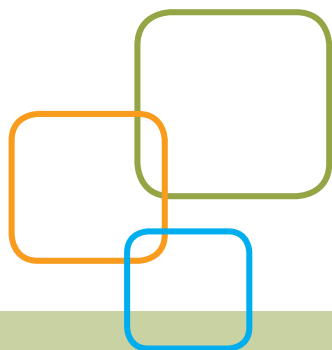


# ACCUPLACER<sup>®</sup>



## Minnesota State Colleges and Universities Intermediate Algebra Sample Questions

# Intermediate Algebra

The Minnesota State Colleges and University (MnSCU) Intermediate Algebra test contains 40 questions that measure proficiency in five content areas. The five content areas are as follows:

**Linear Equations, Inequalities, Functions and Systems** — Topics covered in this category include:

- Algebraic operations with functions, literal equations, direct variation and compound inequalities
- Solving systems of linear equations, linear inequalities and linear functions
- Graphs of linear equations, inequalities and functions
- Symbolic, graphical and numerical representations of linear equations, inequalities and functions
- Linear equations, inequalities and functions with absolute values

**Quadratic and Other Polynomial Expressions, Equations and Functions** — Topics covered in this category include:

- Algebraic operations involving quadratics and polynomials
- Solving quadratic equations
- Graphs of quadratic equations and functions
- Symbolic, graphical, and numerical representations of quadratic equations
- Operations with complex numbers

**Expressions, Equations and Functions Involving Powers, Roots and Radicals** — Topics covered in this category include:

- Algebraic operations involving rational and negative exponents
- Solving radical equations
- Graphs of simple square root functions

**Rational and Exponential Expressions, Equations and Functions** — Topics covered in this category include:

- Algebraic operations involving rational expressions, equations and functions
- Solving rational equations
- Exponential expressions, equations and functions

**Word Problems and Applications** — Topics covered in this category include:

- Translating written phrases or sentences into algebraic expressions or equations
- Solving verbal problems in an algebraic context

## Linear Equations, Inequalities, Functions and Systems

For each of the questions below, choose the best answer from the four choices given. You may use the paper you received as scratch paper.

1. If  $B = \frac{3}{2}x + d$ , then  $x =$

A.  $\frac{2}{3}B - d$

B.  $\frac{2}{3}(B - d)$

C.  $\frac{3}{2}B - d$

D.  $\frac{3}{2}(B - d)$

$$y \geq 5x + 3$$

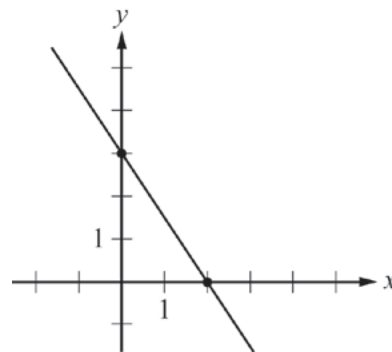
2. If  $x \geq 2$ , then the inequality above is equivalent to which of the following?

A.  $y \geq 10$

B.  $y \leq 10$

C.  $y \geq 13$

D.  $y \leq 13$



3. If the equation  $y = \frac{3}{2}x - 1$  were to be graphed in the  $xy$ -plane above, at what point would the graph intersect the line shown?

A.  $\left(-\frac{4}{3}, 1\right)$

B.  $\left(\frac{4}{3}, 1\right)$

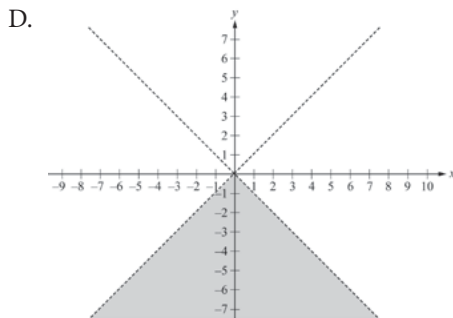
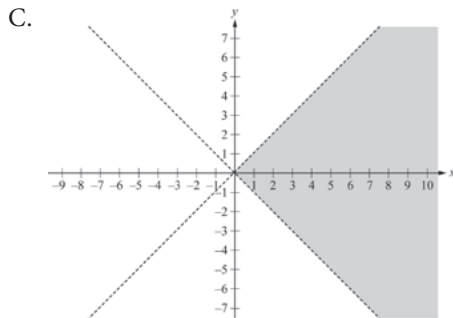
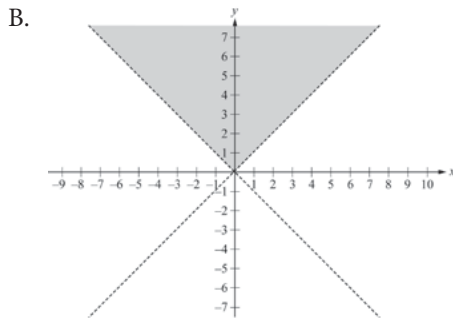
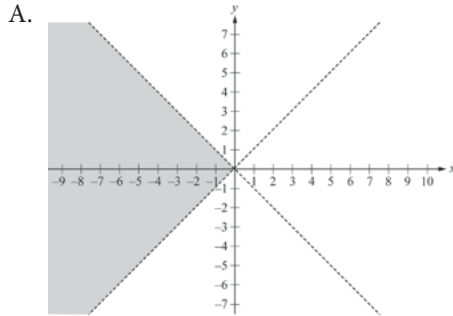
C.  $\left(1, -\frac{4}{3}\right)$

