.

When you have completed the examination, you must sign the statement printed at the end of the answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet cannot be accepted if you fail to sign this declaration.

Notice...

A graphing calculator and a straightedge (ruler) must be available for you to use while taking this examination.

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.
Part I

Answer all 30 questions in this part. Each correct answer will receive 2 credits. Record your answers on your separate answer sheet. [60]

1. Which expression represents “5 less than twice x”? Use this space for computations.
   - (1) $2x - 5$
   - (2) $5 - 2x$
   - (3) $2(5 - x)$
   - (4) $2(x - 5)$

2. Gabriella has 20 quarters, 15 dimes, 7 nickels, and 8 pennies in a jar. After taking 6 quarters out of the jar, what will be the probability of Gabriella randomly selecting a quarter from the coins left in the jar?
   - (1) $\frac{14}{44}$
   - (2) $\frac{30}{44}$
   - (3) $\frac{14}{50}$
   - (4) $\frac{20}{50}$

3. Based on the line of best fit drawn below, which value could be expected for the data in June 2015?

   - (1) 230
   - (2) 310
   - (3) 480
   - (4) 540
4 If the point \((5, k)\) lies on the line represented by the equation \(2x + y = 9\), the value of \(k\) is

(1) 1  
(2) 2  
(3) \(-1\)  
(4) \(-2\)

5 A soda container holds \(5 \frac{1}{2}\) gallons of soda. How many ounces of soda does this container hold?

\[
\begin{array}{|c|}
\hline
1 \text{ quart} = 32 \text{ ounces} \\
1 \text{ gallon} = 4 \text{ quarts} \\
\hline
\end{array}
\]

(1) 44  
(2) 176  
(3) 640  
(4) 704

6 The roots of a quadratic equation can be found using the graph below.

What are the roots of this equation?

(1) \(-4\), only  
(2) \(-4\) and \(-1\)  
(3) \(-1\) and 4  
(4) \(-4\), \(-1\), and 4
7 If the area of a rectangle is represented by \( x^2 + 8x + 15 \) and its length is represented by \( x + 5 \), which expression represents the width of the rectangle?

(1) \( x + 3 \)  
(2) \( x - 3 \)  
(3) \( x^2 + 6x + 5 \)  
(4) \( x^2 + 7x + 10 \)

8 Which set of data describes a situation that would be classified as qualitative?

(1) the colors of the birds at the city zoo  
(2) the shoe size of the zookeepers at the city zoo  
(3) the heights of the giraffes at the city zoo  
(4) the weights of the monkeys at the city zoo

\[ 6! = (6)(5)(4)(3)(2)(1) = 720 \]

9 The value of the expression \( \frac{5!3!}{4!} - 10 \) is

(1) 50  
(2) 102  
(3) 740  
(4) 750

10 Which interval notation represents \(-3 \leq x \leq 3\)?

(1) \([-3, 3]\)  
(2) \((-3, 3]\)  
(3) \([−3, 3)\)  
(4) \((-3, 3)\)

11 The solutions of \( x^2 = 16x - 28 \) are

(1) \(-2\) and \(-14\)  
(2) \(2\) and \(14\)  
(3) \(-4\) and \(-7\)  
(4) \(4\) and \(7\)

\[ x^2 - 16x + 28 = 0 \]
\[ (x-2)(x-14) = 0 \]
\[ x - 2 = 0 \quad \text{or} \quad x - 14 = 0 \]
\[ x = 2 \quad \text{or} \quad x = 14 \]
12 If the expression \((2y^a)^4\) is equivalent to \(16y^8\), what is the value of \(a\)?

