

A photograph of a student with long, wavy brown hair and glasses, wearing a white t-shirt, sitting at a desk and studying. The student is looking down at a book or paper. The desk is cluttered with books and papers. In the background, there is a large window with a wooden frame, and two decorative lanterns hang from the ceiling. The room is brightly lit, and the overall atmosphere is warm and focused.

# 36U NOTE-TAKING GUIDES **2022-2023**

TEACHER EDITION

# TABLE OF CONTENTS

<b>PACING GUIDES</b>	<b>3</b>
----------------------	----------

## **MATH**

Introduction.....	6
The Pythagorean Theorem.....	7
45°-45°-90° and 30°-60°-90° Right Triangles .....	9
Distance and Midpoint .....	10
Substitution .....	11
Linear Relationships .....	12
Perimeter and Area.....	13
Angles – Polygons and Intersecting Lines .....	14
Right Triangle Trigonometry .....	15
Laws of Sines and Cosines.....	16
Circle Trigonometry.....	17
Finding the Average.....	19
Probability.....	20
Solving Linear Equations.....	21
Solving Polynomial Equations .....	22
Solving Absolute Value Equations .....	23
Factoring.....	24
Rational Expressions .....	25
Properties of Exponents.....	26
Solving Exponential Equations.....	27
Properties of Logarithms .....	28
Solving Logarithmic Equations .....	29

## **ENGLISH**

Introduction.....	31
Subject-Verb Agreement .....	32
Punctuation.....	33
Comma Usage.....	34
Transitions.....	35

Redundancy .....	36
Misplaced Modifiers .....	37
Pronoun-Antecedent Agreement .....	38
Possessive Forms .....	39
Adjectives and Adverbs .....	40
Global Items.....	41

## READING

Introduction.....	43
Direct from Text Items .....	44
Meaning from Context Items.....	45
Inference Items.....	46
Point of View Items .....	47
Summary Items.....	48
Prose Fiction Passage .....	49
Social Science Passage.....	50
Humanities Passage .....	51
Natural Science Passage .....	52
Double Passages.....	53

## SCIENCE

Introduction.....	55
Reading Tables.....	56
Reading Graphs .....	57
Data in Different Forms .....	58
Identifying Maxima and Minima.....	59
Analyzing Experiments .....	60
Evaluating Hypotheses.....	61
Multiple Y-Axes.....	62
Vertical Axis Input Values.....	63
Utilizing Multiple Data Sources .....	64

## 36U PACING GUIDE BY TOPIC

Semester pacing (18 weeks) = 1 unit per week

Crash Course pacing (6 weeks) = 3 units per week

Feel free to rearrange topic order to fit your needs.

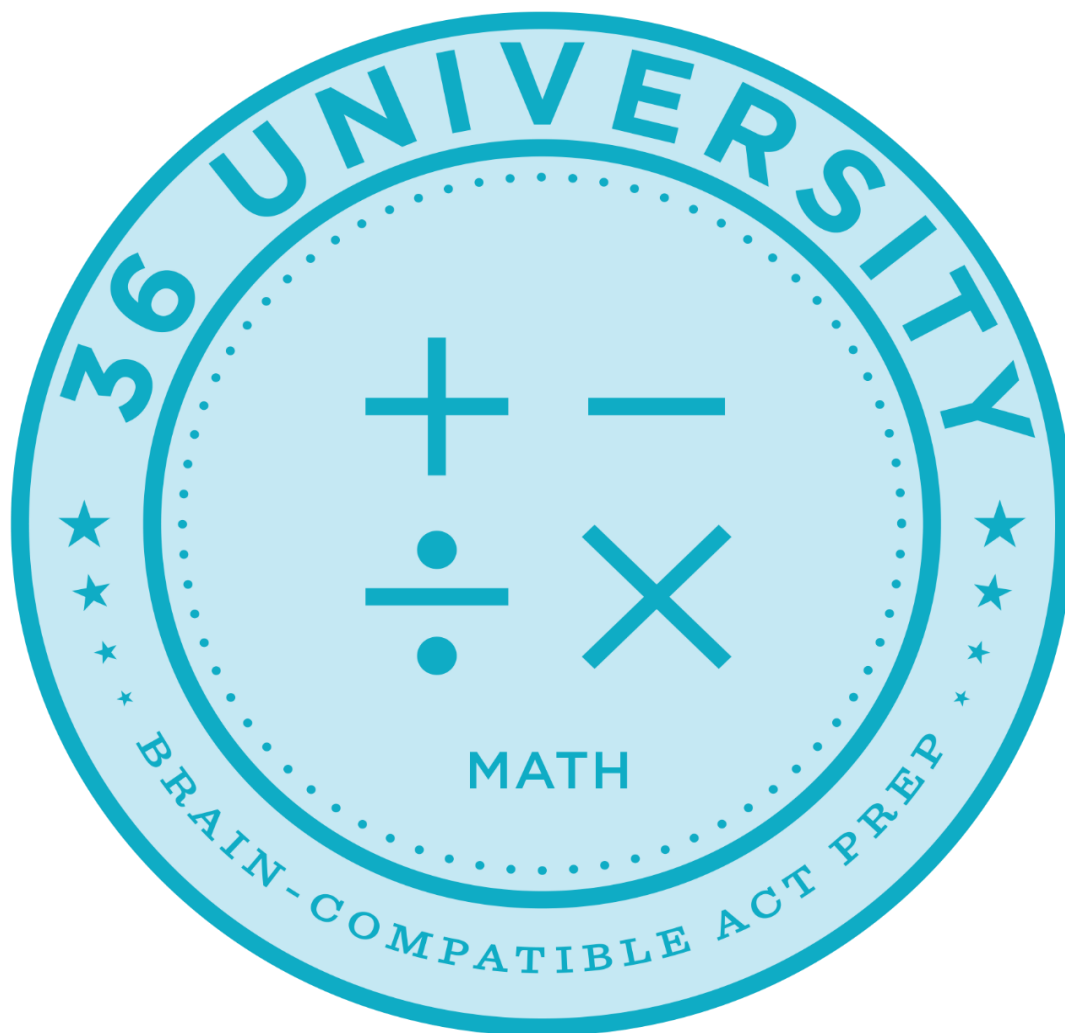
<b>Unit 1 (ACT Math)</b>	ACT Math Introduction Right Triangles Distance and Midpoint
<b>Unit 2 (ACT Math)</b>	Substitution Linear Relationships
<b>Unit 3 (ACT Math)</b>	Perimeter and Area Angles
<b>Unit 4 (ACT Math)</b>	Right Triangle Trigonometry Laws of Sines and Cosines Circle Trigonometry
<b>Unit 5 (ACT Math)</b>	Measures of Central Tendency Probability Video with Note-taking Guide
<b>Unit 6 (ACT Math)</b>	Solving Equations Systems of Equations Rational Expressions Exponential Expressions and Equations Logarithmic Expressions and Equations
<b>Unit 7 (ACT Math)</b>	Numbers and Arithmetic Less Frequently-Tested Topics Statistics and Probability Less Frequently-Tested Topics Algebra Less Frequently-Tested Topics Geometry Less Frequently-Tested Topics
<b>Unit 8 (ACT Math)</b>	Math Final Quizzes
<b>Unit 9 (ACT English)</b>	ACT English Introduction Subject-Verb Agreement Punctuation
<b>Unit 10 (ACT English)</b>	Commas Transitions
<b>Unit 11 (ACT English)</b>	Redundancy Misplaced Modifiers
<b>Unit 12 (ACT English)</b>	Pronoun-Antecedent Agreement Possessive Forms Adjectives and Adverbs
<b>Unit 13 (ACT English)</b>	English – Global Items English Final Quizzes
<b>Unit 14 (ACT Reading)</b>	ACT Reading Introduction Direct from Text Meaning from Context Inferences Point of View Summary Items Writing Techniques Content
<b>Unit 15 (ACT Reading)</b>	Prose Fiction Social Science



	Humanities
	Natural Science
	Double Passages
Unit 16 (ACT Science)	ACT Science Introduction
	Reading Tables
	Reading Graphs
	Data in Different Forms
Unit 17 (ACT Science)	Identifying Maxima and Minima
	Analyzing Experiments
	Evaluating Hypotheses
	Multiple Y-Axes
	Vertical Axis Input Values
	Utilizing Multiple Data Sources
	ACT Science Final Quizzes
Unit 18 (Practice Tests)	2021-2022 Preparing for the ACT Guide (See “Getting Started”
	Section)

## 36U PACING GUIDE BY QUIZ

If you would rather pace your course by quiz than by topic, you can divide the total number of quizzes by the number of days, weeks, or months you’ll be using our program. The program has approximately 170 quizzes, so the pace is almost 10 quizzes per week over an 18-week semester.



## ACT MATH INTRODUCTION

### I. The Setup

60 questions  $\Leftrightarrow$  60 minutes

Generally, questions get more difficult as your progress through the test.

### II. The Pace



1 item per minute

(20 items  $\Leftrightarrow$  20 minutes;

10 items  $\Leftrightarrow$  10 minutes; ...)



Try to bank time on early items so you'll have more time for difficult items toward the end of the test.

### III. Suggested Calculators

#1 – Use the calculator you're used to using. Familiarity is key.

Other greats: Casio fx-115ES Plus, TI-83s, TI-84s, TI-30s

Outlawed: TI-89, TI-92

Time-saving tip: Only use calculator when needed or if the calculations are cumbersome.

### Pro Tips

Math items are wordy!

→ If needed, scan the questions first so you'll know what information you'll need.

→ Sometimes, you can work from the picture.

→ Focus on numbers and equations within the questions.

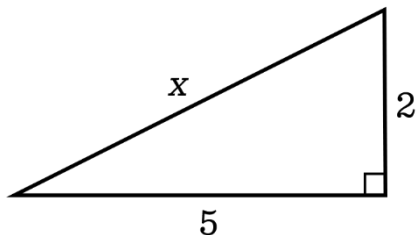
\*\*\*Answer all items. Never leave any blank.\*\*\*

## THE PYTHAGOREAN THEOREM

Frequency: ★★ ★

### I. The Pythagorean Theorem

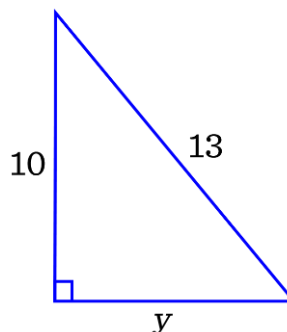
$$\underline{a}^2 + \underline{b}^2 = c^2$$



Setup:  $x^2 = \underline{2^2 + 5^2}$

$$x^2 = \underline{4 + 25}$$

$$x = \underline{\sqrt{29}}$$



Setup:  $10^2 + y^2 = \underline{13^2}$

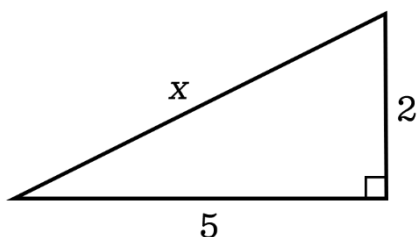
$$y^2 = \underline{13^2 - 10^2}$$

$$y = \underline{\sqrt{69}}$$

### II. The Pythagorean Theorem Simplified

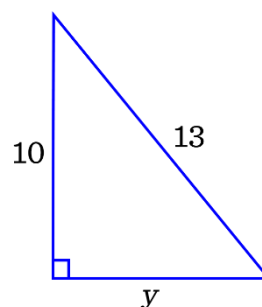
To find the hypotenuse (longest side), you'll want to square the leg lengths and ADD!

To find a leg length, you'll want to square the hypotenuse length, square the leg length, and SUBTRACT!



$$x = \sqrt{2^2 + 5^2}$$

$$x = \underline{\sqrt{29}}$$



$$y = \sqrt{13^2 - 10^2}$$

$$y = \underline{\sqrt{69}}$$





### III. Common Pythagorean Triples

Often, you won't need to use the Pythagorean Theorem to find a missing side in a right triangle! Commit these Pythagorean triples to memory.

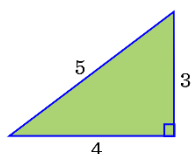
5:12:13

3:4:5

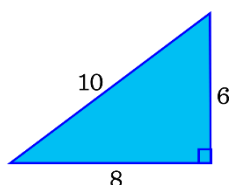
7:24:25

Look for common Pythagorean triples to be scaled up! Let's scale up a 3:4:5.