D.  $\left(1, \frac{4}{3}\right)$

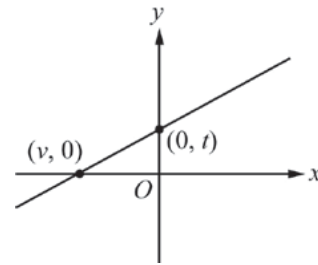
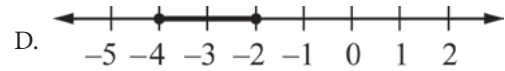
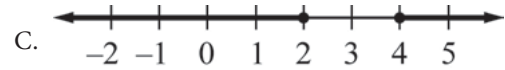
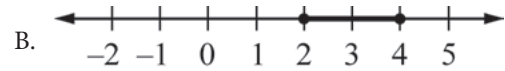
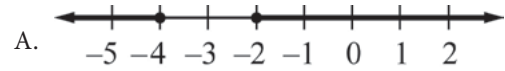
$$y < x$$

$$y > -x$$

4. Which of the following shows the solution set of the system of inequalities above?



5. If  $x + 3 \geq -1$  or  $2x + 5 \leq 1$ , then the graph of the solution set is



6. The equation  $y = mx + b$  is graphed in the  $xy$ -plane above. Which of the following must be equal to  $m$ ?

A.  $\frac{t}{v}$

B.  $-\frac{t}{v}$

C.  $\frac{b}{v}$

D.  $t - v$

$$2x - 6y = 4$$
$$10x - ky = 20$$

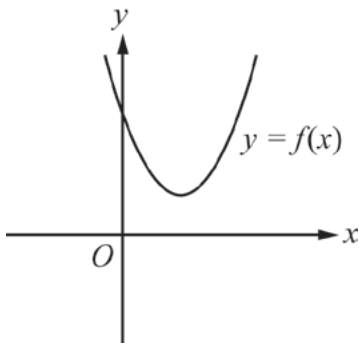
7. In the system of equations above,  $k$  is a constant. If the system has infinitely many solutions, what is the value of  $k$ ?
- A.  $-30$
- B.  $-\frac{5}{6}$
- C.  $\frac{5}{6}$
- D.  $30$
8. For which of the following inequalities is the solution set equal to  $4 \leq t \leq 10$ ?
- A.  $|t+10| \leq 4$
- B.  $|t+7| \leq 3$
- C.  $|t-4| \leq 10$
- D.  $|t-7| \leq 3$

## Quadratic and Other Polynomial Expressions, Equations and Functions

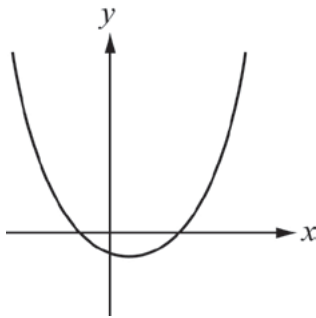
For each of the questions below, choose the best answer from the four choices given. You may use the paper you received as scratch paper.

1. If  $12 - 3x^2 = 2y$  for all real numbers  $x$ , then  $x^2 - 4 =$
- A.  $2y$
- B.  $\frac{2}{3}y$
- C.  $-\frac{2}{3}y$
- D.  $-\frac{3}{2}y$
2. If  $x^4 + x^2 + x + 5 = x^4 + 25$ , then  $x$  could be
- A.  $-5$
- B.  $-4$
- C.  $2$
- D.  $5$
3. If  $x^2 - 2 < \frac{7}{2}x$ , which of the following must be true?
- A.  $-4 < x < 2$
- B.  $-1 < x < 4$
- C.  $x < -\frac{1}{2}$
- D.  $x > 4$

4. In the  $xy$ -plane, if the point  $(x, y)$  is on the  $x$ -axis and  $y = x^4 - 8x^2 - 9$ , then  $(x, y)$  could be
- $(0, -3)$
  - $(0, 1)$
  - $(3, 0)$
  - $(9, 0)$



5. The parabola  $y = f(x)$  is graphed in the  $xy$ -plane above. The graph of the parabola  $y = g(x)$  can be obtained by reflecting the graph of  $f$  across the  $y$ -axis. How many real roots does  $g(x)$  have?
- Zero
  - One
  - Two
  - Three



6. The quadratic function  $y = f(x) = ax^2 + bx + c$  is graphed in the  $xy$ -plane above. The equation  $ax^2 + bx + c = dx$ , where  $d$  is a constant, has
- no real or complex solutions
  - exactly one real solution
  - two real solutions
  - one real solution and one complex solution

