

Do not remove this answer page — you will turn in the entire exam. You have two hours to do this exam. No books or notes may be used. You may use an ACT-approved calculator during the exam, but NO calculator with a Computer Algebra System (CAS), networking, or camera is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of multiple choice questions. Record your answers on this page. For each multiple choice question, you will need to fill in the circle corresponding to the correct answer. For example, if (a) is correct, you must write

- a    b    c    d    e

Do not circle answers on this page, but please circle the letter of each correct response in the body of the exam. It is your responsibility to make it CLEAR which response has been chosen. You will not get credit unless the correct answer has been marked on both this page and in the body of the exam.

**GOOD LUCK!**

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| 10. <input type="radio"/> a <input checked="" type="radio"/> b <input type="radio"/> c <input type="radio"/> d <input type="radio"/> e | 20. <input type="radio"/> a <input type="radio"/> b <input checked="" type="radio"/> c <input type="radio"/> d <input type="radio"/> e |

For grading use:

Number Correct	
	(out of 20 problems)

Total	
	(out of 100 points)

Name: Key

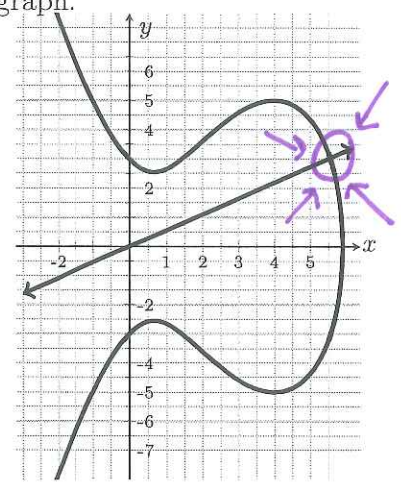
**Multiple Choice Questions**

Show all your work on the page where the question appears.  
Clearly mark your answer both on the cover page on this exam  
and in the corresponding questions that follow.

1. Determine the solutions to the system of equations in the following graph.

Possibilities:

- (a)  $(x = 5.5, y = 3)$  only
- (b)  $(x = 4, y = -5)$  only
- (c)  $(x = -3, y = 5.5)$  only
- (d)  $(x = 3, y = -3)$  only
- (e)  $(x = 0, y = 3)$  and  $(x = 0, y = -3)$



\* Solutions to systems of equations are intersection points on the graph of the system.

2. Use the substitution method to find all solutions of the system of equations.

$$\begin{aligned} x + y^2 &= 6 \\ y - x &= -4 \end{aligned} \Rightarrow \boxed{y = x - 4}$$

Possibilities:

- (a)  $(x = 2, y = 2)$  and  $(x = 6, y = -2)$
- (b)  $(x = 2, y = -2)$  only
- (c) No real solutions
- (d)  $(x = 5, y = 1)$  only
- (e)  $(x = 2, y = -2)$  and  $(x = 5, y = 1)$

$$\begin{aligned} x + (x-4)^2 &= 6 \\ x + x^2 - 8x + 16 &= 6 \\ x^2 - 7x + 10 &= 0 \\ (x-5)(x-2) &= 0 \\ x &= 5, 2 \\ \text{if } y &= x - 4 \\ \text{and } x = 5 & \quad x = 2 \\ y = 5 - 4 & \quad y = 2 - 4 \\ y = 1 & \quad y = -2 \\ (5, 1) & \quad (2, -2) \end{aligned}$$

3. Use the elimination method to solve the system. The multiple choice problem only asks you for  $y$ .

$$\begin{array}{r} 11x + 17y = 146 \\ (11x + 16y = 140) * -1 \Rightarrow -11x - 16y = -140 \end{array} \Rightarrow \begin{array}{r} 11x + 17y = 146 \\ \hline -11x - 16y = -140 \\ \hline y = 6 \end{array}$$

Possibilities:

- (a) Every solution has  $y = \frac{6}{17}$
- (b) Every solution has  $y = -17$
- (c) Every solution has  $y = 4$
- (d) Every solution has  $y = \frac{6}{11}$
- (e) Every solution has  $y = 6$

4. Suppose you are solving the system of equations below using the elimination method. You eliminate  $x^2$  by taking 9 times the top equation, and subtracting 8 times the bottom equation. What equation must you solve then?