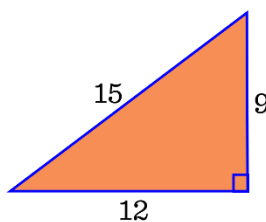
3:4:5



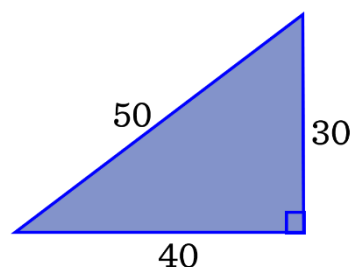
3:4:5 x 2



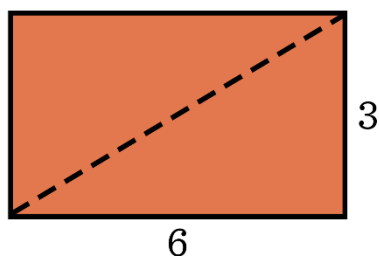
3:4:5 x 3



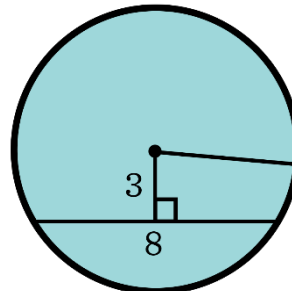
3:4:5 x 10



### HOW WILL THIS LOOK ON THE ACT?



$$\begin{aligned}
 \text{diagonal} &= \sqrt{3^2 + 6^2} \\
 &= \sqrt{45} \\
 &= 3\sqrt{5}
 \end{aligned}$$



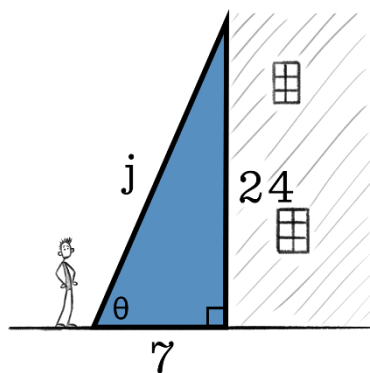
radius = 5

$$C = 2\pi r$$

$$C = \underline{10\pi}$$

$$\text{Area} = \pi r^2$$

$$A = \underline{25\pi}$$



$$j = \underline{25}$$

$$\sin \theta = \frac{\text{opposite leg}}{\text{hypotenuse}}$$

$$\sin \theta = \frac{24}{25}$$

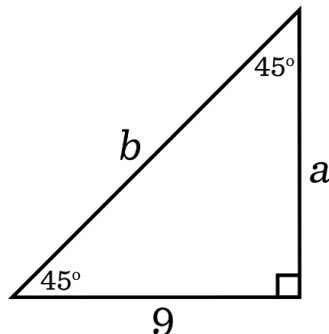
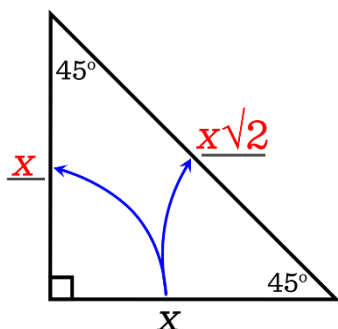
## 45°-45°-90° & 30°-60°-90° TRIANGLES

Frequency: ★

Save time when working with right triangles by memorizing the ratios between sides in 45-45-90 and 30-60-90 triangles.

### I. 45°-45°-90° Triangles

The ratios between sides in a 45°-45°-90° triangle are 1:1:√2.

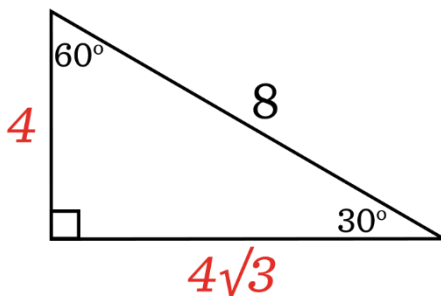
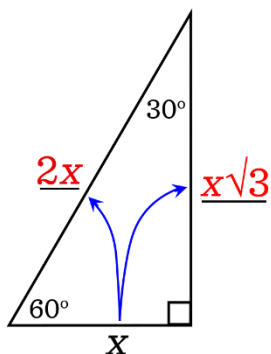


$$a = \underline{9}$$

$$b = \underline{9\sqrt{2}}$$

### II. 30°-60°-90° Triangles

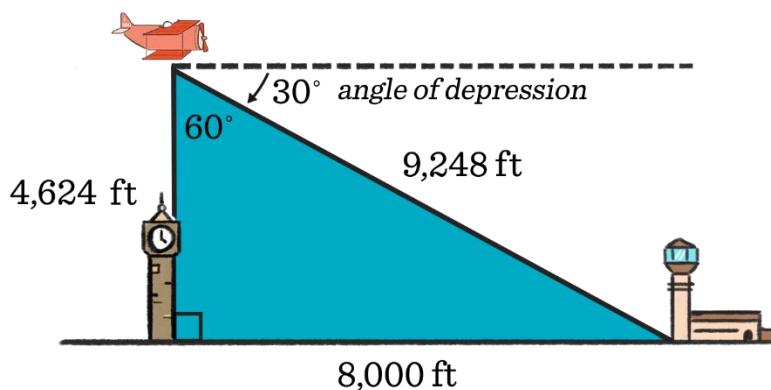
The ratios between sides in a 30°-60°-90° triangle are 1:√3:2.



$$y = \underline{4}$$

$$z = \underline{4\sqrt{3}}$$

HOW WILL THIS LOOK ON THE ACT?



# DISTANCE AND MIDPOINT

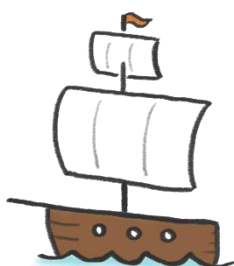
Frequency: ★★

## I. Finding the Distance Between Two Points

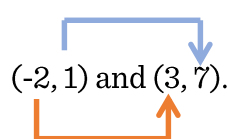
### A. Number Line

To find the distance between two points on a number line, you can count between the points or you can subtract.

### B. Coordinate Plane



Find the distance between



$$\Delta x = \underline{5} \quad \Delta y = \underline{6}$$

$$\text{distance} = \sqrt{(\Delta x)^2 + (\Delta y)^2}$$

$$\text{distance} = \sqrt{5^2 + 6^2}$$

$$\text{distance} = \sqrt{25 + 36}$$

$$\text{distance} = \sqrt{61}$$

$$\text{distance} \approx 7.8 \text{ (Use your calculator.)}$$

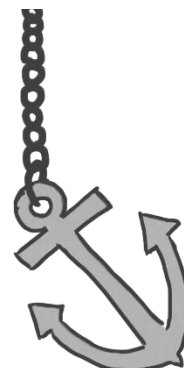
## II. The Midpoint Formula

### A. Number Line

To find the midpoint between two points on a number line, you add the points and divide by two. (Average!)

### B. Coordinate Plane

To find the midpoint between two points on a coordinate plane, average the x-coordinates and average the y-coordinates.



$$\text{midpoint} = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

## HOW WILL THIS LOOK ON THE ACT?

1. Find the distance between (2, -4) and (-5, 1).      2. Find the midpoint of (2, -4) and (-5, 1).

$$d = \sqrt{7^2 + 5^2}$$

$$d = \sqrt{49 + 25}$$

$$d = \sqrt{74} \text{ or } \underline{8.6}$$

$$\text{midpoint} = \left( \frac{2 + -5}{2}, \frac{-4 + 1}{2} \right)$$

$$\text{midpoint} = (-1.5, -1.5)$$

## SUBSTITUTION

Frequency: ★★ ★

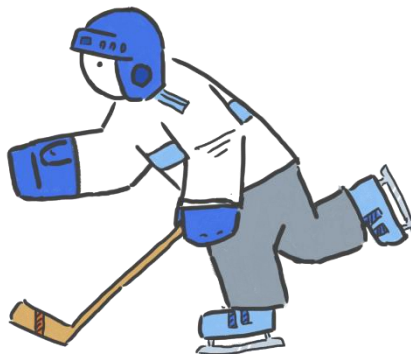
### I. Simple Substitution

$$f(x) = |3x^2 - 2x + 1|$$

$$f(-2) = |3(-2)^2 - 2(-2) + 1|$$

$$f(-2) = |3(4) + 4 + 1|$$

$$f(-2) = 17$$



### II. Substituting into Different Types of Functions

Linear Function	Quadratic Function	Rational Function	Exponential Function
$f(x) = 5x - 7$	$g(x) = 5x^2 + 2x - 7$	$h(x) = \frac{x^2 - 2}{3x + 1}$	$j(x) = 3^x - 5$
$f(2) = 5(2) - 7$	$g(2) = 5 \cdot 2^2 + 2 \cdot 2 - 7$	$h(0) = \frac{0^2 - 2}{3(0) + 1}$	$j(2) = 3^2 - 5$
$f(2) = 3$	$g(2) = 17$	$h(0) = -2$	$j(2) = 4$

### III. Substituting into Functions of Two Variables

$$f(x, y) = 2x + 3y \quad f(-3, 5) = 2(-3) + 3(5) \quad f(-3, 5) = 9$$

#### HOW WILL THIS LOOK ON THE ACT?

Ex. 1  $y = \frac{x^2 - 2}{3x + 1}$

When  $x = -3$ ,  $y = \frac{(-3)^2 - 2}{3(-3) + 1}$

$$y = \frac{9 - 2}{-9 + 1}$$

$$y = -\frac{7}{8}$$

Ex. 2  $f(x) = x^2 + 3x + 1$

$$f(2x + 1) = (2x + 1)^2 + 3(2x + 1) + 1$$

$$f(2x + 1) = (2x + 1)(2x + 1) + 3(2x + 1) + 1$$

$$f(2x + 1) = 4x^2 + 4x + 1 + 6x + 3 + 1$$

$$f(2x + 1) = 4x^2 + 10x + 5$$

Ex. 3 Thirty degrees Celsius is equivalent to what Fahrenheit temperature?

$$C = \frac{5}{9}(F - 32) \quad 30 = \frac{5}{9}(F - 32) \quad 54 = (F - 32) \quad F = 86$$



# LINEAR RELATIONSHIPS

Frequency: ★★

## I. Lines and Constant Rates of Change

Linear relationships have constant rates of change.

x	y
-2	-5
-1	-2
0	1
1	4
2	7

The relationship between x and y in this table is linear. For each increase of x, y increases by 3.

## II. Writing Equations of Lines

Slope-intercept form:  $y = mx + b$

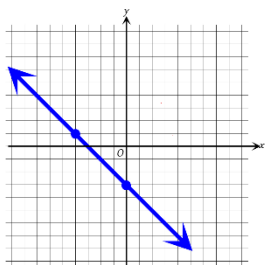
The relationship in the table above can be represented by the linear equation,  $y = \underline{3x + 1}$ .  
 (Substitute the rate of change for the slope.)

### HOW WILL THIS LOOK ON THE ACT?

1. Find the slope of the linear equation  $2x - 3y = 6$ .

Rearranged:  $y = \frac{2}{3}x - 2$       Slope =  $2/3$

2. Write a linear equation of the following graph. The line passes through  $(-4, 1)$  and  $(0, -3)$ .



$$m = \frac{\text{rise}}{\text{run}} \quad m = \frac{-4}{4} \quad m = -1$$

The y-intercept, b, is -3.

Equation:  
 $y = -1x - 3$  or  $y = -x - 3$

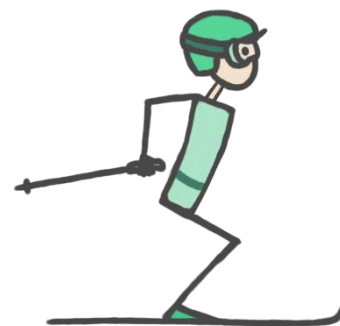
3. Write a linear equation that expresses the relationship between x and y.

x	y
-2	9
-1	7
0	5
1	3
2	1

The rate of change, or slope, is a constant -2.

The y-intercept, b, is -5.