(1) 12  (3) 32
(2) 2  (4) 4

\[
(2y^a)^4 = 16y^8 \\
16y^{4a} = 16y^8 \\
4a = 8 \\
a = 2
\]

13 Which table shows bivariate data?

Only 1 numerical variable

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

Only 1 numerical variable

<table>
<thead>
<tr>
<th>Type of Car</th>
<th>Average Gas Mileage (mpg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>van</td>
<td>25</td>
</tr>
<tr>
<td>SUV</td>
<td>23</td>
</tr>
<tr>
<td>luxury</td>
<td>26</td>
</tr>
<tr>
<td>compact</td>
<td>28</td>
</tr>
<tr>
<td>pickup</td>
<td>22</td>
</tr>
</tbody>
</table>

Only 1 numerical variable

<table>
<thead>
<tr>
<th>Time Spent Studying (hr)</th>
<th>Test Grade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
</tr>
<tr>
<td>2</td>
<td>72</td>
</tr>
<tr>
<td>3</td>
<td>83</td>
</tr>
<tr>
<td>4</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>92</td>
</tr>
</tbody>
</table>

Only 1 numerical variable

<table>
<thead>
<tr>
<th>Day</th>
<th>Temperature (degrees F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>63</td>
</tr>
<tr>
<td>Tuesday</td>
<td>58</td>
</tr>
<tr>
<td>Wednesday</td>
<td>72</td>
</tr>
<tr>
<td>Thursday</td>
<td>74</td>
</tr>
<tr>
<td>Friday</td>
<td>78</td>
</tr>
</tbody>
</table>

Note: It can be argued that bivariate data does not have to be numerical, in which case options (2) and (4) could also be correct.
14 The box-and-whisker plot below represents the results of test scores in a math class.

What do the scores 65, 85, and 100 represent?

(1) $Q_1$, median, $Q_3$
(2) $Q_1$, $Q_3$, maximum
(3) median, $Q_1$, maximum
(4) minimum, median, maximum

15 The expression $\frac{x - 3}{x + 2}$ is undefined when the value of $x$ is

-2, only
-2 and 3
-3 and 2

16 If $rx - st = r$, which expression represents $x$?

$\frac{r + st}{r}$
$\frac{r}{r + st}$
$\frac{r}{r - st}$
$\frac{r - st}{r}$

17 What is the solution of the equation $\frac{x + 2}{2} = \frac{4}{x}$?

1 and $-8$
2 and $-4$
$-1$ and 8
$-2$ and 4
18 Which type of function is graphed below?

- linear
- quadratic
- exponential
- absolute value

19 What is the slope of the line represented by the equation $4x + 3y = 12$?

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

Strategy: Convert to slope-intercept form.

$$4x + 3y = 12$$
$$3y = -4x + 12$$
$$y = \frac{-4}{3}x + 4$$

$m = -\frac{4}{3}$
20 The diagram below shows the graph of which inequality?

(1) \( y > x - 1 \)  
(2) \( y \geq x - 1 \)  
(3) \( y < x - 1 \)  
(4) \( y \leq x - 1 \)

21 Carol plans to sell twice as many magazine subscriptions as Jennifer. If Carol and Jennifer need to sell at least 90 subscriptions in all, which inequality could be used to determine how many subscriptions, \( x \), Jennifer needs to sell?

(1) \( x \geq 45 \)  
(2) \( 2x \geq 90 \)  
(3) \( 2x - x \geq 90 \)  
(4) \( 2x + x \geq 90 \)

22 When \( 2x^2 - 3x + 2 \) is subtracted from \( 4x^2 - 5x + 2 \), the result is

(1) \( 2x^2 - 2x \)  
(2) \( -2x^2 + 2x \)  
(3) \( -2x^2 - 8x + 4 \)  
(4) \( 2x^2 - 8x + 4 \)

23 Which expression represents the number of hours in \( w \) weeks and \( d \) days?

(1) \( 7w + 12d \)  
(2) \( 84w + 24d \)  
(3) \( 168w + 24d \)  
(4) \( 168w + 60d \)  

\[ 7 \times 24 = 168 \]

\[ 168(\text{weeks}) + 24(\text{days}) \]

\[ 168w + 24d \]
28 There are 18 students in a class. Each day, the teacher randomly selects three students to assist in a game: a leader, a recorder, and a timekeeper. In how many possible ways can the jobs be assigned?