$$\begin{array}{r} (8x^2 + 2y = 6) * 9 \Rightarrow 72x^2 + 18y = 54 \\ (9x^2 + 4y^5 = 3) * -8 \Rightarrow -72x^2 - 32y^5 = -24 \end{array} \Rightarrow \begin{array}{r} 72x^2 + 18y = 54 \\ \hline -72x^2 - 32y^5 = -24 \\ \hline 18y - 32y^5 = 30 \end{array}$$

Possibilities:

- (a)  $18y - 32y^5 = 30$
- (b)  $\sqrt{6 - 9y} = 4y^5$
- (c)  $8x^2 + 2y = 9x^2 + 4y^5$
- (d)  $9x^2 + 4(6 - 8x^2)^5 = 3$
- (e)  $8x^2 + 2\sqrt[5]{3 - 9x^2} = 6$

5. Use the elimination method to find all solutions of the system of equations.

$$\begin{cases} \frac{25}{x} + \frac{26}{y} = 47 \\ \left( \frac{7}{x} + \frac{13}{y} = 22 \right) * -2 \Rightarrow \end{cases} \Rightarrow \begin{array}{r} \frac{25}{x} + \frac{26}{y} = 47 \\ -\frac{14}{x} - \frac{26}{y} = -44 \\ \hline \frac{11}{x} = 3 \end{array}$$

Possibilities:

(a)  $(x = 25, y = 26)$ ,  $(x = -25, y = 26)$ ,  $(x = 7, y = 13)$ , and  $(x = -7, y = -13)$

(b)  $(x = 25, y = 26)$  and  $(x = 7, y = 13)$

(c)  $\left(x = \frac{11}{3}, y = \frac{11}{17}\right)$  only

(d)  $\left(x = \frac{11}{3}, y = \frac{11}{17}\right)$  and  $\left(x = -\frac{11}{3}, y = -\frac{11}{17}\right)$

(e)  $(x = -25, y = 26)$  and  $(x = -7, y = 13)$

$$\begin{array}{l} \frac{11}{x} = 3 \\ 11 = 3x \\ \frac{11}{3} = x \end{array}$$

$$\begin{array}{l} \frac{25}{\frac{11}{3}} + \frac{26}{y} = 47 \\ 25\left(\frac{3}{11}\right) + \frac{26}{y} = 47 \\ \frac{26}{y} = \frac{47(11) - 25(3)}{11} \\ \frac{26}{y} = \frac{442}{11} \end{array}$$

$$\begin{array}{l} 442 y = 26(11) \\ y = \frac{286}{442} = \frac{11}{17} \end{array}$$

6. Use substitution to solve the system.

$$\begin{array}{l} 9x + 2y = 29 \\ 8x + y = 19 \Rightarrow \underline{y = 19 - 8x} \end{array}$$

Possibilities:

(a)  $x = -\frac{7}{299}$ ,  $y = -\frac{7}{251}$

(b)  $x = \frac{9}{7}$ ,  $y = \frac{61}{7}$

(c)  $x = \frac{29}{9}$ ,  $y = \frac{19}{8}$

(d)  $x = \frac{61}{7}$ ,  $y = \frac{9}{7}$

(e)  $x = 299$ ,  $y = 251$

$$9x + 2(19 - 8x) = 29$$

$$9x + 38 - 16x = 29$$

$$-7x = -9$$

$$x = \frac{-9}{-7} = \frac{9}{7}$$

$$8\left(\frac{9}{7}\right) + y = 19$$

$$\frac{72}{7} + y = 19$$

$$y = 19 - \frac{72}{7} = \frac{61}{7}$$

7. Use algebraic, graphical, or numerical methods to find all real solutions of the equation, approximating when necessary to four decimal places.

*\*Other methods are possible!!*

$$\cancel{(x+2)^9} + 13x = 36 + \cancel{(x+2)^9}$$

$$- \cancel{(x+2)^9} \qquad - \cancel{(x+2)^9}$$

$$13x = 36$$

$$x = \frac{36}{13} \approx 2.7692$$

Possibilities:

- (a)  $x = 2.7692$
- (b)  $x = 2.7709$
- (c)  $x = 2.7726$
- (d)  $x = 2.7743$
- (e)  $x = 2.7760$

8. Find an equation that helps solve for the worker's old salary, call it  $x$ , in the following problem:  
A worker gets a 3.75% pay raise and now makes \$1780 per month. What was the worker's old salary?