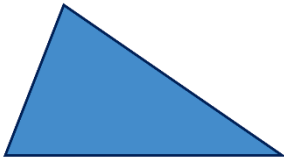
Equation:  $y = -2x + 5$



## PERIMETER AND AREA

Frequency: ★★★★★

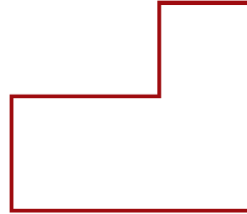
### I. Perimeter and Circumference



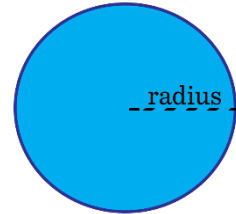
$$P = \underline{s_1 + s_2 + s_3}$$



$$P = \underline{2l + 2w}$$



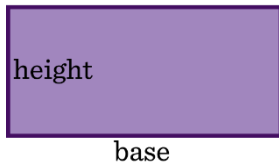
$$P = \underline{d_1 + d_2 + d_3 + d_4 + d_5 + d_6}$$



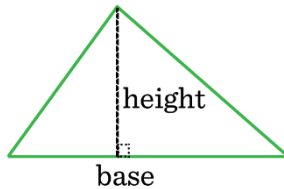
$$C = \underline{\pi d}$$

$$C = \underline{2\pi r}$$

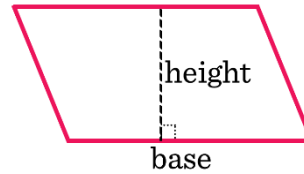
### II. Area



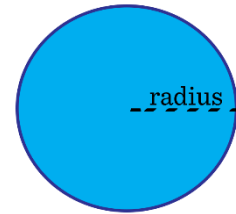
$$A = \underline{b \cdot h}$$



$$A = \underline{\frac{1}{2} \cdot b \cdot h}$$

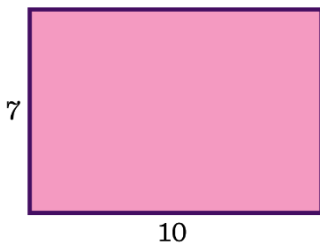


$$A = \underline{b \cdot h}$$



$$A = \underline{\pi r^2}$$

### HOW WILL THIS LOOK ON THE ACT?



$$P = \underline{2(7) + 2(10)}$$

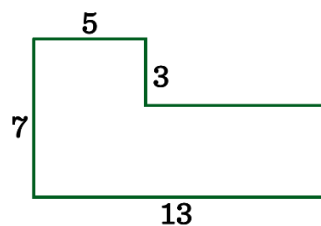
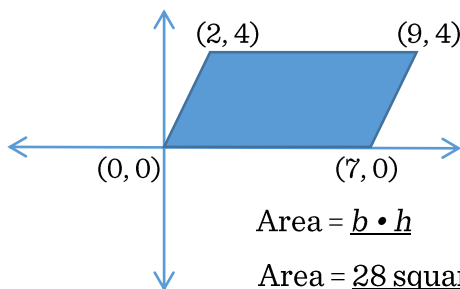
$$P = \underline{34}$$



$$A = 48$$

$$P = 32$$

Dimensions: 4 x 12



$$A = \underline{35 + 32}$$

$$A = \underline{67 \text{ square units}}$$

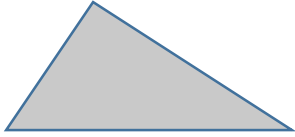
$$P = \underline{7 + 5 + 3 + 8 + 4 + 13}$$

$$P = \underline{40 \text{ units}}$$

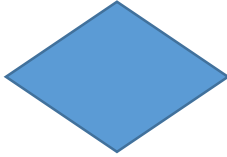
## ANGLE RELATIONSHIPS

Frequency: ★★

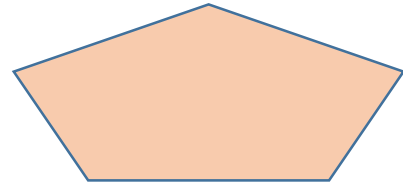
### I. Interior Angle Sums for Polygons



Interior Angle Sum = 180°



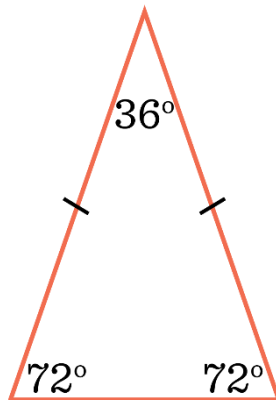
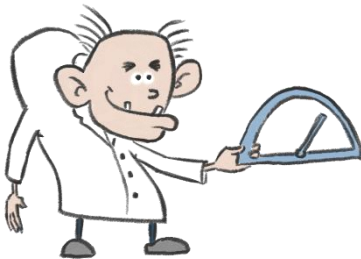
Interior Angle Sum = 360°



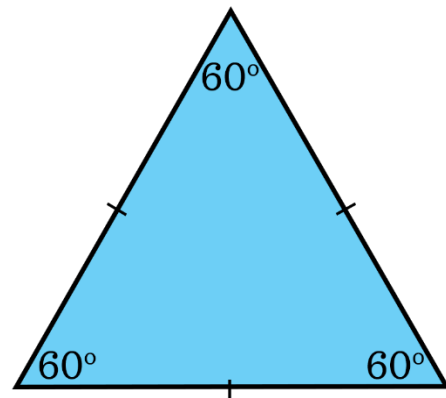
Interior Angle Sum = 540°

### II. Equilateral and Isosceles Triangles

Isosceles Triangle

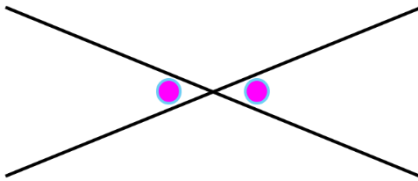


Equilateral Triangle



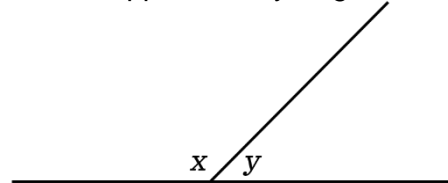
### III. Vertical Angles and Supplementary Angles

Vertical Angles



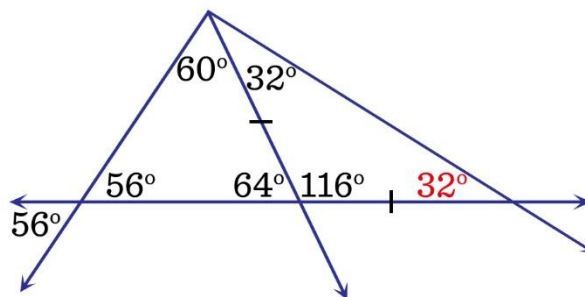
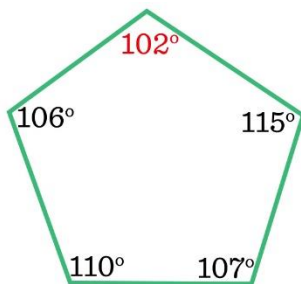
Vertical angles have the same measure.

Supplementary Angles



$$x + y = 180^\circ$$

### HOW WILL THIS LOOK ON THE ACT?



# RIGHT TRIANGLE TRIGONOMETRY

Frequency: ★★

## I. The Concept of Trig

When angles in a triangle are determined, the shape of the triangle is set. This allows us to set up trig ratios for right triangles because ratios between side lengths are constant.

## II. The Three Main Trig Ratios



SOHCAHTOA

or



$S \frac{O}{H} \quad C \frac{A}{H} \quad T \frac{O}{A}$

$$\sin \theta = \frac{\text{opposite leg}}{\text{hypotenuse}}$$

$$\cos \theta = \frac{\text{adjacent leg}}{\text{hypotenuse}}$$

$$\tan \theta = \frac{\text{opposite leg}}{\text{adjacent leg}}$$

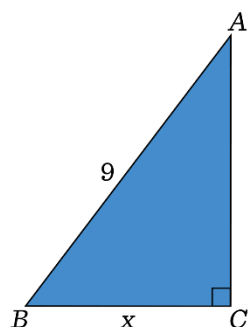
## III. The Three Secondary Trig Ratios

$$\cos \theta = \frac{\text{adjacent leg}}{\text{hypotenuse}} \longrightarrow \sec \theta = \frac{\text{hypotenuse}}{\text{adjacent leg}}$$

$$\sin \theta = \frac{\text{opposite leg}}{\text{hypotenuse}} \longrightarrow \csc \theta = \frac{\text{hypotenuse}}{\text{opposite leg}}$$

$$\tan \theta = \frac{\text{opposite leg}}{\text{adjacent leg}} \longrightarrow \cot \theta = \frac{\text{adjacent leg}}{\text{opposite leg}}$$

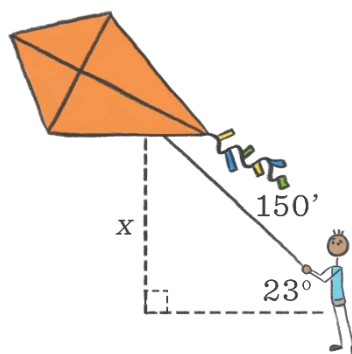
## HOW WILL THIS LOOK ON THE ACT?



Find  $\tan A$ .

$$AC = \sqrt{9^2 - x^2}$$

$$\tan x = \frac{x}{\sqrt{9^2 - x^2}}$$



Find  $x$ .

$$\sin 23^\circ = \frac{x}{150}$$

$$x = 150 \cdot \sin 23^\circ$$





## THE LAWS OF SINES AND COSINES

*Frequency:*

Use the Law of Sines or Cosines when your triangle doesn't have a right angle.

### I. Which Law Do I Use?

Use the **Law of Sines** when you are given an angle measure and the opposite side length.

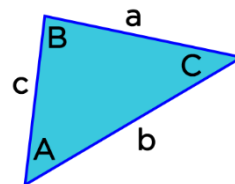
$$\frac{\sin \angle A}{a} = \frac{\sin \angle B}{b} = \frac{\sin \angle C}{c}$$

Use the **Law of Cosines** when you are given

1) two sides and the included angle.

or

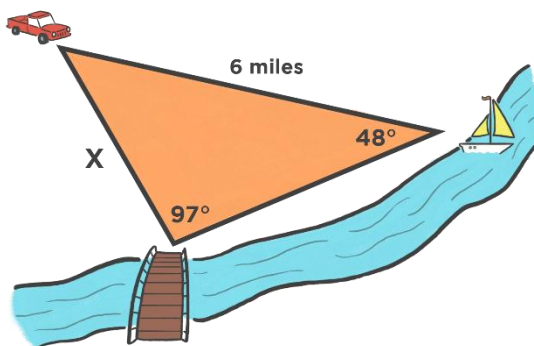
2) all three side lengths.



$$c^2 = a^2 + b^2 - 2ab \cdot \cos C$$

### HOW WILL THIS LOOK ON THE ACT?

#### II. Using the Law of Sines



Setup:

$$\frac{\sin 97^\circ}{6} = \frac{\sin 48^\circ}{x}$$

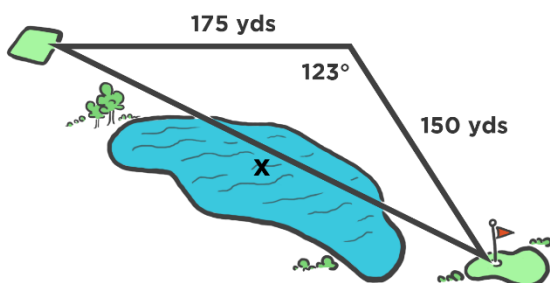
Solve:

$$x \cdot \sin 97^\circ = 6 \cdot \sin 48^\circ$$

$$x = \frac{6 \cdot \sin 48^\circ}{\sin 97^\circ}$$

$$x \approx \underline{4.5} \text{ miles}$$

#### III. Using the Law of Cosines



Setup:

$$x^2 = 175^2 + 150^2 - 2(175)(150) \cdot \cos 123^\circ$$

Solve:

$$x = \sqrt{175^2 + 150^2 - 2(175)(150) \cdot \cos 123^\circ}$$

$$x \approx \underline{286} \text{ yards}$$

# CIRCLE TRIGONOMETRY

Frequency: ★

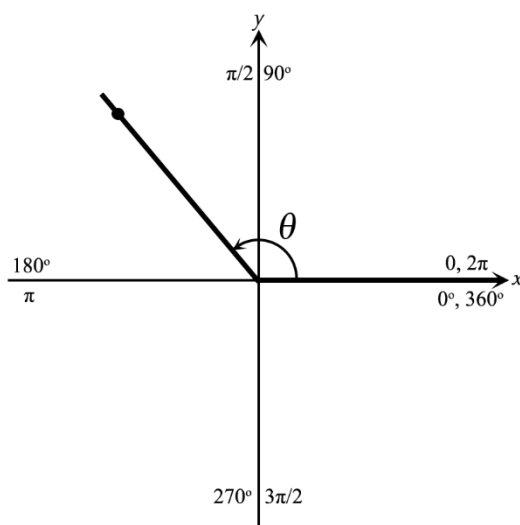
Circular trigonometry is not all that different from triangle trigonometry. You need to understand angle rotation, positive and negative values on a coordinate plane, and transfer your understanding of triangle trig concepts.

## I. Angle Rotation and Angle Measures

Angle rotation is measured from

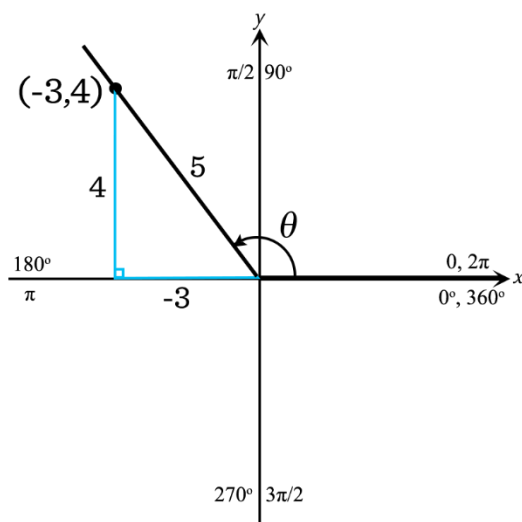
- 1) the positive x-axis      and      2) with a counterclockwise rotation.