- (1) 306
- (2) 816
- (4) 5832

29 In triangle $RST$, angle $R$ is a right angle. If $TR = 6$ and $TS = 8$, what is the length of $RS$?

- (1) 10
- (2) 2
- (4) $7\sqrt{2}$

30 How many solutions are there for the following system of equations?

- (1) 1
- (3) 3
- (2) 2
- (4) 0
24 Given:

\[ R = \{1, 2, 3, 4\} \]
\[ A = \{0, 2, 4, 6\} \]
\[ P = \{1, 3, 5, 7\} \]

What is \( R \cap P \)?

(1) \{0, 1, 2, 3, 4, 5, 6, 7\}  (2) \{1, 2, 3, 4, 5, 7\}  (3) \{1, 3\}  (4) \{2, 4\}

Use this space for computations.

25 Which equation could be used to find the measure of angle \( D \) in the right triangle shown in the diagram below?

\[ \sin D = \frac{12}{13} \]
\[ \cos D = \frac{5}{13} \]
\[ \tan D = \frac{12}{5} \]

(1) \( \cos D = \frac{12}{13} \)  (2) \( \cos D = \frac{13}{12} \)  (3) \( \sin D = \frac{5}{13} \)  (4) \( \sin D = \frac{12}{13} \)

See Formulas Page

\[ \sin = \text{opposite} \]
\[ \cos = \text{adjacent} \]
\[ \tan = \text{opposite} \]

26 If the roots of a quadratic equation are \(-2\) and 3, the equation can be written as

(1) \( (x - 2)(x + 3) = 0 \)  (2) \( (x + 2)(x - 3) = 0 \)  (3) \( (x + 2)(x + 3) = 0 \)  (4) \( (x - 2)(x - 3) = 0 \)

27 Which equation represents a line that is parallel to the \( y \)-axis and passes through the point (4,3)?

(1) \( x = 3 \)  (2) \( x = 4 \)  (3) \( y = 3 \)  (4) \( y = 4 \)

Integrated Algebra – June ’13
Part II

Answer all 3 questions in this part. Each correct answer will receive 2 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [6]

31 Solve the inequality \(-5(x - 7) < 15\) algebraically for \(x\).

\[
\begin{align*}
-5(x - 7) &< 15 \\
-5x + 35 &< 15 \\
-5x + 20 &< 0 \\
20 &< 5x \\
4 &< x \\
or & \\
x &> 4
\end{align*}
\]
Oatmeal is packaged in a cylindrical container, as shown in the diagram below.

The diameter of the container is 13 centimeters and its height is 24 centimeters. Determine, in terms of \( \pi \), the volume of the cylinder, in cubic centimeters.
Part III

Answer all 3 questions in this part. Each correct answer will receive 3 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [9]

34 The menu for the high school cafeteria is shown below.

<table>
<thead>
<tr>
<th>Main Course</th>
<th>Vegetable</th>
<th>Dessert</th>
<th>Beverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>veggie burger</td>
<td>corn</td>
<td>gelatin</td>
<td>milk</td>
</tr>
<tr>
<td>pizza</td>
<td>green beans</td>
<td>fruit salad</td>
<td>juice</td>
</tr>
<tr>
<td>tuna sandwich</td>
<td>carrots</td>
<td>yogurt</td>
<td>bottled water</td>
</tr>
<tr>
<td>frankfurter</td>
<td></td>
<td>cookie</td>
<td></td>
</tr>
<tr>
<td>chicken tenders</td>
<td></td>
<td>ice cream cup</td>
<td></td>
</tr>
</tbody>
</table>

Determine the number of possible meals consisting of a main course, a vegetable, a dessert, and a beverage that can be selected from the menu.

$$\text{Main Course Choices} \times \text{Veggie Choices} \times \text{Dessert Choices} \times \text{Beverage Choices} = 5 \times 3 \times 5 \times 3 = 225$$

Determine how many of these meals will include chicken tenders.

$$\text{Main Course Choices} \times \text{Veggie Choices} \times \text{Dessert Choices} \times \text{Beverage Choices} = 1 \times 3 \times 5 \times 3 = 45$$