*let  $x =$  old salary*

*old salary + raise = new salary*

$$x + .0375x = 1780$$

Possibilities:

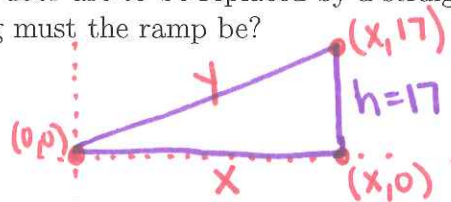
- (a)  $x = 1780 - 3.75$
- (b)  $0.0375x = 1780$
- (c)  $x = (3.75)(1780)$
- (d)  $x + 0.0375x = 1780$
- (e)  $3.75x = 1780$

*\* a pay raise is a percentage of one's old salary.*

9. The door of a campus building is  $h = 17$  inches above ground level. To allow wheelchair access, the steps in front of the door are to be replaced by a straight ramp with constant slope  $\frac{1}{20}$ , as shown in the figure. How long must the ramp be?

Possibilities:

- (a) 37.00 inches
- (b) 357.00 inches
- (c) 0.85 inches
- (d) 26.25 inches
- (e) 340.42 inches



$$\text{Slope of line } y = \frac{\Delta h}{\Delta x} = \frac{17}{x} = \frac{1}{20}$$

$$\text{so } x = (17)(20) = 340$$

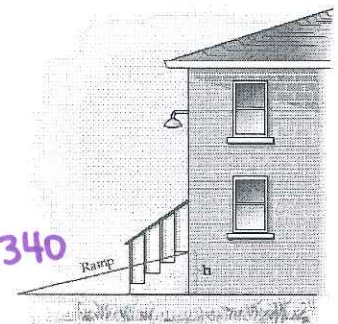
*Now we need distance  $y$ .*

$$x^2 + h^2 = y^2$$

$$(340)^2 + (17)^2 = y^2$$

$$115889 = y^2$$

$$\text{So } y = \sqrt{115889} \approx 340.42$$



10. Find the equilibrium price. In the supply and demand equations,  $p$  is price (in dollars) and  $x$  is quantity (in thousands). Please round your answer to the nearest hundredth (the nearest cent).

→ "solve for p"  
so eliminate x!

$$\begin{aligned} \text{Supply: } (p &= 8x - 2) * 9 \Rightarrow 9p = 72x - 18 \\ \text{Demand: } (p &= -9x + 4) * 8 \Rightarrow 8p = -72x + 32 \end{aligned}$$

$$17p = 14$$

$$p = \frac{14}{17} \approx .8235$$

$$\boxed{\$0.82}$$

Possibilities:

- (a)  $p = \$8.50$
- (b)  $p = \$0.82$
- (c)  $p = \$1$
- (d)  $p = \$0.35$
- (e)  $p = \$2$

11. The cost of a nut mix depends on how many pounds of each type of nut it contains: peanuts cost \$3.00 per pound and cashews cost \$4.50 per pound. How many pounds of peanuts and cashews should be added to 10 pounds of \$4.00 per pound mixed nuts to get 41 pounds of \$3.50 per pound mixed nuts?

Possibilities:

- (a) 15.50 lbs of peanuts and 15.50 lbs of cashews
- (b) 24.00 lbs of peanuts and 7.00 lbs of cashews
- (c) 13.67 lbs of peanuts and 27.33 lbs of cashews
- (d) 27.33 lbs of peanuts and 13.67 lbs of cashews
- (e) 7.00 lbs of peanuts and 24.00 lbs of cashews

original mix 10 pounds \$4/lb.	+	Peanuts p lbs. \$3/lb.	+	Cashews c lbs. \$4.50/lb.	=	new mix 41 lbs. \$3.50/lb.
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Solve the system:  $\begin{cases} 10 + p + c = 41 & \text{(total lbs.)} \\ 10(4) + p(3) + c(4.50) = 41(3.50) & \text{(total cost).} \end{cases}$