Label angle rotations in degrees and radians.



## II. From Triangle Trigonometry to Circle Trigonometry

If  $\cos \theta = -3/5$  and  $90^\circ < \theta < 180^\circ$ , then  $\sin \theta = ?$ ,  $\tan \theta = ?$

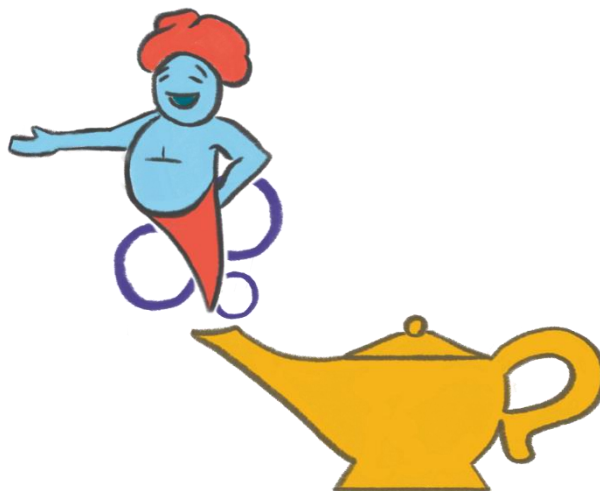


$$\sin \theta = \underline{4/5}$$

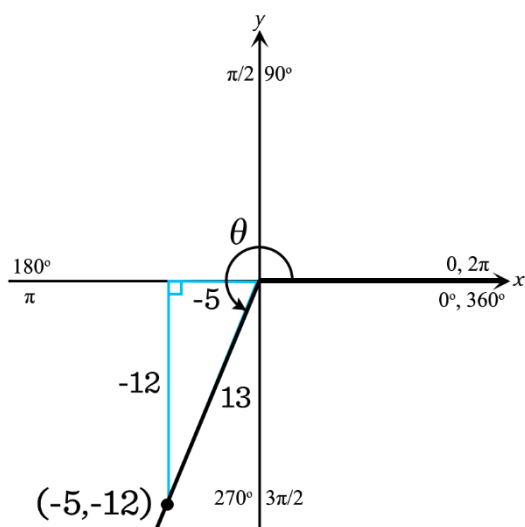
$$\tan \theta = \underline{-4/3}$$



## HOW WILL THIS LOOK ON THE ACT?



If  $\tan \theta = 12/5$  and  $180^\circ < \theta < 270^\circ$ ,  
then  $\cos \theta = ?$



Step 1: Use the angle inequality to determine that the angle terminates in the 3<sup>rd</sup> quadrant.

Step 2: Draw in the triangle that sits on the x-axis. Use  $\tan \theta = (\text{opposite leg})/(\text{adjacent leg})$  to draw 12/5 into the coordinate plane. Be sure to remember that both coordinates are negative in the 3<sup>rd</sup> quadrant.

Step 3: Recognize the 5:12:13 triangle to find the length of the hypotenuse.

Step 4: Find the cosine  $\theta$ .

$$\cos \theta = (\text{adjacent leg})/(\text{hypotenuse})$$

$$\cos \theta = \underline{-5/13}$$

## CENTRAL TENDENCY

Frequency Rating: ★★

### I. Basic Average

Scores: 82, 71, and 92.

$$\text{Average} = \frac{82+71+92}{3}$$

Average  $\approx$  81.7

### II. Finding Average Given Frequency

Scores: five 82s, six 71s, and three 92s. Average =  $\frac{5(82)+6(71)+3(92)}{14}$  Average  $\approx$  79.4

### III. Median

The median is the middle data value after arranging in order.

\$102,000, \$105,990, \$107,300, \$108,000, \$112,500

Median = \$107,300

\$102,000, \$105,000, \$105,990, \$107,300, \$108,000, \$112,500 Median =  $\frac{105,990+107,300}{2}$

Median = \$106,645

### IV. Mode

The mode is the data value that occurs most often.

\$102,000, \$105,000, \$105,990, \$107,300, \$108,000, \$112,500

Mode: No mode

\$102,000, \$103,500, \$103,500, \$105,000, \$105,990, \$107,300, \$108,000, \$108,000, \$112,500 Modes: \$103,500 and \$108,000

## HOW WILL THIS LOOK ON THE ACT?

(Simple Average) Disc golf scores: 54, 52, 50, and 48.

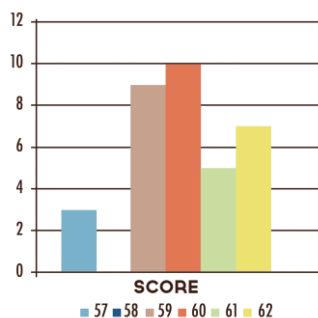
$$\text{Average} = \frac{54+52+50+48}{4}$$

Average = 51

(Missing Score) Disc golf scores: 54, 52, 50, and 48. Dolly needs an average of 50.

$$50 = \frac{54+52+50+48+x}{5}$$

Dolly needs to score a 46 on her 5th round.



$$\text{Average} = \frac{3(57) + 9(59) + 10(60) + 5(61) + 7(62)}{34}$$

Average  $\approx$  60



# PROBABILITY

Frequency: ★★★★★

If all outcomes are equally likely,...

$$\text{Probability of event } A = \frac{\text{\# of outcomes that correspond with event } A}{\text{total \# of possible outcomes}}$$

## I. Simple Probability

Diana rolls two dice. What is the probability she rolls a sum of 5?

Possible Outcomes:



1,1 1,2 1,3 1,4 1,5 1,6  
 2,1 2,2 2,3 2,4 2,5 2,6  
 3,1 3,2 3,3 3,4 3,5 3,6  
 4,1 4,2 4,3 4,4 4,5 4,6  
 5,1 5,2 5,3 5,4 5,5 5,6  
 6,1 6,2 6,3 6,4 6,5 6,6

How many outcomes have a sum of 5? 4



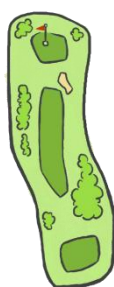
$$P(\text{sum of 5}) = \frac{4}{36} \rightarrow \frac{1}{9}$$

## II. Probability of Multiple Events

Based on past performances, what is the probability Victor birdies both holes 17 and 18?



HOLE 17

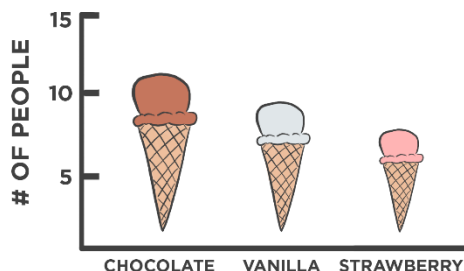


HOLE 18



$$P(\text{birdie on both holes}) = \frac{6}{10} \cdot \frac{8}{12} \rightarrow \frac{2}{5}$$

## HOW WILL THIS LOOK ON THE ACT?



$$P(\text{vanilla or chocolate}) = \frac{20}{27}$$


# SOLVING LINEAR EQUATIONS

Frequency: ★★

Solutions of linear equations, when graphed on the coordinate plane, form lines.

## I. Linear Equations in One Variable

Solve for  $x$ .

$$6x - 10 = x + 5$$


$$-x \quad -x$$

$$5x - 10 = 5$$

$$+10 \quad +10$$

$$5x = 15$$

$$/5 \quad /5$$

$$x = 3$$

**Step 1:** Get the variable on ONE SIDE of the equal sign.

**Step 2:** Get the variable BY ITSELF.

## II. Linear Equations in Two Variables

For these items, you're going to need to rearrange the equation to solve for the indicated variable.

Solve for  $A$ .

$$5V - 2 = 4(3A + 1)$$

$$5V - 2 = 12A + 4$$

$$-4 \quad -4$$

$$5V - 6 = 12A$$

$$/12 \quad /12$$

$$\frac{5V - 6}{12} = A$$

Distribute the 4.

Subtract 4 from both sides.

Divide by 12 on both sides.

# SOLVING POLYNOMIAL EQUATIONS

Frequency: ★

The degree of an equation tells you how many solutions you can find for that equation.

## Perfect Squares and Perfect Cubes to Solve Equations

Save time when solving polynomial equations by knowing common perfect squares and perfect cubes.

Perfect squares		Perfect cubes
$1^2 = 1$	$7^2 = 49$	$1^3 = 1$
$2^2 = 4$	$8^2 = 64$	$2^3 = 8$
$3^2 = 9$	$9^2 = 81$	$3^3 = 27$
$4^2 = 16$	$10^2 = 100$	$4^3 = 64$
$5^2 = 25$	$11^2 = 121$	$5^3 = 125$
$6^2 = 36$	$12^2 = 144$	$6^3 = 216$

### I. Solving by Isolating the Variable

Solve for x  $5x^2 = 45$

$$\begin{array}{l} \textcolor{red}{/5} \quad \textcolor{red}{/5} \\ x^2 = 9 \\ x = 3 \text{ or } -3 \end{array}$$

Solve for x  $2x^3 + 7 = 23$

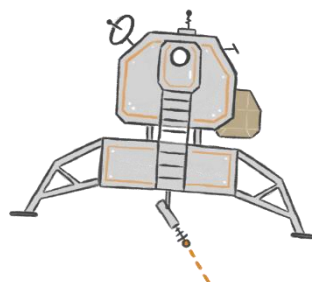
$$\begin{array}{l} \textcolor{red}{-7} \quad \textcolor{red}{-7} \\ 2x^3 = 16 \\ \textcolor{red}{/2} \quad \textcolor{red}{/2} \\ x^3 = 8 \\ x = 2^* \end{array}$$

\*Don't expect to need the imaginary solutions.

### II. Solving by Factoring

Solve for x  $x^3 - 2x^2 = 3x$

$$\begin{array}{l} x^3 - 2x^2 - 3x = 0 \\ x(x^2 - 2x - 3) = 0 \\ x(x - 3)(x + 1) = 0 \\ x = 0, 3, \text{ or } -1 \end{array}$$



### III. Solving by Using the Quadratic Formula

Solve for x  $3x^2 + 4x = 1$

$$3x^2 + 4x - 1 = 0$$

$$a = 3, b = 4, c = -1$$

$$x = \frac{-4 \pm \sqrt{(4)^2 - 4(3)(-1)}}{2(3)}$$

$$x = \frac{-4 \pm \sqrt{28}}{6}$$

$$x = \frac{-2 + \sqrt{7}}{3} \quad \text{or} \quad x = \frac{-2 - \sqrt{7}}{3}$$

← Set equal to 0.

← Identify a, b, and c.

← Substitute into the quadratic formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

← Simplify.



# FACTORING

Frequency: ★★

## I. Common Factors

Start your factoring efforts by looking for a greatest common factor.

$$5x^4 + 10x^2 - 20x \quad \longrightarrow \quad 5x(x^3 + 2x - 4)$$

## II. Difference of Squares

$$x^2 - 36 \quad \longrightarrow \quad (x + 6)(x - 6)$$



Check your answer:

$$\begin{aligned} &(x + 6)(x - 6) \\ &\rightarrow x^2 + 6x - 6x - 36 \\ &\rightarrow x^2 - 36 \end{aligned}$$

## III. Trinomials

Ex. 1 Factor  $x^2 - 7x + 12$ .

$$\begin{aligned} &\rightarrow (x \quad)(x \quad) \\ &\rightarrow (x - 3)(x - 4) \\ &\rightarrow (x - 3)(x - 4) \end{aligned}$$

Check your answer:

$$\begin{aligned} &(x - 3)(x - 4) \\ &\rightarrow x^2 - 4x - 3x + 12 \\ &\rightarrow x^2 - 7x + 12 \end{aligned}$$

Ex. 2 Factor  $3x^2 + 20x - 7$ . (Attempt #1)

$$\begin{aligned} &\rightarrow (3x \quad)(x \quad) \\ &\rightarrow (3x - 7)(x - 1) \\ &\rightarrow (3x - 7)(x + 1) \end{aligned}$$

Check your answer:

$$\begin{aligned} &(3x - 7)(x + 1) \\ &\rightarrow 3x^2 + 3x - 7x - 7 \\ &\rightarrow 3x^2 - 4x - 7 \quad \times \end{aligned}$$

Ex. 2 Factor  $3x^2 + 20x - 7$ . (Attempt #2)

$$\rightarrow (3x - 1)(x + 7)$$

Check your answer:

$$\begin{aligned} &(3x - 1)(x + 7) \\ &\rightarrow 3x^2 + 20x - 1x - 7 \\ &\rightarrow 3x^2 + 20x - 7 \quad \checkmark \end{aligned}$$

# RATIONAL EXPRESSIONS

Frequency: ★★

## I. Domain of Rational Functions

Input values that result in a denominator equal to zero are excluded from the domain.

$$f(x) = \frac{3}{(x-5)(x+2)}$$

Values excluded from domain:  $x = 5, -2$

$x$  can be any value but 5 or -2.