7. In the  $xy$ -plane, the graph of the parabola  $y = a(x - h)^2 + k$ , where  $h$  and  $k$  are constants, intersects the  $x$ -axis at two distinct points if and only if
- $h > 0$
  - $a < 0$
  - the product of  $a$  and  $k$  is a negative number
  - the product of  $a$  and  $k$  is a positive number
8. Which of the following products, when multiplied out and simplified, does NOT result in a quadratic with real coefficients?
- $(2x - \sqrt{3})(x + \sqrt{3})$
  - $(ix)(1 - ix)$
  - $(x - 8i)(x + 8i)$
  - $(x + 2 - 3i)(x + 2 + 3i)$

## Expressions, Equations and Functions Involving Powers, Roots and Radicals

For each of the questions below, choose the best answer from the four choices given. You may use the paper you received as scratch paper.

1.  $27^{\frac{4}{3}}$  =
- 9
  - 36
  - 81
  - 243
2. If  $x$  is a positive number,  $\frac{\sqrt{2x^3}}{\sqrt{8x}}$  =
- $\frac{x}{2}$
  - $\frac{x}{4}$
  - $\frac{x^2}{2}$
  - $\frac{x^2}{4}$

3.  $\sqrt{12} - 2\sqrt{3} =$

- A. 0
- B. 2
- C.  $\sqrt{6}$
- D.  $2\sqrt{3}$

4. If  $x$  is a nonnegative number, then  $\sqrt{x^2 + 2x + 1} - 1 =$

- A.  $x - 1$
- B.  $x$
- C.  $x + \sqrt{2x}$
- D.  $x + \sqrt{2x - 1}$

5. If  $f(x) = \sqrt{x - 5}$ , for what value of  $x$  does  $f(x) = 10$ ?

- A. 15
- B. 95
- C. 105
- D. 225

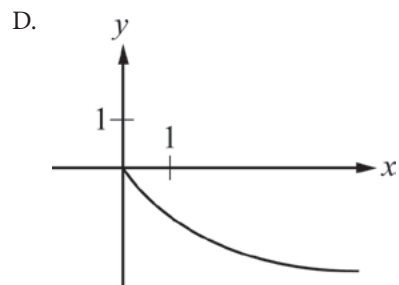
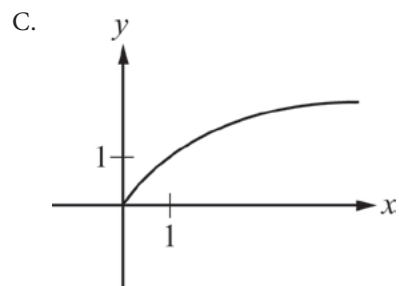
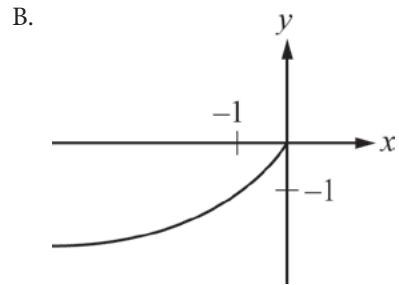
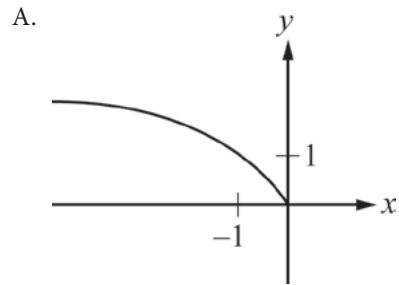
6. If  $\sqrt{a} + \sqrt{3} = \sqrt{48}$ , then  $a =$

- A. 16
- B. 24
- C. 27
- D. 45

7. For what value of  $x$  does  $x = \sqrt{(x - 1)^2 + 60} - 1$ ?

- A. 30
- B. 15
- C. 8
- D. 7

8. Which of the following could be the graph of  $y = -\sqrt{-x}$  in the  $xy$ -plane?



## Rational and Exponential Expressions, Equations and Functions

For each of the questions below, choose the best answer from the four choices given. You may use the paper you received as scratch paper.

1.  $\frac{7x}{x-3} - \frac{21}{x-3} =$

A.  $\frac{7}{x-3}$

B.  $\frac{7}{x}$

C. 7

D. 0

2.  $\left(\frac{1}{a} - \frac{a}{b^2}\right) \div \left(\frac{b^2 - a^2}{ab}\right) =$

