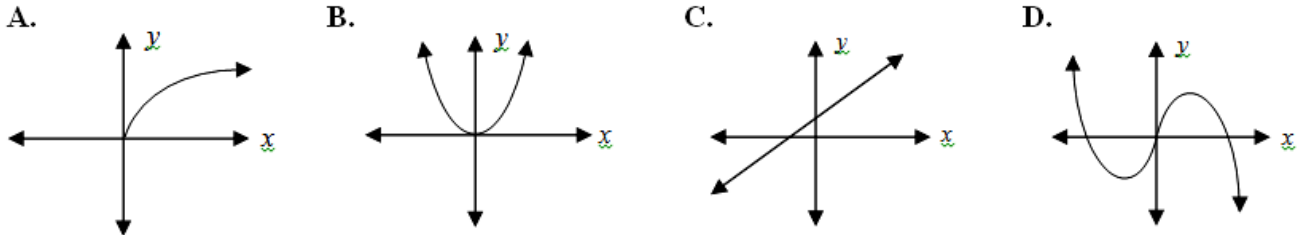


Worksheet 4-3: Properties of Linear Relations

▪ **Linear Relation as a Straight Line:**

A linear relation can be represented **graphically** as a straight line because a change in the independent variable causes a corresponding change in the dependent variable at a **constant rate**.

1. Which of the following graphs shows a linear relationship?



▪ **Linear Relation as a First Degree Equation:**

A linear relation can be represented **algebraically** as a first degree equation where the highest exponent of the variables in the equation is 1.

Some **examples of linear equations** are $3x + 4y = 9$, $y = -3x + 6$, or $x - 5y - 11 = 0$.

2. Which of the following are linear equations?

- (a) $y = 2x + 5$ (b) $y = 2x^3$ (c) $2x + 6y - 8 = 0$ (d) $y = x^2 + 5x - 3$
 (e) $y = 3^x$ (f) $3x - 7y = 1$ (g) $y = 2$ (h) $x = 0$

▪ **Linear Relation Has Constant First Differences (Rate of Change):**

A linear relation can also be determined by calculating the first differences from its table of values. The first differences of a linear relation are constant.

3. Which of the following tables of value does not represent a linear relation?

A.

x	y
1	3
2	6
3	9
4	12

B.

x	y
0	12
2	5
4	-2
6	-9

C.

x	y
-2	60
1	48
4	36
7	24

D.

x	y
1	2
2	4
3	8
4	16

Forms of Linear Equations

Linear equations can be expressed in many different forms. The two common forms are:

(i) **Standard Form:** $Ax + By + C = 0$,
 where A, B, C are integers. A and B are not both zero, A is positive.

4. Which of the following linear equations are not in the standard form, $Ax + By + C = 0$?

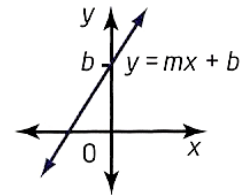
- (a) $2x - y + 6 = 0$ (b) $-6x - 15 - 3y = 0$ (c) $2x + 5y + 4 = 2$ (d) $x + 3 = 0$
 (e) $7x - \frac{1}{2}y + 1 = 0$ (f) $3y + 4x + 1 = 0$ (g) $-3x + y - 1 = 0$ (h) $x - 9y + 15 = 0$

(ii) **Slope-Intercept Form:** $y = mx + b$

where m is the slope of the line, and b is the y-intercept of the graph of the line.

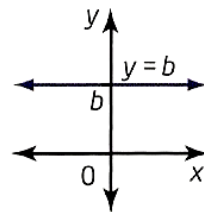
The coefficient “ m ” of the independent variable “ x ” is the slope and also the **rate of change**.

The y-intercept “ b ” is the y-coordinate of the point at which the line cuts the y-axis. It is the value of the dependent variable “ y ” when the independent variable “ x ” is 0.



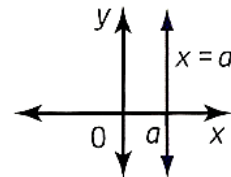
Special Cases:

⊙ **Horizontal Line:** A horizontal line is written in the form $y = b$, where b is the y-intercept. The slope of a horizontal line is zero.



⊙ **Vertical Line:** A vertical line is written in the form $x = a$, where a is the x-intercept. The slope of a vertical line is undefined.

The x-intercept “ a ” is the x-coordinate of the point at which the line cuts the x-axis.