## II. Simplifying Rational Expressions

$$\frac{x^2 - 4x + 3}{(x-3)(x+1)} \rightarrow \frac{(x-3)(x-1)}{(x-3)(x+1)}$$

$$\rightarrow \frac{(x-1)}{(x+1)}$$

## III. Finding a Common Denominator

$$\begin{aligned} & \frac{3}{x} - \frac{2}{x+5} \\ \rightarrow & \frac{3(x+5)}{x(x+5)} - \frac{2(x)}{x+5(x)} \\ \rightarrow & \frac{3(x+5)-2x}{x(x+5)} \\ \rightarrow & \frac{3x+15-2x}{x(x+5)} \\ \rightarrow & \frac{x+15}{x(x+5)} \end{aligned}$$



## HOW WILL THIS LOOK ON THE ACT?

$$\begin{aligned} \frac{5x^2 - 20}{3(x-2)} & \rightarrow \frac{5(x^2-4)}{3(x-2)} \\ & \rightarrow \frac{5(x-2)(x+2)}{3(x-2)} \\ & \rightarrow \frac{5(x+2)}{3} \end{aligned}$$

# PROPERTIES OF EXPONENTS

Frequency: ★

## I. Multiplying with the Same Base

When multiplying with the same base, add the exponents:

$$x^a x^b \Leftrightarrow \underline{x^{a+b}}$$

$$x^3 x^4 \rightarrow (\underline{x \cdot x \cdot x}) \cdot (\underline{x \cdot x \cdot x \cdot x}) \rightarrow \underline{x^7}$$

## II. Dividing with the Same Base

When dividing with the same base, subtract the exponents:

$$\frac{x^a}{x^b} \Leftrightarrow \underline{x^{a-b}} \text{ (x cannot equal 0)}$$

$$\frac{x^5}{x^3} = \frac{\cancel{x \cdot x \cdot x \cdot x \cdot x}}{\cancel{x \cdot x \cdot x}} = x^2 \text{ (because there were 2 more x's in the numerator)}$$

$$\frac{x^3}{x^5} = \frac{\cancel{x \cdot x \cdot x}}{x \cdot x \cdot \cancel{x \cdot x \cdot x}} = \frac{1}{x^2} \text{ (because there were 2 more x's in the denominator)}$$

## III. Base and a Power to a Power

When you have a base and power to a power, multiply the exponents:

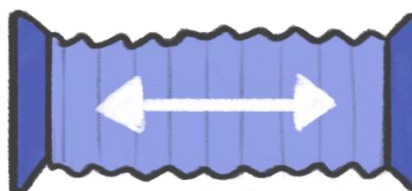
$$(x^a)^b \Leftrightarrow x^{ab}$$

$$(x^3)^4 \rightarrow (\underline{x^3}) \cdot (\underline{x^3}) \cdot (\underline{x^3}) \cdot (\underline{x^3}) \rightarrow \underline{x^{12}}$$

## IV. Distributing Exponents

$$(xy)^a = x^a y^a$$

$$\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a} \text{ (y cannot equal 0)}$$



## V. The Zero Power

$$x^0 = 1 \text{ (x cannot equal 0)}$$

# SOLVING EXPONENTIAL EQUATIONS

Frequency: ★

## Common Exponential Values

$2^0 = 1$	$3^0 = 1$	$4^0 = 1$	$5^0 = 1$	$6^0 = 1$	$7^0 = 1$	$8^0 = 1$	$9^0 = 1$
$2^1 = 2$	$3^1 = 3$	$4^1 = 4$	$5^1 = 5$	$6^1 = 6$	$7^1 = 7$	$8^1 = 8$	$9^1 = 9$
$2^2 = 4$	$3^2 = 9$	$4^2 = 16$	$5^2 = 25$	$6^2 = 36$	$7^2 = 49$	$8^2 = 64$	$9^2 = 81$
$2^3 = 8$	$3^3 = 27$	$4^3 = 64$	$5^3 = 125$	$6^3 = 216$	$7^3 = 343$		
$2^4 = 16$	$3^4 = 81$	$4^4 = 256$	$5^4 = 625$				
$2^5 = 32$	$3^5 = 243$						
$2^6 = 64$							

## Negative Exponents

You can rewrite exponential expressions with negative exponents by moving them across the fraction line:

$$8^{-3} = \frac{1}{8^3} \quad \text{and} \quad \frac{1}{8^{-3}} = 8^3$$

The tricky part is recognizing when to use these properties.

## I. Reducing to the Same Base

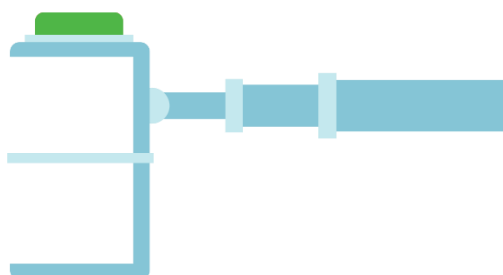
Solve for x.

$$3^{5x-2} = 27$$

$$3^{5x-2} = 3^3$$

$$5x - 2 = 3$$

$$x = 1$$



Solve for x.

$$5^{2x} = 1/25$$

$$5^{2x} = 1/5^2$$

$$5^{2x} = 5^{-2}$$

$$2x = -2$$

$$x = -1$$

## II. Setting the Exponent Equal to 0

When an exponential equation equals 1, you know the exponent must equal 0.

Solve for x.  $5^{3x-6} = 1$

$$3x - 6 = 0$$

$$x = 2$$



# PROPERTIES OF LOGARITHMS

Frequency: ★

Logarithms were developed to assist in computing with LARGE numbers by allowing mathematicians to work with addition instead of multiplication, subtraction instead of division, and multiplication instead of exponents. The invention of the modern computer has decreased their usefulness.

## I. Logarithms and Exponents

$$\log_7 49 \rightarrow 2$$

$$\log_5 5 \rightarrow 1$$

$$\log 1000 \rightarrow 3$$

## II. Properties of Logarithms

Here are the logarithmic conversions you will need to know for the ACT:

### Converting Multiplication into Addition

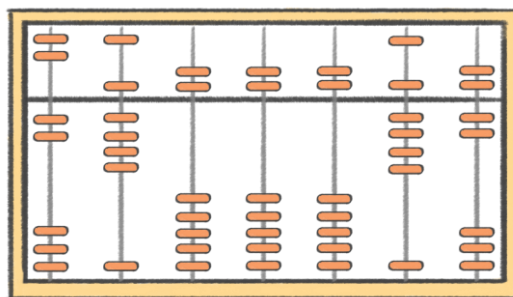
$$\log_b(AC) \Leftrightarrow \log_b A + \log_b C$$

### Converting Division into Subtraction

$$\log_b(A/C) \Leftrightarrow \log_b A - \log_b C$$

### Converting Exponents into Multiplication

$$\log_b A^C \Leftrightarrow C \cdot \log_b A$$



## HOW WILL THIS LOOK ON THE ACT?

Simplify  $5\log_6 6^{3/5}$ .

$$\underline{(3/5) \cdot 5\log_6 6}$$

$$\underline{3 \cdot \log_6 6}$$

$$\underline{3 \cdot 1}$$

$$\underline{3}$$

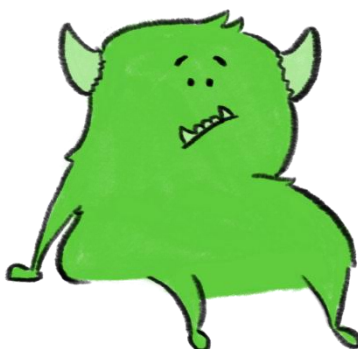
# SOLVING LOGARITHMIC EQUATIONS

Frequency: ★

## Converting Between Exponential and Logarithmic Forms

$x = \log_b A$  is equivalent to  $b^x = A$

This property defined where  $A, C, b > 0$  and  $b \neq 1$ .



HOW WILL THIS LOOK ON THE ACT?

Solve for x.

$$\log_4 2x = 3$$

$$4^3 = 2x$$

$$64 = 2x$$

$$x = 32$$

Solve for x.

$$\log_3 x + \log_3 5 = 2$$

$$\log_3 5x = 2$$

$$3^2 = 5x$$

$$9 = 5x$$

$$x = 9/5$$



## ACT ENGLISH INTRODUCTION

### I. The Setup

You'll read a passage and simultaneously answer 15 items. You'll need to do that 5 times in the 45 minutes.

5 passages • 15 questions → 75 questions

### II. The Pace

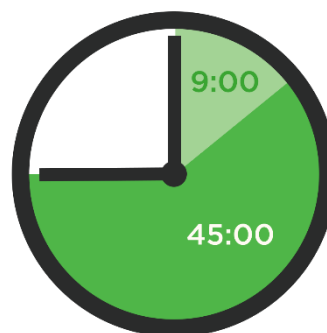


75 items ⇔ 45 minutes

Pace by passage: 9 minutes per passage

( 2 passages ⇔ 18 minutes;

1 passage ⇔ 9 minutes;...)



Quickest pace of any section: 36 seconds per item

Pacing tip: Round pace to 30 seconds

(20 items ⇔ 10 minutes; 10 items ⇔ 5 minutes;...)

### III. The Juggling Act: Local and Global Questions

Local Questions → Can be answered by reading a single sentence or just a few sentences

Global Questions → Require you to understand full paragraphs and the entire passage  
(often found at end of question set)

Juggling Act → You'll be reading a passage and answering local questions—all the while you need to be aware of the structure and purpose of the passage.

### Pro Tips

Distractor choices → unnecessary words and extra punctuation.

If you have to guess → shortest answer with least punctuation is often right!

## SUBJECT-VERB AGREEMENT

Frequency: ★★★★★★★

### I. Basic Subject-Verb Agreement

plural

plural

Even though Sam is scared of heights, rollercoasters and the freefall are his favorite amusement park rides.

### II. Subject-Verb Separation

Checking subject-verb agreement can be a challenge when the ACT puts distance between the subject and the verb.

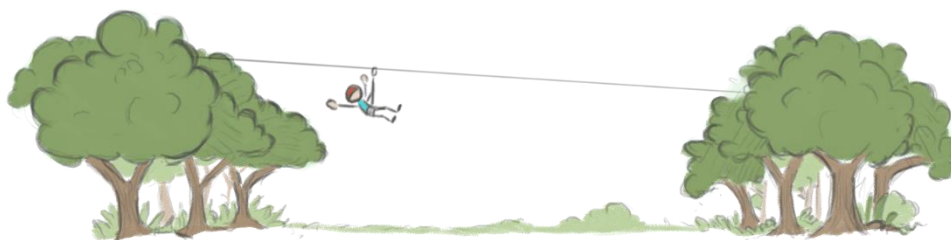
subject

verb

Fly fishing, though one of my dad's favorite pastimes, is too slow for my taste.

\*\*\*If needed, remove the nonessential side comment to make checking for subject-verb agreement easier.\*\*\*

Checking for subject-verb agreement becomes more difficult when the phrase between the subject and the verb is essential because essential phrases aren't framed with commas.



Zip lining through the trees in Costa Rica is on my bucket list.

### III. Matching Tense

The introductory element tells us we're in past tense. Choose a past tense verb.

On October 1<sup>st</sup>, 1901, Annie Taylor successfully plunged over Niagara Falls in a barrel.

You'll also be expected to match the tense of verbs used elsewhere in the sentence.

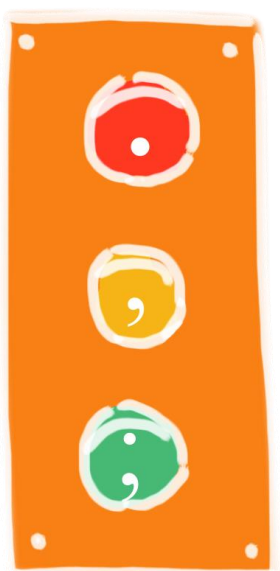
The black hole eats the stars, and the supernova threatens nearby systems.

# PUNCTUATION

Frequency: ★★★★★★★

## Punctuation Part I

The purpose of punctuation is to make written communication clearer by providing a way to communicate necessary pauses and to clarify meaning.



### I. The Period

A period is used to indicate a complete stop, or a separation between ideas.

### II. The Comma

A comma is used to indicate a pause and allows you to show a small degree of separation between ideas.