A. 1

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

C.  $\frac{1-a}{b}$

D.  $\frac{a}{b(b^2 - a^2)}$

3.  $\frac{s}{3t-1} - \frac{s}{3t+1} =$

A. 0

B.  $\frac{1}{3t^2 - 1}$

C.  $\frac{6st}{9t^2 - 1}$

D.  $\frac{2s}{9t^2 - 1}$

$$\frac{3}{x} - \frac{2}{x-1} = \frac{1}{12}$$

4. There are two solutions to the equation above. What is the product of these two solutions?

A. -36

B. -9

C. 13

D. 36

5. How many different solutions does the equation

$$\frac{3}{x(x-3)} + \frac{7}{x} = \frac{1}{x-3} \text{ have?}$$

A. None

B. One

C. Two

D. More than two

6. If  $f(x) = \frac{2x}{x-1}$  and  $1 < c < 2$ , which of the following could be  $f(c)$ ?

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

B.  $\frac{5}{2}$

C. 4

D. 6

7. If  $x + 8 = \frac{20}{x}$  and  $x > 0$ , which of the following is true?

A.  $-1 < x < 1$

B.  $\frac{1}{2} < x < 3$

C.  $2 < x < \frac{9}{2}$

D.  $5 < x < 20$



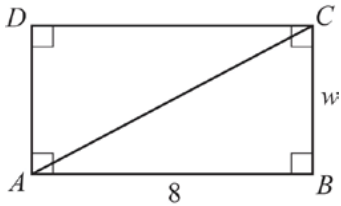
8. In the  $xy$ -plane, which of the following points lies on the graph of  $y = x - \frac{1}{x}$ ?
- A.  $(-1, -2)$   
 B.  $(0, -1)$   
 C.  $(1, 0)$   
 D.  $(2, \frac{1}{2})$
2. A group of adults and children are at a puppet show. The number of children who attended was 8 more than the number of adults. If  $c$  children are at the puppet show, which of the following represents the fraction of the people at the puppet show who are adults?
- A.  $\frac{c-8}{c}$   
 B.  $\frac{c}{2c-8}$   
 C.  $\frac{c-8}{2c-8}$   
 D.  $\frac{c+8}{2c+8}$

## Word Problems and Applications

For each of the questions below, choose the best answer from the four choices given. You may use the paper you received as scratch paper.



1. To make a wood photo frame, Bella charges \$3 per inch of the perimeter of the photo plus a fixed fee of \$15 for the glass. If the square photo shown below has an area of  $A$  square inches, how much would Bella charge, in dollars, to make a wood frame for the photo?
- A.  $3A + 15$   
 B.  $3\sqrt{A} + 15$   
 C.  $3\sqrt{A+15}$   
 D.  $12\sqrt{A} + 15$
3. A new factory opens and produces 5,000 units of a product the first day. Each day after the first, the factory produces 10,000 units of the product. Which of the following expresses the number of units of the product the factory produces the first  $d$  days it is open?
- A.  $10,000d - 5,000$   
 B.  $10,000d + 5,000$   
 C.  $10,000(d + 1) + 5,000$   
 D.  $10,000(2d) - 5,000$
4. Marjorie is renting an artist's studio for a month at a cost of \$800. During the month, if she makes  $n$  pieces of pottery, her total cost, in dollars, for rent and materials will be  $C(n) = 25n + 800$ , and the function  $g(n) = \frac{C(n)}{n}$  gives the cost, in dollars, per piece of making  $n$  pieces of pottery. According to these functions, which of the following is true?
- A. The total cost of making 100 pieces of pottery is the same as the total cost of making 120 pieces of pottery.  
 B. The total cost of making 100 pieces of pottery is less than the total cost of making 120 pieces of pottery.  
 C. The cost per piece of making 100 pieces of pottery is greater than the cost per piece of making 120 pieces of pottery.  
 D. The cost per piece of making 100 pieces of pottery is less than the cost per piece of making 120 pieces of pottery.



5. In rectangle  $ABCD$  above, how much longer is diagonal  $\overline{AC}$  than side  $\overline{AD}$ ?
- A.  $\sqrt{64 - w^2}$   
 B.  $\sqrt{64 + w^2} - w$   
 C.  $\sqrt{64 + w^2} - 8$   
 D.  $8 + w - \sqrt{64 + w^2}$
6. Working alone, Emma can paint a room in 1 hour, and working alone, Mason can paint the same room in 2 hours. If Emma and Mason work together, how long would it take for them to paint the room?
- A. 40 minutes  
 B. 30 minutes  
 C. 25 minutes  
 D. 20 minutes
7. A ball was dropped from the top of a building, and the ball's height above the ground, in feet,  $t$  seconds after it was dropped was  $h(t) = -16t^2 + 100$ . How many seconds after it was dropped did the ball hit the ground?
- A. 1.6  
 B. 2.5  
 C. 6.25  
 D. 10
8. Ava bought some pens for \$2 each and some pencils for \$1 each. She bought 3 more pens than pencils and spent a total of \$12. How many pencils did Ava buy?
- A. 2  
 B. 3  
 C. 4  
 D. 5