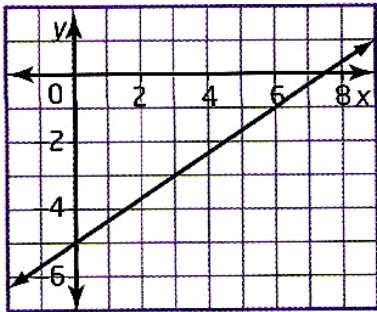


5. Arrange the following lines from the steepest to the flattest.

- (a) $y = -2x + 5$ (b) $y = \frac{3}{5}x + 9$ (c) $y = 6x - 4$ (d) $y = -10x + 7$ (e) $y = 20$

6. Write the equation of each line.

(a)

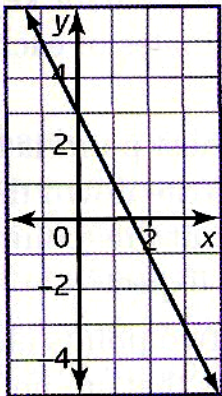


Slope = $m =$

y-intercept = $b =$

Equation of the line: $y = mx + b =$

(b)

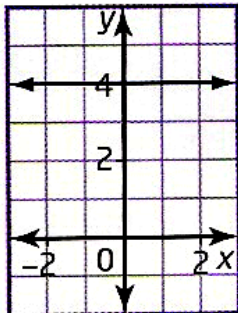


Slope = $m =$

y-intercept = $b =$

Equation of the line: $y = mx + b =$

(c)

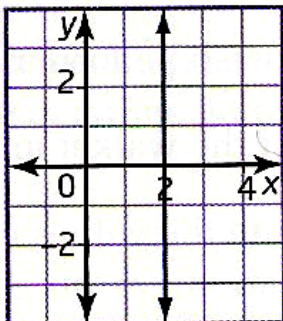


Slope = $m =$

y-intercept = $b =$

Equation of the line: $y = mx + b =$

(d)



Slope = $m =$

y-intercept = $b =$

Equation of the line: $y = mx + b =$

The Equation of a Line in Slope-Intercept Form: $y = mx + b$

Slope

y-intercept

In Algebra language: Slope = m = Coefficient of x ; y - intercept = b = Constant Term

7. For the following linear equations, state the slope and y-intercept of each line.

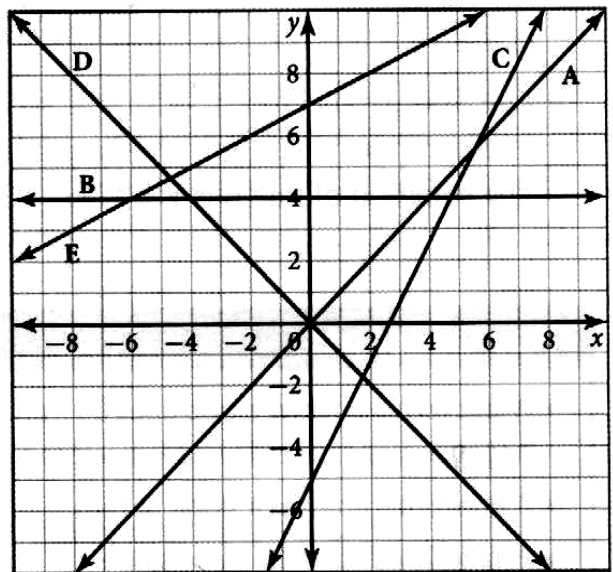
- (a) $y = 3x - 5$ Slope: y-intercept:
- (b) $y = \frac{4}{3}x - 7$ Slope: y-intercept:
- (c) $y = -0.6x + 3.7$ Slope: y-intercept:
- (d) $y = -x$ Slope: y-intercept:
- (e) $y = 6 + x$ Slope: y-intercept:

8. State whether the slope of each line is positive, negative, 0 or undefined.

- (a) $y = 2x + 5$ (b) $y = -0.5x + 2$
- (c) $y = 4 - 3x$ (d) $y = 7$
- (e) $x = 4$ (f) $y = -4 + 9x$

9. Match each line to its equation.

- (a) $y = 4$
- (b) $y = -x$
- (c) $y = 2x - 5$
- (d) $y = x$
- (e) $y = \frac{1}{2}x + 7$



Answers: 1. c ; 2. a, c, f, g, h ; 3. d ; 4. b, c, e, f, g ; 5. d, c, a, b, e ;

6. (a) $y = \frac{2}{3}x - 5$, (b) $y = -2x + 3$, (c) $y = 4$, (d) $x = 2$; 7. (a) $m = 3, b = -5$, (b) $m = \frac{4}{3}, b = -7$,
 (c) $m = -0.6, b = 3.7$, (d) $m = -1, b = 0$, (e) $m = 1, b = 6$; 8. (a) B, (b) D, (c) C, (d) A, (e) E