Using substitution,  $p = 41 - 10 - c = 31 - c$   
 then  $10(4) + (31 - c)(3) + c(4.50) = 41(3.50)$   
 $40 + 93 - 3c + 4.50c = 143.50$

continued  
→

#11 continued

$$133 + 1.5c = 143.50$$

$$1.5c = 10.5$$

$$c = 7$$

7 lbs. of cashews

then  $p = 31 - c$

$$p = 31 - 7 = 24$$

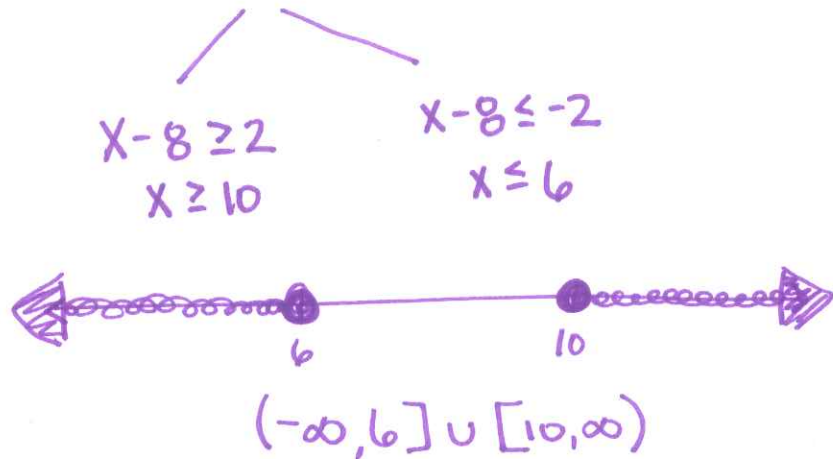
24 lbs. of peanuts

12. Solve the inequality. Answer in interval notation.

$$|x - 8| \geq 2$$

Possibilities:

- (a)  $[2, \infty)$
- (b)  $[2, 8]$
- (c)  $[0, 10]$
- (d)  $(-\infty, 6] \cup [10, \infty)$
- (e)  $[6, 10]$



13. Solve the inequality. Answer in interval notation.

$$12x + 18 > 8x + 4$$

Possibilities:

- (a)  $[-\frac{7}{2}, \infty)$
- (b)  $[\frac{1}{2}, \frac{3}{2}]$
- (c)  $(-\frac{7}{2}, \infty)$
- (d)  $(-\infty, \infty)$
- (e)  $(-\infty, 12] \cup [18, \infty)$

$$12x + 18 > 8x + 4$$

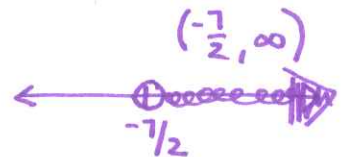
$$\begin{matrix} -8x & & -8x \end{matrix}$$

$$4x + 18 > 4$$

$$\begin{matrix} -18 & & -18 \end{matrix}$$

$$4x > -14$$

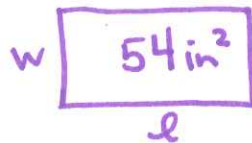
$$x > \frac{-14}{4} = -\frac{7}{2}$$



14. A rectangle must have an area of 54 square inches and a length of at most 3 inches. How wide can this rectangle be?

Possibilities:

- (a) at most 162 inches
- (b) at least 6 inches
- (c) at most 6 inches
- (d) at least 18 inches
- (e) at most 18 inches



$$A = l \cdot w$$

$$54 = l \cdot w$$

$$\frac{54}{w} = l \quad \text{but } l \leq 3$$

$$\frac{54}{w} \leq 3$$

$$54 \leq 3w$$

$$18 = \frac{54}{3} \leq w$$

$$18 \leq w$$



15. A business executive is considering two options for leasing a car. The first option is \$325 per month, but the first month costs \$160 extra. The second option is \$345 per month with no extra cost for the first month. The business executive wants to know which option is cheapest based on how many months they plan on leasing the car. Which choice below most accurately describes the situation?

Possibilities:

- (a) The first option is cheaper if the lease is 7 months or shorter, the second option is cheaper if the lease is 9 months or longer, and the two options are the same price if the lease is exactly 8 months
- (b)** The first option is cheaper if the lease is 9 months or longer, the second option is cheaper if the lease is 7 months or shorter, and the two options are the same price if the lease is exactly 8 months
- (c) Both options cost the same regardless of the length of the lease.
- (d) The first option is cheaper if the lease is 21 months or longer, the second option is cheaper if the lease is 19 months or shorter, and the two options are the same price if the lease is exactly 20 months
- (e) The first option is cheaper if the lease is 19 months or shorter, the second option is cheaper if the lease is 21 months or longer, and the two options are the same price if the lease is exactly 20 months

let  $x = \# \text{ months leasing car}$

option 1:  $325x + 160$

option 2:  $345x$

\* Cost is the same if

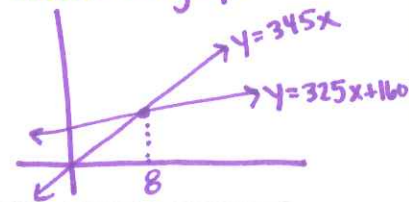
option 1 = option 2

$325x + 160 = 345x$

$160 = 20x$

$8 = x$

look at graph...