If a student chooses pizza, corn or carrots, a dessert, and a beverage from the menu, determine the number of possible meals that can be selected.

$$\text{Main Course Choices} \times \text{Veggie Choices} \times \text{Dessert Choices} \times \text{Beverage Choices} = 1 \times 2 \times 5 \times 3 = 30$$
The distance from Earth to Mars is 136,000,000 miles. A spaceship travels at 31,000 miles per hour. Determine, to the nearest day, how long it will take the spaceship to reach Mars.

\[
\begin{align*}
31,000 \text{ miles per hour} \\
\underline{\times 24 \text{ hours per day}} \\
\rightarrow 744,000 \text{ miles per day}
\end{align*}
\]

\[
\frac{136,000,000}{744,000} = 182.795699
\]

\[
\boxed{183 \text{ days}}
\]
A man standing on level ground is 1000 feet away from the base of a 350-foot-tall building. Find, to the nearest degree, the measure of the angle of elevation to the top of the building from the point on the ground where the man is standing.

Note: Be sure to use degree mode in your graphing calculator.
36 Express $\sqrt{25} - 2\sqrt{3} + \sqrt{27} + 2\sqrt{9}$ in simplest radical form.

\[
5 - 2\sqrt{3} + \sqrt{27} + 2\sqrt{9} \\
5 - 2\sqrt{3} + \sqrt{9\sqrt{3}} + 2(3) \\
5 - 2\sqrt{3} + 3\sqrt{3} + 6 \\
\boxed{11 + \sqrt{3}}
\]
Part IV

Answer all 3 questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [12]

37 Solve algebraically: \( \frac{2}{3x} + \frac{4}{x} = \frac{7}{x + 1} \)

[Only an algebraic solution can receive full credit.]

\[
\frac{2}{3x} + \frac{4}{x} = \frac{7}{x + 1} \\
\frac{(2x)}{(3x)(x)} + \frac{(3x)(4)}{(3x)(x)} = \frac{7}{x + 1} \\
\frac{2x}{3x^2} + \frac{12x}{3x^2} = \frac{7}{x + 1} \\
\frac{2}{3x} + \frac{12}{3x} = \frac{7}{x + 1} \\
\frac{14}{3x} = \frac{7}{x + 1} \\
14(x + 1) = 3x(7) \\
14x + 14 = 21x \\
14 = 7x \\
2 = x
\]
A jar contains five red marbles and three green marbles. A marble is drawn at random and not replaced. A second marble is then drawn from the jar.

Find the probability that the first marble is red and the second marble is green.

\[
P(A + B) = P(A) \times P(B)
\]

\[
\frac{5R}{8 total} \quad P(R) = \frac{5}{8} \quad \frac{4R}{7 total} \quad P_G = \frac{3}{7}
\]

\[
P(R + G) = \left( \frac{5}{8} \right) \left( \frac{3}{7} \right) = \frac{15}{56}
\]

Find the probability that both marbles are red.

\[
\frac{5R}{3G} \quad P(R) = \frac{5}{8} \quad \frac{4R}{3G} \quad P(R) = \frac{4}{7}
\]

\[
P(R + R) = \left( \frac{5}{8} \right) \left( \frac{4}{7} \right) = \frac{20}{56}
\]

Find the probability that both marbles are the same color.

\[
P(G + G) = \left( \frac{3}{8} \right) \left( \frac{2}{7} \right) = \frac{6}{56}
\]

\[
P(R + R) \text{ or } P(G + G) = \left( \frac{20}{56} \right) + \left( \frac{6}{56} \right) = \frac{26}{56}
\]
In the diagram below of rectangle AFEB and a semicircle with diameter $\overline{CD}$, $AB = 5$ inches, $AB = BC = DE = FE$, and $CD = 6$ inches. Find the area of the shaded region, to the nearest hundredth of a square inch.

Area Rectangle - Area Semicircle = Shaded Area

$(5 \times 16) - \frac{\pi \cdot 5^2}{2} = 80 - \frac{25\pi}{2} = 80 - 4.5\pi = \text{shaded area}

65.86 \text{ in}^2$