# Answer Key

Linear Equations, Inequalities, Functions and Systems		
Question Number	Correct Answer	Rationale
1	B	Choice (B) is correct. If $B = \frac{3}{2}x + d$ , then $B - d = \frac{3}{2}x$ . It follows that $x = \frac{2}{3}(B - d)$ .
2	C	Choice (C) is correct. If $y \geq 5x + 3$ and $x \geq 2$ , then $5x \geq (5)(2) = 10$ . It follows that $y \geq 5x + 3 \geq 10 + 3 = 13$ .
3	B	Choice (B) is correct. The line graphed in the figure has slope $-\frac{3}{2}$ and has $y$ -intercept equal to 3. It follows that the equation of this line is $y = -\frac{3}{2}x + 3$ . If the equation $y = \frac{3}{2}x - 1$ were to be graphed in the same $xy$ -plane, then the point of intersection of the two lines would be the point $(x, y)$ such that $x$ and $y$ satisfy both equations. If $y = -\frac{3}{2}x + 3$ and $y = \frac{3}{2}x - 1$ both hold, then $-\frac{3}{2}x + 3 = \frac{3}{2}x - 1$ , so $4 = \frac{6}{2}x = 3x$ , and then $x = \frac{4}{3}$ . It follows that $y = \left(-\frac{3}{2}\right)\left(\frac{4}{3}\right) + 3 = -2 + 3 = 1$ . Thus the graphs intersect at the point $\left(\frac{4}{3}, 1\right)$ .
4	C	Choice (C) is correct. The region in the $xy$ -plane consisting of the points below the graph of the line $y = x$ is the graph of $y < x$ . The region in the $xy$ -plane consisting of the points above the graph of the line $y = -x$ is the graph of $y > -x$ . The intersection of these two regions is the solution to the system of equalities $y < x$ and $y > -x$ . This is the region shown in option (C).
5	D	Choice (D) is correct. If $x + 3 \geq -1$ , then $x \geq -4$ . If $2x + 5 \leq 1$ , then $2x \leq -4$ , and $x \leq -2$ . It follows that if $x + 3 \geq -1$ and $2x + 5 \leq 1$ , then $x \geq -4$ or $x \leq -2$ . These inequalities describe the solution set graphed in option (D).
6	B	Choice (B) is correct. The equation $y = mx + b$ is in slope-intercept form, so the coefficient of $x$ , which is $m$ , is equal to the slope of the line. Also, the slope of the line is equal to $\frac{t-0}{0-v} = \frac{t}{-v} = -\frac{t}{v}$ . Therefore, $m$ must be equal to $-\frac{t}{v}$ .
7	D	Choice (D) is correct. If the system has infinitely many solutions, then the two equations are equivalent. That is, the set of pairs $(x, y)$ that satisfy $2x - 6y = 4$ is the same set of pairs that satisfy $10x - ky = 20$ . The equation $2x - 6y = 4$ is equivalent to $10x - 30y = 20$ . Therefore, the equations $10x - 30y = 20$ and $10x - ky = 20$ are also equivalent. It follows that $k = 30$ .
8	D	Choice (D) is correct. The inequality $4 \leq t \leq 10$ is equivalent to the inequality $4 - 7 \leq t - 7 \leq 10 - 7$ , which is $-3 \leq t - 7 \leq 3$ . By the definition of absolute value, this is equivalent to $ t - 7  \leq 3$ .

## Quadratic and Other Polynomial Expressions, Equations and Functions

Question Number	Correct Answer	Rationale
1	C	Choice (C) is correct. The equation $12 - 3x^2 = 2y$ can be rewritten as $3(4 - x^2) = 2y$ . Multiplying both sides of the new equation by $-1$ and dividing by $3$ gives $x^2 - 4 = -\frac{2}{3}y$ .
2	A	Choice (A) is correct. Subtracting $x^4$ from both sides of the equation $x^4 + x^2 + x + 5 = x^4 + 25$ gives $x^2 + x + 5 = 25$ , which is equivalent to $x^2 + x - 20 = 0$ . Since $x^2 + x - 20 = (x + 5)(x - 4)$ , it follows that the solutions of the equation $x^2 + x - 20 = 0$ are $-5$ and $4$ . Therefore, of the choices given, $x$ can only be $-5$ .
3	B	Choice (B) is correct. The inequality $x^2 - 2 < \frac{7}{2}x$ can be rewritten as $x^2 - \frac{7}{2}x - 2 < 0$ , which is equivalent to $\left(x + \frac{1}{2}\right)(x - 4) < 0$ . The solutions to the equation $\left(x + \frac{1}{2}\right)(x - 4) = 0$ are $x = -\frac{1}{2}$ and $x = 4$ . For $-\frac{1}{2} < x < 4$ , the inequality $\left(x + \frac{1}{2}\right)(x - 4) < 0$ holds because $x + \frac{1}{2} > 0$ and $x - 4 < 0$ . For all other real values of $x$ , the product $\left(x + \frac{1}{2}\right)(x - 4)$ will be either positive, since both factors have the same sign, or zero. Therefore, $x$ must be between $-\frac{1}{2}$ and $4$ , which implies that $x$ must also be between $-1$ and $4$ .
4	C	Choice (C) is correct. Since the equation of the $x$ -axis is $y = 0$ , the point $(x, y)$ is of the form $(x, 0)$ . The $x$ -coordinate of the point can then be found by solving the equation $x^4 - 8x^2 - 9 = 0$ , which can be rewritten as $(x^2 + 1)(x^2 - 9) = 0$ . It follows that $x^2 = -1$ or $x^2 = 9$ . The first of these equations has the two complex solutions $i$ and $-i$ , and the second has the two real solutions $3$ and $-3$ . Therefore, of the choices given, only $(3, 0)$ could be the point that satisfies the two conditions of the problem.
5	A	Choice (A) is correct. The real roots of a function are the $x$ -coordinates of the points where the graph of the function intersects the $x$ -axis. Since the graph of $f$ does not intersect the $x$ -axis and the graph of $g$ is obtained by reflecting the graph of $f$ across the $y$ -axis, the graph of parabola $y = g(x)$ does not intersect the $x$ -axis. Therefore, $g(x)$ has no real roots.
6	C	Choice (C) is correct. The graph of the function $y = dx$ is a non-vertical line that passes through the origin of the $xy$ -plane. Any such line intersects the graph of the given parabola in two distinct points with different $x$ -coordinates. Therefore, the equation $ax^2 + bx + c = dx$ has two real solutions.