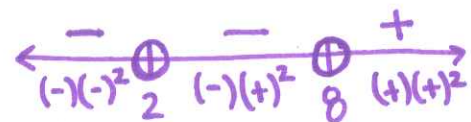
16. Solve the inequality. Answer by choosing the correct number line.

$0 < (x - 8)(x - 2)^2$

Possibilities:

- (a)
- (b)
- (c)
- (d)
- (e)

Zeros at 8, 2



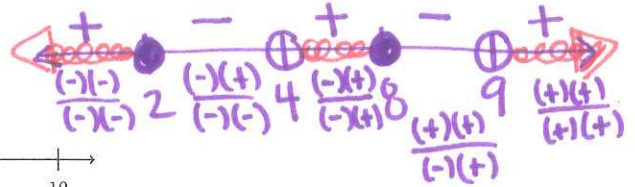
"where  $> 0$ ?"  
↳ where its positive!

$(2, 8)$

17. Solve the inequality. Answer by choosing the correct number line.

$$0 \leq \frac{(x-8)(x-2)}{(x-9)(x-4)}$$

Zeros at 8, 2  
undefined at 9, 4



Possibilities:

- (a)
- (b)
- (c)
- (d)
- (e)**

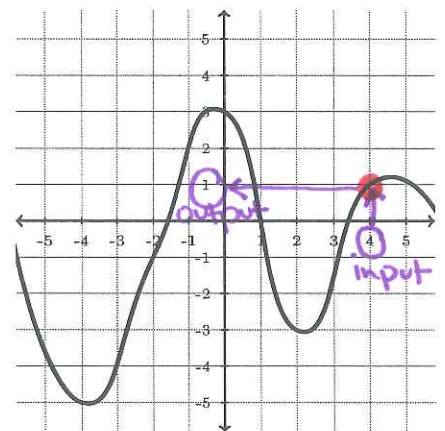
where  $\geq 0$ ?  
where it's "+"!

18. Find  $f(4)$  from the graph of  $y = f(x)$ .

4 is the input

Possibilities:

- (a)  $f(4) = 4$
- (b)  $f(4) = 0$
- (c)  $f(4) = 7$
- (d)**  $f(4) = 1$
- (e)  $f(4) = 3$



19. Let the piecewise function  $g(x)$  be given by:

$$g(x) = \begin{cases} x^2 + 3 & \text{if } x \leq 2 \\ |x - 11| & \text{if } 2 < x \leq 6 \\ 10x + 2 & \text{if } 6 < x < 9 \\ \sqrt{x - 5} & \text{if } 9 \leq x \end{cases}$$

Evaluate  $g(5)$

input is 5

Possibilities:

- (a)  $g(5) = 28$
- (b)  $g(5) = 52$
- (c)  $g(5) = 6$
- (d)  $g(5) = 5$
- (e)  $g(5) = 0$

Since  $2 < \underline{5} \leq 6$   
then for  $x = 5$   
 $g(x) = |x - 11|$   
 $g(5) = |5 - 11| = |-6| = \boxed{6}$

20. Let  $f(x) = 2x^2 + 8x$ . Find  $\frac{f(x+h) - f(x)}{h}$  if  $h \neq 0$ . Simplify your answer.

Possibilities:

- (a) 16
- (b)  $\frac{h + 16x}{h}$
- (c)  $4x + 2h + 8$
- (d)  $2h + 8$
- (e)  $4x + 8h$

$$\begin{aligned} f(x+h) &= 2(x+h)^2 + 8(x+h) \\ &= 2(x^2 + 2xh + h^2) + 8(x+h) \\ &= 2x^2 + 4xh + 2h^2 + 8x + 8h \\ f(x) &= 2x^2 + 8x \\ \text{then } \frac{f(x+h) - f(x)}{h} &= \frac{(2x^2 + 4xh + 2h^2 + 8x + 8h) - (2x^2 + 8x)}{h} \\ &= \frac{4xh + 2h^2 + 8h}{h} = \frac{h(4x + 2h + 8)}{h} \\ &= 4x + 2h + 8 \end{aligned}$$