When you connect two independent clauses with a comma, make sure to include a conjunction!

### III. The Semicolon

When you want to show that two complete statements are closely related, you can use the semicolon. Be careful: this connection is similar to connecting with a comma, but you won't use a conjunction here.

## Punctuation Part II



### IV. The Colon

Colons communicate that you should look for more information ahead. On the ACT, a colon is often introducing a list.

## Extraneous Punctuation

On the ACT, it is critical that you are able to spot overuse of punctuation. Look for the ACT to place extraneous punctuation in the following places:

- 1) Between a subject and its verb.
- 2) Before a prepositional phrase.
- 3) Between an adjective and its noun.

## COMMA USAGE

Frequency: ★★★★★★★★★★

### I. Introductory Elements

Introductory elements provide the setting for the rest of the sentence and should be set apart with commas.

**After my twitter account got hacked,** all of my followers had DMs asking them to visit a shady site.

### II. Interrupters: Essential and Nonessential

Nonessential interrupters (or side comments) identify or restrict the noun they are describing. Nonessential interrupters can be removed from the sentence, and the sentence still works. Communicate that the comment is nonessential by surrounding it with commas.



The new Gone Bananas album, **which will be released this year,** is sure to sell a billion songs.

Essential interrupters should not be separated from the rest of the sentence with commas.

The new album **by the artist Gone Bananas** will be released this year!

### III. Series of Adjectives

To communicate that the order of the adjectives is NOT important, separate the adjectives with commas.

If the order of the adjectives is important, then the adjectives do not need to be separated by commas.

### IV. The Comma Splice

To avoid a comma splice when connecting two independent clauses (complete statements), use either a comma with a coordinating conjunction or use a semicolon.

## TRANSITIONS

Frequency: ★★★★★★

### I. Examining the Ideas Before and After the Transition

The first step towards finding the right transition is to determine how the ideas are related to each other.

#### Connections Examples

SIMILAR: My brother is a soccer fanatic, and I, likewise, have a real passion for the sport.

CONTRASTING: Many people in the south enjoy watching football on Sunday afternoon. In contrast, I find myself searching the channels for an exciting soccer match.

CAUSE AND EFFECT: My friend studied in Holland; consequently, he is a fan of the Dutch national team.

MORE INFO: If you become a fan of soccer now, you can watch the English Premier League now. Furthermore, the World Cup is right around the corner!

### II. Sorting Transitions

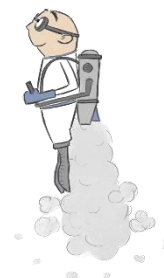
Place the transition words in the correct column!

Contrasting	Similar	Cause/Effect	Additional Information
however but on the other hand even so although though nevertheless still instead besides	also and no only...but also	consequently as a result because since thus therefore accordingly so	to illustrate in fact in other words for example in addition furthermore

### HOW WILL THIS LOOK ON THE ACT?

The astronaut hooked up his propulsion pack for the spacewalk so the cargo bay doors were jammed.

- A. NO CHANGE
- B. spacewalk, however,
- C. spacewalk, but**
- D. spacewalk; therefore





## REDUNDANCY

Frequency: ★★★★★

The ACT will expect you to identify redundancy, or unnecessary repetition, and correct it.

### I. Given a Word and Its Definition

**Redundant:** Because Repeat wouldn't leave Pete alone, Pete was left in a quandary, which was puzzling.

**Better:** Because Repeat wouldn't leave Pete alone, Pete was left in a quandary.

### II. Given Two Synonyms

Or similarly, the ACT may give you two words that have the same meaning as we have here.

**Redundant:** At heart, Pete yearns and longs for the opportunity to explore the cosmos.

**Better:** At heart, Pete yearns for the opportunity to explore the cosmos.



### III. Redundancy With Comparatives and Superlatives

You probably already know that when an adjective is supersized with “er” or “est” (like hungry changed to hungrier or hungriest), you don't need more or most.

**Redundant:** During the summer, the shark population in the Gulf is far more busier than in the winter months.

**Better:** During the summer, the shark population in the Gulf is far busier than it is in the winter months.

## HOW WILL THIS LOOK ON THE ACT?

Though Pete is occasionally annoyed by Repeat every now and then, they are still brothers and best friends!

- A. NO CHANGE
- B. Repeat from time to time,
- C. Repeat sometimes,
- D. Repeat.**

## MISPLACED MODIFIERS

Frequency: ★★

### I. Logical Placement

Just as adjectives are placed right beside the nouns they describe, other modifiers are also best placed near the terms they are describing.



**INCORRECT:** The tourists snapped pictures of the large rhino in the jeep.

**CORRECT:** The tourists in the jeep snapped pictures of the large rhino.

### II. Dangling Modifiers

When sentences begin with a description, be careful not to leave a dangling modifier.

Identify the subject immediately after the introduction.



**INCORRECT:** Floating in the river, the zebra watched for crocodiles.

**CORRECT:** Floating in the river, the crocodiles watched for prey.

## PRONOUN-ANTECEDENT AGREEMENT

Frequency: ★★ ★

Pronouns must agree with their antecedents, just like verbs must agree with their subjects!



Rafting the Colorado River is fun. Its swift water makes for quite an adventure.

antecedent

pronoun

Keep in mind these three key differentiators when determining pronoun-antecedent agreement...

### I. Is the Antecedent Singular or Plural?

My friends enjoy hang gliding. They have spent years honing their skills.

### II. Is the Antecedent a Person or an Object?

Yosemite's El Capitan is a mecca for rock climbers, many of whom sleep on its steep face during the long ascent.



(Be careful to refer to people as a who, not a *which* or a *that*!)

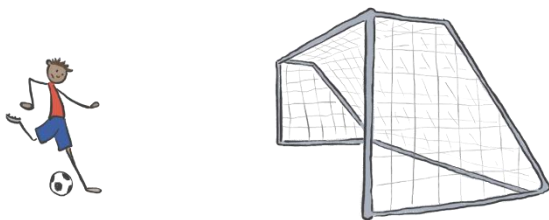
### III. Should the Pronoun be Possessive?

Louise enjoys climbing, but rappelling is her favorite.

## POSSESSIVE FORMS

Frequency: ★★ ★

### I. Possessive Form Basics



For most terms, the possessive form is formed by adding an ***apostrophe*** and an ***s***.  
 Ex. In this season, Spanish sides have been some of soccer's best teams.

### II. Plural Possessive Forms

For most plural nouns, show possession by adding an apostrophe after the “s.”  
 Ex. In the Premier League, players' salaries average over two million pounds per year.

### III. The ACT's Favorites

The ACT likes to test the following. Be ready!

The possessive form of ***it*** is ***its***.

\*\*\*Be careful: ***it's*** = ***it is*** or ***it has***.

The possessive form of ***they*** is ***their***.

\*\*\*Be careful: ***they're*** = ***they are***.

The possessive form of ***who*** is ***whose***.

\*\*\*Be careful: ***who's*** = ***who is***.

## HOW WILL THIS LOOK ON THE ACT?

Messi and Ronaldo will be remembered as two of the sport's most gifted and accomplished athletes.



## ADJECTIVES AND ADVERBS

Frequency: ★★

### I. Adjectives

What is an adjective?

Adjectives describe nouns and pronouns.

Example:

Meet my tall, smart, green friend Bob.



### II. Adverbs

What is an adverb?

Adverbs describe verbs, adjectives, and other adverbs.

Adverbs often end in “ly.”

Example:

Minnie gracefully jumps backward over the slightly blue moon.



## HOW WILL THIS LOOK ON THE ACT?

At the reception, Bob brought out his wild popular dance move.

- A. NO CHANGE
- B. wildly popular
- C. wildly popularly
- D. wild popularly

## ACT ENGLISH – GLOBAL ITEMS

Frequency: ★ x 16

### I. Deletion Items

The ACT will test you on the effect of deleting a phrase or a full sentence from a passage. Ask yourself how the message would change as a result of the deletion.

### II. Addition Items

Addition items focus on the structure and meaning of a passage. It is critical that you can identify a paragraph's main topic in order to find the best introduction, transition, or conclusion.

### III. Split into Two Paragraphs Items

Don't be surprised if the ACT combines two paragraphs and asks you where they should be split. Often, the ACT tells you which details they want separated. Use their specifications to determine your answer.



### IV. Placement Items

Placement and order are key pieces of written communication. And the ACT will expect you to zero in on appropriate placement. Expect to choose best placement for phrases within sentences, sentences within paragraphs, and possibly paragraphs within essays.

### V. Writer's Purpose Items

The ACT will tell you the writer's purpose for the passage and ask you to evaluate whether the essay's message fulfills that purpose.

1. Eliminate the Yes or No answers immediately by answering their specific question.
2. Decide between the remaining two choices by determining the purpose of the passage.



## ACT READING INTRODUCTION

### I. The Setup

The ACT Reading test consists of 4 passages.

With each passage, you'll need to answer 10 questions, for a total of 40 items.

You'll be given 35 minutes to complete this section.

### II. The Pace

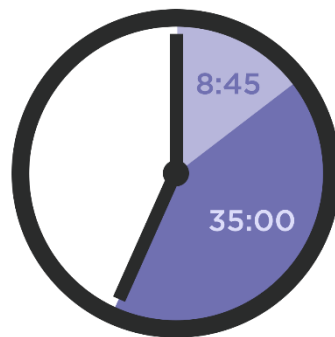


40 items ⇔ 35 minutes

Pace by passage:

8 minutes 45 seconds per passage

Pace by item: 52.5 seconds per item



Pacing Tip: Round pace to 1 minute

(15 items ⇔ 15 min; 10 items ⇔ 10 min; etc.)

### III. The Passages

Passage 1: Prose Fiction

Passage 2: Social Science

Passage 3: Humanities

Passage 4: Natural Science

### IV. Question Types

Level 1: Direct from Text ← Answers are **recall** from specific part of passage

Level 2: Inference, Meaning from Context ← Need to understand what is **implied** in local part of passage

Level 3: Point of View, Summary, Literary Techniques ← Need to understand **full** paragraphs and passage

#### Pro Tips

Make sure your answer choice is based on what is written in the passage.

Do not rush through the passage so quickly that you have to reread large portions of the text.

Never leave any blank!



## DIRECT FROM TEXT ITEMS

*Frequency per passage:* ★★★★★

The “direct from text” items are the easiest ACT Reading items. The answers come directly from the text!

### I. What Do These Items Look Like?

According to the narrator, which of the following...?

The passage states that...?

The narrator indicates that...?



### II. How to Handle These Items

When you come across a “direct from text” question, you will need to recall the needed information... or quickly find the relevant text.

The correct answer choice will be a restatement, though not necessarily with the exact same words, of what is written in the passage.

## MEANING FROM CONTEXT ITEMS

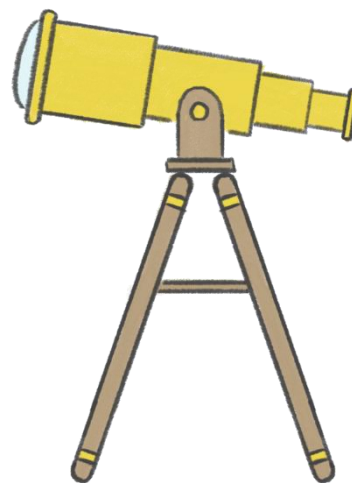
*Frequency per passage:* ★

The ACT will ask you to use context clues to define particular words, phrases, or statements.

### I. What Do These Items Look Like?

As used in line 23, the word “real” refers to:

The narrator’s statement in lines 45 - 46 most nearly means:



### II. How To Handle These Items

The identified text will often be a commonly used statement that can have multiple meanings.

Use the context to discern the author’s intended meaning within the passage.

## INFERENCE ITEMS

*Frequency per passage:* ★★ ★

Inference items are slightly more difficult than the “direct from text” items because the correct answer choice will be implied, but not stated explicitly.

### I. What Do These Items Look Like?

The passage most strongly suggests ...

It can reasonably be inferred ...

The character would most likely agree with...



### II. How to Handle These Items

Inference items require you to understand what is suggested in the text, but isn't stated explicitly. The text will have built a case for one of the given answers.

If needed, locate the specified text to identify the supported conclusion.

## POINT OF VIEW ITEMS

*Frequency per passage:* ½ ★

Point of view items require you to identify the author's or narrator's perspective or attitude as revealed in the text.

### I. What Do These Items Look Like?

At the time of the events of the story, the narrator is:

The point of view from which the passage is told is...



### II. How to Handle These Items

Point of view items expect you to piece together details to see a cohesive perspective of the writer or narrator.

As you read, make sure you pick up on details about the narrator or author— age, relationship to other characters, thoughts, feelings, and so forth.

Determine whether the narrator is speaking in first or third person.