7	C	Choice (C) is correct. The graph of the parabola $y = a(x-h)^2 + k$ intersects the $x$ -axis at two distinct points if and only if the equation $a(x-h)^2 + k = 0$ has two distinct real solutions. Since the equation $a(x-h)^2 + k = 0$ can be rewritten as $(x-h)^2 = -\frac{k}{a}$ , it follows that the equation $a(x-h)^2 + k = 0$ has two distinct real solutions if and only if $k$ and $a$ have opposite signs, or, equivalently, the product of $a$ and $k$ is a negative number.
8	B	Choice (B) is correct. Multiplying out the product $(ix)(1-ix)$ gives $ix + x^2$ . Since the imaginary number $i$ is the coefficient of $x$ , not all the coefficients of the quadratic $ix + x^2$ are real numbers.  All the other products, when multiplied out and simplified, result in quadratics with real coefficients: $(2x - \sqrt{3})(x + \sqrt{3}) = 2x^2 + \sqrt{3}x - 3$ ; $(x - 8i)(x + 8i) = x^2 + 64$ ; and $(x + 2 - 3i)(x + 2 + 3i) = x^2 + 4x + 13$ .

## Expressions, Equations and Functions Involving Powers, Roots and Radicals

Question Number	Correct Answer	Rationale
1	C	Choice (C) is correct. Using the laws of exponents, $27^{\frac{4}{3}}$ can be rewritten as $\left(27^{\frac{1}{3}}\right)^4$ . Since the expression $27^{\frac{1}{3}}$ is the cube root of 27, which is equal to 3, it follows that $27^{\frac{4}{3}} = 3^4 = 81$ .
2	A	Choice (A) is correct. The expression $\frac{\sqrt{2x^3}}{\sqrt{8x}}$ can be rewritten as $\sqrt{\frac{2x^3}{8x}}$ , which is equal to $\sqrt{\frac{x^2}{4}}$ .  Since $x$ is a positive number, $\sqrt{\frac{x^2}{4}}$ is equal to $\frac{x}{2}$ .
3	A	Choice (A) is correct. The expression $\sqrt{12}$ is equal to $\sqrt{4 \times 3}$ , which is equal to $\sqrt{4} \times \sqrt{3}$ , or $2\sqrt{3}$ . Therefore, $\sqrt{12} - 2\sqrt{3} = 2\sqrt{3} - 2\sqrt{3} = 0$ .
4	B	Choice (B) is correct. Since $(x+1)^2 = x^2 + 2x + 1$ , the expression $\sqrt{x^2 + 2x + 1} - 1$ can be rewritten as $\sqrt{(x+1)^2} - 1$ . Since $x$ is a nonnegative number, $x + 1$ is also nonnegative, and so $\sqrt{(x+1)^2} - 1 = (x+1) - 1 = x$ .
5	C	Choice (C) is correct. From the definition $f(x) = \sqrt{x-5}$ , if $f(x) = 10$ , then $10 = \sqrt{x-5}$ . Squaring both sides of $10 = \sqrt{x-5}$ gives $100 = x - 5$ , or $x = 105$ . Substituting $x = 105$ in the definition for $f(x)$ gives $f(105) = \sqrt{105-5} = \sqrt{100} = 10$ .

6	C	Choice (C) is correct. If $\sqrt{a} + \sqrt{3} = \sqrt{48}$ , then $\sqrt{a} = \sqrt{48} - \sqrt{3}$ . Since $\sqrt{48} = \sqrt{16 \times 3} = \sqrt{16} \times \sqrt{3} = 4\sqrt{3}$ , it follows that $\sqrt{a} = 4\sqrt{3} - \sqrt{3} = 3\sqrt{3} = \sqrt{9} \times \sqrt{3} = \sqrt{27}$ . Therefore, $a = 27$ .
7	B	Choice (B) is correct. The equation $x = \sqrt{(x-1)^2 + 60} - 1$ can be rewritten as $x + 1 = \sqrt{(x-1)^2 + 60}$ , and squaring both sides of $x + 1 = \sqrt{(x-1)^2 + 60}$ gives $(x+1)^2 = (x-1)^2 + 60$ . Expanding both sides of $(x+1)^2 = (x-1)^2 + 60$ gives $x^2 + 2x + 1 = x^2 - 2x + 1 + 60$ , which simplifies to $4x = 60$ , or $x = 15$ . Substituting $x = 15$ back into $x = \sqrt{(x-1)^2 + 60} - 1$ gives $15 = \sqrt{14^2 + 60} - 1$ , which is true since $\sqrt{14^2 + 60} - 1 = \sqrt{256} - 1 = 15$ .
8	B	Choice (B) is correct. Each of the four graphs in the options could be the graph of a radical function. Since the square root is defined only for nonnegative arguments and always has a nonnegative value, the function $y = -\sqrt{-x}$ is defined only for nonpositive values of $x$ and always yields a nonpositive value for $y$ . Hence the graph of $y = -\sqrt{-x}$ must lie within Quadrant IV of the $xy$ -plane. Therefore, only the graph in (B) could be the graph of $y = -\sqrt{-x}$ in the $xy$ -plane.

## Rational and Exponential Expressions, Equations and Functions

Question Number	Correct Answer	Rationale
1	C	Choice (C) is correct. The difference of the fractional expressions, $\frac{7x}{x-3} - \frac{21}{x-3}$ , is equivalent to $\frac{7x-21}{x-3}$ . Factoring out 7 in $7x-21$ gives $\frac{7x-21}{x-3} = \frac{7(x-3)}{x-3} = 7$ .
2	B	Choice (B) is correct. Dividing by a rational expression is equivalent to multiplying by its reciprocal. Hence $\left(\frac{1}{a} - \frac{a}{b^2}\right) \div \left(\frac{b^2 - a^2}{ab}\right) = \left(\frac{1}{a} - \frac{a}{b^2}\right) \left(\frac{ab}{b^2 - a^2}\right)$ . Since $\frac{1}{a} - \frac{a}{b^2} = \frac{b^2 - a^2}{ab^2}$ , it follows that $\left(\frac{1}{a} - \frac{a}{b^2}\right) \left(\frac{ab}{b^2 - a^2}\right)$ can be rewritten as $\left(\frac{b^2 - a^2}{ab^2}\right) \left(\frac{ab}{b^2 - a^2}\right)$ , which simplifies to $\frac{1}{b}$ .
3	D	Choice (D) is correct. Since $\frac{s}{3t-1} - \frac{s}{3t+1} = \frac{s(3t+1) - s(3t-1)}{(3t-1)(3t+1)}$ , multiplying out the numerator and the denominator of the latter fraction gives $\frac{3st + s - 3st + s}{9t^2 - 1}$ , which equals $\frac{2s}{9t^2 - 1}$ .

4	D	<p>Choice (D) is correct. The equation <math>\frac{3}{x} - \frac{2}{x-1} = \frac{1}{12}</math> can be rewritten as <math>\frac{x-3}{x(x-1)} = \frac{1}{12}</math>. Cross-multiplying in the latter equation gives <math>12(x-3) = x(x-1)</math>, which can be rewritten as <math>x^2 - 13x + 36 = 0</math>. Since the original equation <math>\frac{3}{x} - \frac{2}{x-1} = \frac{1}{12}</math> has two solutions, which are also solutions of the quadratic equation <math>x^2 - 13x + 36 = 0</math>, the product of these solutions is the constant term of <math>x^2 - 13x + 36 = 0</math>, which is 36. (In fact, the two solutions are <math>x = 4</math> and <math>x = 9</math>.)</p>
5	A	<p>Choice (A) is correct. The equation <math>\frac{3}{x(x-3)} + \frac{7}{x} = \frac{1}{x-3}</math> can be rewritten as <math>\frac{3}{x(x-3)} - \frac{1}{x-3} = -\frac{7}{x}</math>, which is equivalent to the equation <math>\frac{1}{x} = \frac{7}{x}</math>. Since <math>\frac{1}{x} = \frac{7}{x}</math> has no solutions, it follows that the original equation <math>\frac{3}{x(x-3)} + \frac{7}{x} = \frac{1}{x-3}</math> has no solutions as well.</p>
6	D	<p>Choice (D) is correct. If <math>c = \frac{3}{2}</math>, then <math>c - 1 = \frac{1}{2}</math>. Hence <math>f(c) = \frac{2c}{c-1} = \frac{2\left(\frac{3}{2}\right)}{\frac{1}{2}} = 3 \times 2 = 6</math>. Other choices cannot be <math>f(c)</math>, because, if <math>1 &lt; c &lt; 2</math>, then <math>\frac{1}{c-1} &gt; 1</math>, and so <math>f(c) = \frac{2c}{c-1} = 2 + \frac{2}{c-1}</math> must be greater than 4.</p>
7	B	<p>Choice (B) is correct. Multiplying both sides of the equation <math>x + 8 = \frac{20}{x}</math> by <math>x</math> gives <math>x^2 + 8x = 20</math>, or <math>x^2 + 8x - 20 = 0</math>, which has two solutions: <math>x = -10</math> and <math>x = 2</math>. Since <math>x &gt; 0</math>, it follows that <math>x = 2</math>. Therefore, of the choices given, only <math>\frac{1}{2} &lt; x &lt; 3</math> is true.</p>
8	C	<p>Choice (C) is correct. Substituting <math>x = 1</math> and <math>y = 0</math> in the equation <math>y = x - \frac{1}{x}</math> gives <math>0 = 1 - \frac{1}{1}</math>, which is true. Analogous substitutions for the other points given in the choices do not yield any true statements.</p>