Does the narrator have a limited perspective, or is she omniscient, knowing everything?

Be prepared to zoom out from the details to see the full landscape.

## SUMMARY ITEMS

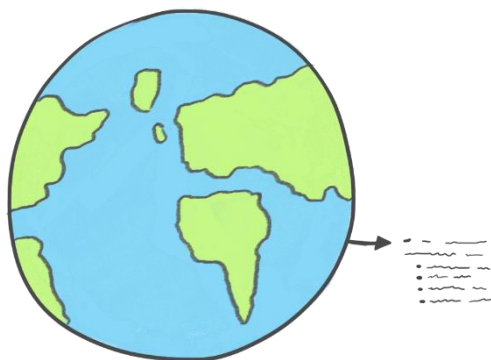
**Frequency per passage:** ★★

The “summary” items require you to find a main idea of a paragraph or full passage, identify the purpose of a sentence or paragraph, or generalize about specific characters.

### I. What Do These Items Look Like?

The primary purpose of the last paragraph is to:

Which of the following best describes the purpose of the 3<sup>rd</sup> paragraph?



### II. How to Handle These Items

Give yourself enough distance from the passage’s particulars long enough to determine how all the details fit together.

Zoom out from the details to see the full landscape presented in the text.

If you add all the details, what is their message?

What is the overall picture painted by a paragraph or about a character?

What purpose does the indicated text serve in the passage?

Hints for handling global or summary items:

1. Quickly scan the indicated text to bring the details together in order to see the big picture.
2. Try to summarize all the details in 5 words or less.

## PROSE FICTION PASSAGE

**Frequency: 1 passage**

ACT calls the first passage either Prose Fiction or Literary Narrative. Do not expect differences in passage types.

The Prose Fiction passage is the only fiction passage on the ACT Reading section.

Expect the author to explain the actions, experiences, and thoughts of the characters.

### I. How Should You Read the Passage?

Specifically, pay attention to what the characters do, think, and feel.

Close reading is key.

Look for recurring themes and main ideas.

### II. What Questions Will They Ask?

On average, you can expect...

3 Direct from Text items

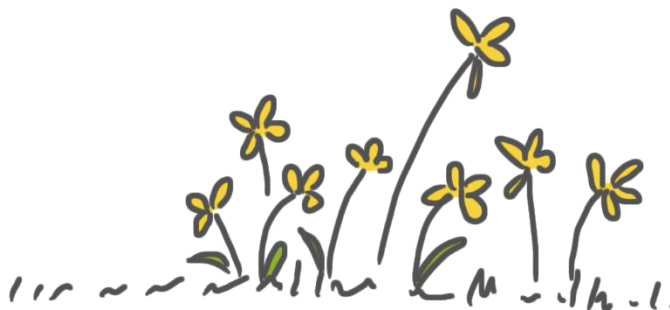
3 Inference items

1 Meaning from Context item

1 Point of View item

1 Summary item

1 Writing Technique item



### \*\*\*ACT Reading Tip\*\*\*

All answers must be based on what is written in the text.

## SOCIAL SCIENCE PASSAGE

*Frequency: 1 passage*

The Social Science passage will likely deal with topics in the following fields: anthropology, economics, political science, psychology, and sociology.

Look for the passage to present historical figures, government practices, or economic issues.

### I. How Should You Read the Passage?

As you read, pay special attention to the author's viewpoints and opinions.

Try not to get so caught up in the details that you don't see the main idea.

### II. What Questions Will They Ask?

The Social Science passage content is different from what you will encounter on the Prose Fiction passage, but the question types are very similar.

On average, you can expect...

3 Direct from Text items

3 Inference items

1 Meaning from Context item

1 Point of View item

1 Summary item

1 Writing Technique item



### \*\*\*ACT Reading Tip\*\*\*

If you are running low on time, you can attempt to answer items that refer to specific lines.

## HUMANITIES PASSAGE

**Frequency: 1 passage**

The Humanities passage is often about cultural or societal topics, sometimes from a historical perspective, and often with a personal touch.

Often the humanities passage has double passages—two smaller, related texts.

### I. How Should You Read the Passage?

As you read, try to visualize the events.

Take mental note of the sequence of events.

Tune in to the narrator's beliefs, thoughts, and opinions.

Note the writer's or narrator's place within the story.

Step back from the details to see the main theme and purpose of the passage.

### II. What Questions Will They Ask?

On average, you can expect...

3 Direct from Text items

3 Inference items

1 Meaning from Context item

1 Point of View item

1 Summary item

1 Writing Technique item





## NATURAL SCIENCE PASSAGE

*Frequency: 1 passage*

The Natural Science passage is the last passage before the ACT science test.

The Natural Science passage could delve into any science topic in a variety of science fields including astronomy, biology, Earth science, and physics.

### I. How Should You Read the Passage?

The Natural Science passage tends to be detail-heavy, so close reading is required.

Pay attention to the specifics!

### II. What Questions Will They Ask?

On average, you can expect...

5 Direct from Text items

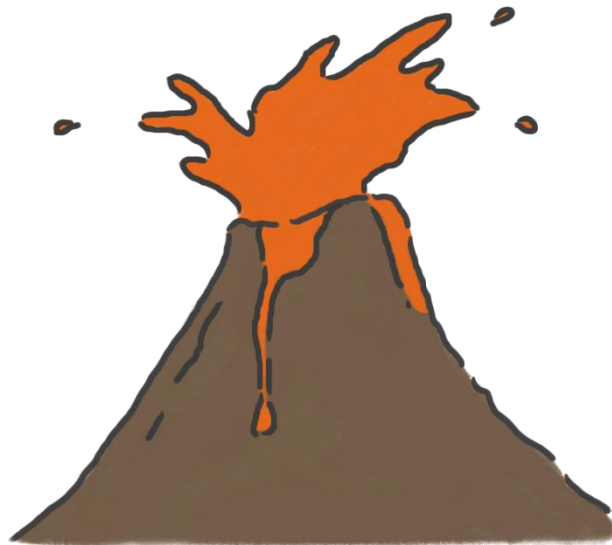
The other five items are a mix of:

Meaning from Context items

Inference items

Summary items

Writing Technique items



Expect to see more Direct from Text items on the Natural Science passage because the passage is dense with facts.

## DOUBLE PASSAGES

**Frequency: 1 passage**

Expect one of the four reading sets to have two smaller passages instead of one larger passage.

### I. Dealing with the Passages Separately

The questions accompanying the texts will be divided into three sets.

The first set will ask questions about the first passage; the second set will ask questions about the second passage, and the third set of questions will ask you about relationship between the passages.

You may want to read the first passage and then answer the first set of questions before reading the second passage and answering the second and third question sets.



### II. Connections Between the Passages

The last set of questions consists of a few items that will ask you to synthesize information from both texts.

Look for the connection between the passages...

Do the texts have the same author? If so, expect to be asked about the writing styles displayed in the texts.

Do the passages cover the same topic?

Is there a character that appears in both passages?



## ACT SCIENCE INTRODUCTION

### I. The Setup

Scenarios: 6 or 7

Items per scenario: 5 to 7

Total items: 40

All but one scenario will have a combination of diagrams, tables, and graphs.

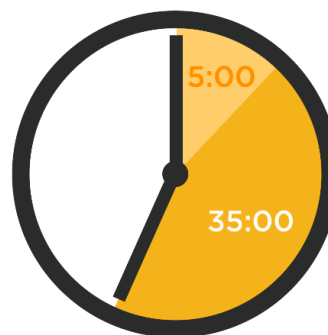
### II. The Pace



40 items ⇔ 35 minutes

Pace by scenario: 5 minutes per scenario (if 7 scenarios)

Pace by item: 52.5 seconds per item



Pacing Tip: Round pace to 1 minute per item

(10 items ⇔ 10 minutes; 5 items ⇔ 5 minutes; ...)

### III. Plan of Attack

Read the text carefully to determine the scenario's setting, paying special attention to the experimental design and noting controls and variables.

In tables, scan row and column labels.

In graphs, scan axes labels and the key.

Let the questions tell you where you should investigate further!

The Conflicting Viewpoints passage will consist almost entirely of text. Underline differences between hypotheses to ensure you are ready for the questions.

### Pro Tips

If you are a slower reader, consider saving the conflicting viewpoints passage for last.

If you are struggling to finish the science test, try starting with the questions and read the scenario only when the questions require it.

## READING TABLES

Frequency:



### I. Identify the WHOs and the WHATs

The first column, and sometimes the first two columns, indicates WHO the table is about.

The remaining columns are WHAT the table is going to tell you about each WHO.

TABLE 1			
	AUG DAILY TEMPERATURE °C	pH	DISSOLVED O <sub>2</sub> (MG/L)
MARCH	7	5.8	11.7
APRIL	9	6.1	10.5
MAY	12	5.9	9.6
JUNE	15	5.7	7.5
JULY	19	5.8	6.2
AUGUST	24	5.8	5.4

Diagram illustrating the structure of Table 1:

- The first column (Months) is labeled **WHO**.
- The remaining columns (AUG DAILY TEMPERATURE °C, pH, DISSOLVED O<sub>2</sub> (MG/L)) are labeled **WHAT**.

### II. Identify Relationships Between Variables

Scan the data values to determine if there are relationships between the variables.

In the example above, note that as the temperature increases, the dissolved oxygen decreases.

## READING GRAPHS

Frequency: ★★★★★★

### Strategy:

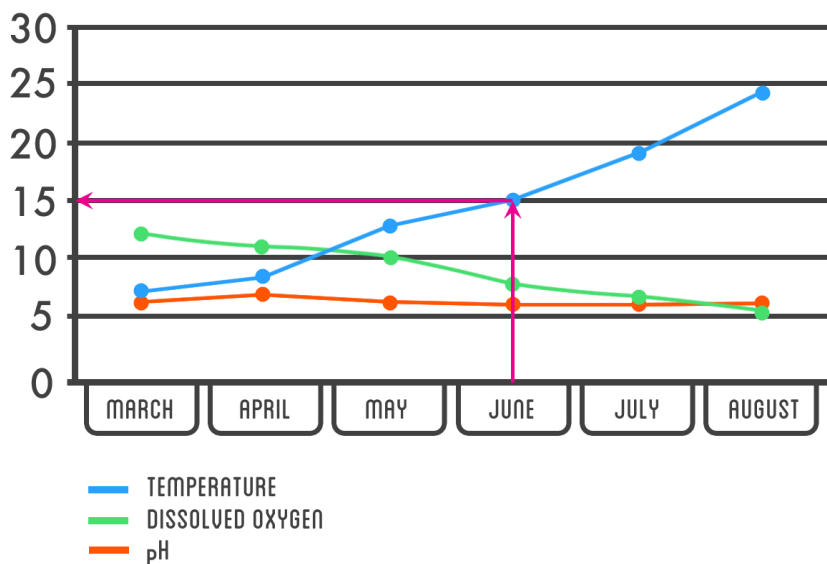
First, quickly identify big picture information from the graphs. Then, the questions will guide you to specific parts of the graphs to mine the details!

### I. Use the Key and Labels

Scan the labels on the horizontal and vertical axes. Check for a key.

### II. Given Input Value → Read Output Value

Can you find the average temperature for the month of June? (Trace from the horizontal axis up to the temperature line and across to the vertical axis.)



The average daily temperature for June is 15 degrees Celsius.

The temperature reading of 20°C was likely taken in July.

### III. Find Trends in the Data. Increasing? Decreasing?

(Label the graph above with arrows as in the video.)

As temperature increases, dissolved oxygen decreases.

The largest decrease in dissolved oxygen is between May and June.

## DATA IN DIFFERENT FORMS

Frequency: ★★

Data can be displayed in many different forms like tables, graphs, and histograms.

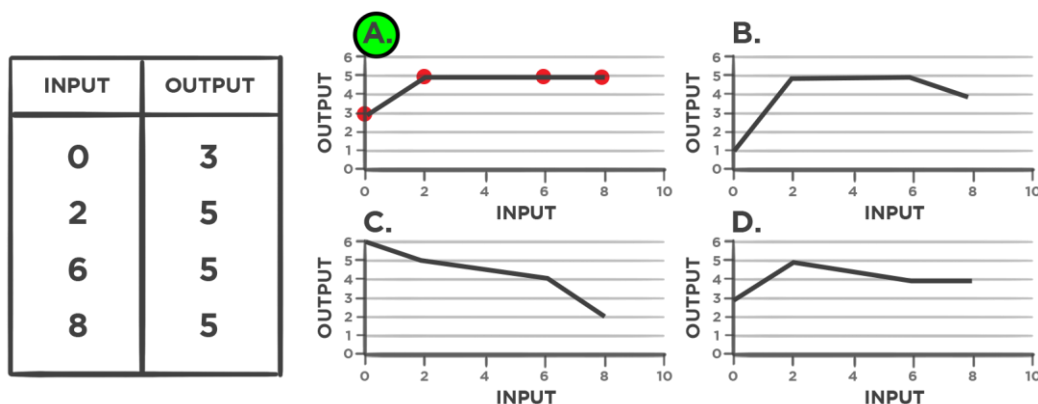
You need to be able to match data from tables with their corresponding graphs...

### I. From Table to Points to Graph

Match the data from the following table with the corresponding graph.

Step 1: Recognize the values as ordered pairs.

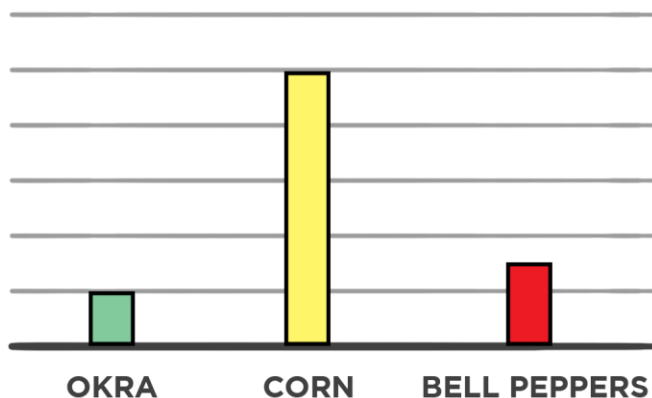
Step 2: Plot the ordered pairs to eliminate graphs that don't match the data.



### II. From Categorical Data to Bar Graphs

Practice making a bar graph from the categorical data.

VEGGIE	HARVEST (lbs.)
OKRA	15
CORN	75
BELL PEPPERS	22



# MAXIMUMS AND MINIMUMS

Frequency: ★★

Identifying maximums and minimums, or high and low values, are often some of the easier items you'll encounter on the ACT science section.

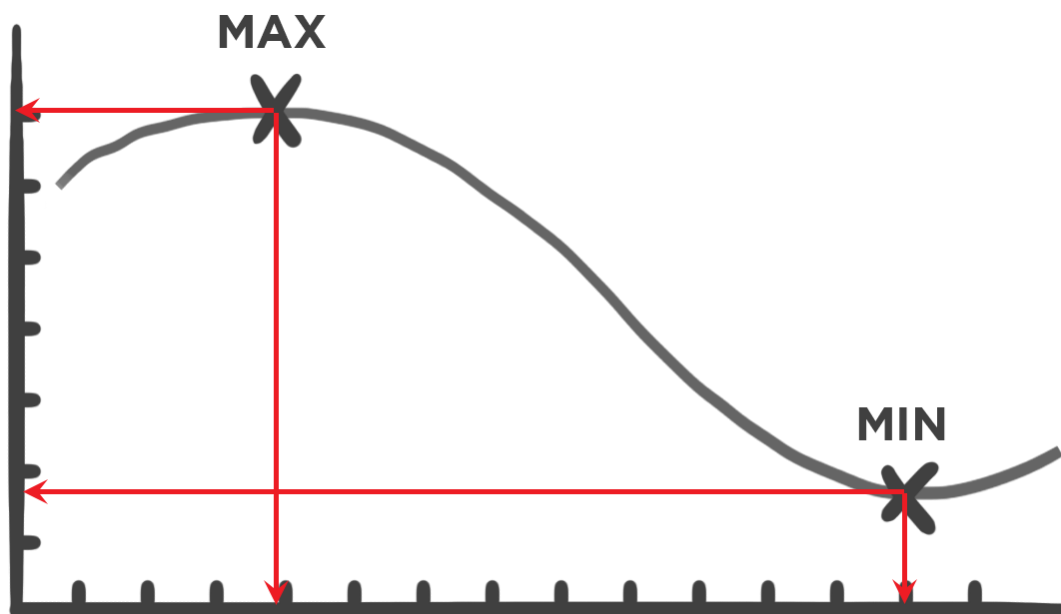
## I. Tables: Max and Min

Be prepared to find maximum and minimum values from tables. The most difficult part is often identifying the correct table and finding the correct column.

\*For help identifying the correct table and finding the important information, check out the Reading Tables video.

## II. Graphs: Max and Min

Sketch in arrows to find the corresponding input and output values for both the maximum and the minimum.





# ANALYZING EXPERIMENTS

Frequency: ★★

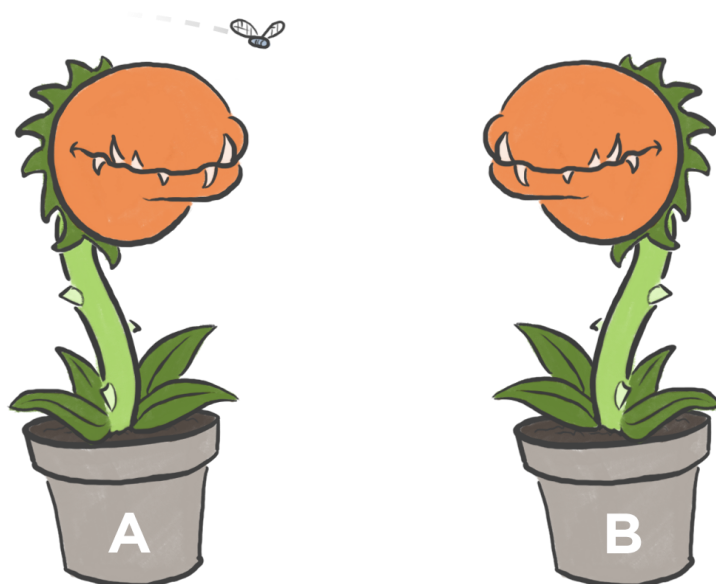
## I. Elements in Experiments

Controls: variables kept constant across different trials

Variables: factor that changes across trials

Independent Variable: variable directly manipulated by experimenter

Dependent Variable: variable measured to determine its dependence on the independent variable



Identify the controls in this experiment.

plant size, soil, pots

Identify the independent variable in this experiment.

number of flies eaten

Identify the dependent variable in this experiment.

plant height

## II. Interpreting Results

Correlation: measure of relationship between variables

When an increase in one variable corresponds with an increase in another variable, there is a positive correlation between the variables.

When an increase in one variable corresponds with a decrease in another variable, there is a negative correlation between the variables.

When an increase in one variable doesn't correspond with a change in another variable, there is little to no correlation between the variables.

## EVALUATING HYPOTHESES

Frequency: ★★ ★

A hypothesis is an explanation that is based on repeated observations. This explanation, or hypothesis, describes previous observations and is used to predict future outcomes.

### I. Evaluating Hypotheses Items Look Like...

Given a new hypothesis... “Do the data in the scenario support this claim?”

Given new information... “Which of the following hypotheses is most likely to be true?”

### II. Do the Data Support the Hypothesis?

When you are presented with a hypothesis and asked to evaluate the merit of the hypothesis, analyze the appropriate tables and graphs to determine whether the hypothesis fits the data.

#### DATA SUPPORT HYPOTHESIS?



When you are provided with details of a new outcome and asked to identify a hypothesis that fits with the new scenario, synthesize the new outcome with the data presented previously, and then choose the correct hypothesis.

#### DATA SUPPORT HYPOTHESIS?



## MULTIPLE Y-AXES

Frequency: ★★

Often, one set of input values is paired with more than one set of output values.

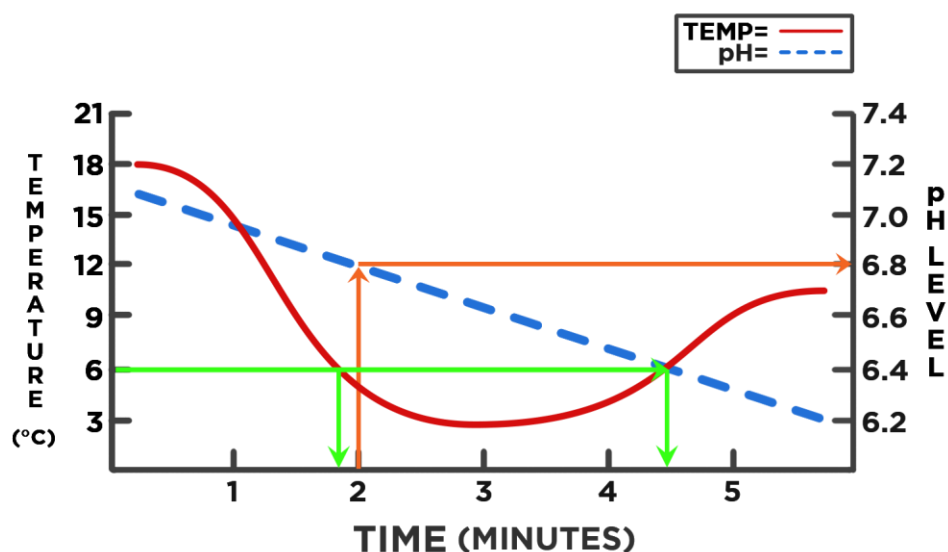
Instead of making separate graphs for each of those sets of outputs, it is often more efficient to plot the data on the same graph and use multiple y-axes.

### How Should You Handle Multiple Y-Axes Graphs?

#### Step 1: Utilize the Key

Use the key to match the graphs with their corresponding axes.

#### Step 2: Read Data Values



Can you find the pH reading at the two-minute mark?

At the 2-minute mark, the pH reads 6.8. (See the orange arrows.)

The temperature was 6 degrees Celsius at what time(s)?

The temperature was 6°C between 1 and 2 minutes and between 4 and 5 minutes.

(See the green arrows.)

## VERTICAL AXIS INPUT VALUES

**Frequency:** ★★

When the ACT gives data about a vertical medium like the atmosphere, a vertical slice of the earth's crust, or a water column, look for input values to be displayed on a vertical axis.

Output values will be displayed on a horizontal axis. If there is more than one set of output values, you will likely find two horizontal axes.

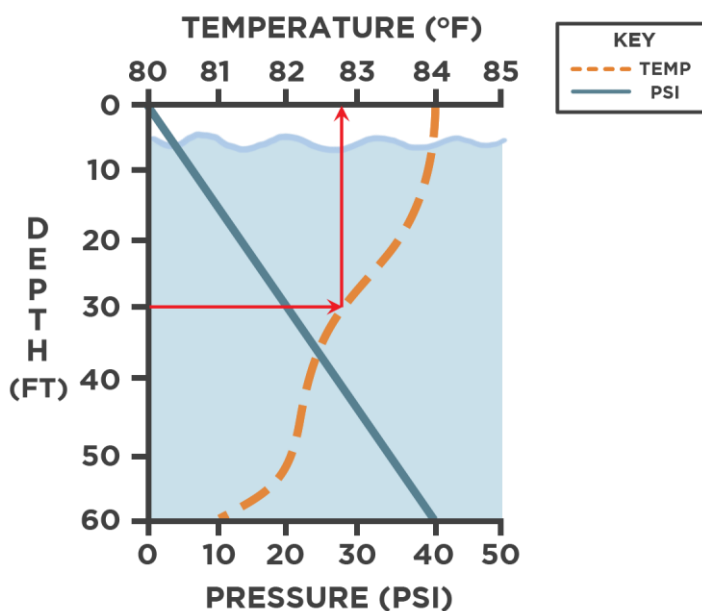
### How Should You Handle Vertical Axis Input Values Graphs?

Tip 1: Utilize the key

Use the key to match the graphs with their corresponding axes.

Tip 2: Read Data Values

Can you find the water temperature at a depth of 30 feet? (Draw in arrows.)



The water temperature at 30 feet is between 82° and 83° F.

Tip 3: Turn the Graph Sideways

Turning the graph sideways is a great strategy for identifying correlations when working with input values displayed on the vertical axis.

## MULTIPLE DATA SOURCES

Frequency: ★★★★★

Many of the more difficult items will require you to pull information from more than one place in the scenario.

### I. Combining Text with Data

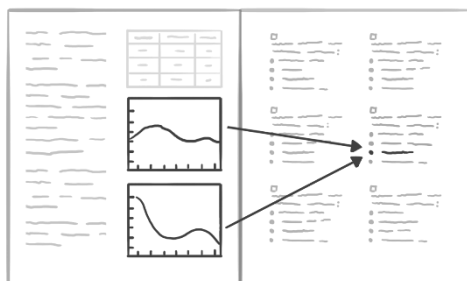
Though it may be tempting to save time by skipping the text, some of the more difficult items will require you to glean information from the text and use it in connection with the tables and graphs.

Use your understanding of the setting to interpret the presented data correctly.

### II. Utilizing Multiple Data Sources

The most difficult items, which often show up in the final few questions of a scenario, will require you to synthesize information from multiple data sources in order to answer correctly.

1. Be prepared to use the info from two or more graphs to answer a single question.



2. You may need to use the introductory text to understand a table to interpret a graph.