## Word Problems and Applications

Question Number	Correct Answer	Rationale
1	D	Choice (D) is correct. Since the photo is a square and has area $A$ square inches, each side of the photo is $\sqrt{A}$ inches long. Therefore, the perimeter of the photo is $4\sqrt{A}$ inches. Hence Bella would charge \$3 per inch of the perimeter of the photo, or $12\sqrt{A}$ dollars, plus a fixed fee of \$15 for the glass. Therefore, the total Bella would charge, in dollars, to make a wood frame for the photo would be $12\sqrt{A} + 15$ .
2	C	Choice (C) is correct. Since $c$ children are at the puppet show and there are 8 more children than adults, the number of adults at the puppet show is $c - 8$ . Hence the total number of people — adults and children — at the puppet show is $c + (c - 8) = 2c - 8$ . Since $c - 8$ of these $2c - 8$ people are adults, the fraction of people at the puppet show who are adults is $\frac{c - 8}{2c - 8}$ .
3	A	Choice (A) is correct. The first day it is open, the factory produces 5,000 units of the product. For each of the next $d - 1$ days it is open, the factory produces 10,000 units of the product, which gives a total of $10,000(d - 1)$ units for these $d - 1$ days. Therefore, the total number of units of the product that the factory produces the first $d$ days it is open is $5,000 + 10,000(d - 1) = 5,000 + 10,000d - 10,000 = 10,000d - 5,000$ .
4	D	Choice (D) is correct. The function $g(n) = \frac{C(n)}{n} = \frac{25n + 800}{n} = 25 + \frac{800}{n}$ gives the cost, in dollars, <u>per piece</u> of making $n$ pieces of pottery. As $n$ takes on larger positive integer values, $\frac{800}{n}$ gets smaller, and so the function $g(n) = 25 + \frac{800}{n}$ decreases as $n$ , the number of pieces of pottery Marjorie makes, increases. It follows that the cost <u>per piece</u> of making 100 pieces of pottery is less than the cost <u>per piece</u> of making 120 pieces of pottery.
5	B	Choice (B) is correct. Since $ABCD$ is a rectangle, triangle $ADC$ is a right triangle with legs $\overline{AD}$ and $\overline{DC}$ of lengths $w$ and 8, respectively. By the Pythagorean theorem, $\overline{AC}$ has length $\sqrt{8^2 + w^2} = \sqrt{64 + w^2}$ . Therefore, $\overline{AC}$ is longer than $\overline{AD}$ by $AC - AD = \sqrt{64 + w^2} - w$ .
6	A	Choice (A) is correct. Since Emma can paint the room in 1 hour, or 60 minutes, for each minute she works, Emma can paint $\frac{1}{60}$ of the room. Since Mason can paint the room in 2 hours, or 120 minutes, for each minute he works, Mason can paint $\frac{1}{120}$ of the room. Hence, for each minute Emma and Mason work together, they can paint $\frac{1}{60} + \frac{1}{120} = \frac{2}{120} + \frac{1}{120} = \frac{3}{120} = \frac{1}{40}$ of the room. Therefore, if Emma and Mason work together, it would take them 40 minutes to paint the room.



7	<b>B</b>	Choice (B) is correct. When the ball hits the ground, its height above the ground is 0 feet. Hence the ball will hit the ground after $t$ seconds, where $0 = h(t) = -16t^2 + 100$ . Solving this equation for $t$ gives $t^2 = \frac{100}{16} = 6.25$ , or $t = \pm 2.5$ . Since the value $t = -2.5$ seconds makes no sense in the setting of the problem, the solution is $t = 2.5$ . Therefore, the ball hit the ground 2.5 seconds after it was dropped.
8	<b>A</b>	Choice (A) is correct. Let $n$ be the number of pencils Ava bought. Since Ava bought 3 more pens than pencils, she bought $n + 3$ pens. Since the pens cost \$2 each and the pencils cost \$1 each, Ava spent a total, in dollars, of $2(n + 3) + 1(n) = 3n + 6$ . Since the total amount Ava spent was \$12, it follows that $3n + 6 = 12$ , which gives $n = 2$ . Therefore, Ava bought 2 pencils.