Linear vs Literal Equations Worksheet with Examples from Economics, Nursing and Physics

Directions: Solve the linear equation on the left-side and then solve the corresponding literal equation on the right-side. Write down every step used to solve the linear equation and apply those same techniques when solving the literal equation on the right.

1. $\frac{x}{3} - 7 = 9$
2. $8 - 3\left(\frac{8}{u}\right) = 2$
3. $-4(2x + 3) = 7$
4. $\frac{x}{3} - y = z$ (solve for x)
5. $x - 3\left(\frac{y}{u}\right) = r$ (solve for u)
6. $-m(2x + 3) = l$ (solve for x)

Physics

7. $P = I^2R$ where P = Power loss, I = Current, R = Resistance (ohms). If $I = 2$ and $R = 6$ what is the power loss?

8. $P = I^2R$ Suppose you are tasked with figuring out the amount of resistance a certain carrying apparatus has. You will be provided the numbers for power loss and current. Solve the equation for resistance (R).

9. If a weight stretches a spring, the length L of the spring is linearly related to the amount of weight (w) for small weights. Suppose an unstretched spring has a length of 50mm and a weight of 400 grams and it stretches it 30mm. What is the relationship between w and L?

10. The maximum horizontal range, S, of a fire stream (stream of water from the hose fire fighters use) is calculated using the formula $S = 0.5N + 26S$ where is in feet and N is the nozzle pressure in pounds for a ¾ inch nozzle. Add 5 feet to the answer for every 1/8 inch increase in nozzle diameter over this. The nozzle pressure is 86 pounds and the nozzle diameter is 1 3/8 inches. What is the maximum horizontal range of the stream? Hint: Try updating the equation for changes in nozzle diameter as a literal equation first then plug in the nozzle pressure and solve.

Medicine and Nursing

11. Blood arrives at the lab you work at and you need to test whether the patient in question is anemic. You start by testing the ratio of liquid to solids in the blood (Hct). You then take it for a red cell count (RC). The mean corpuscular volume or mean cell volume (MCV) tells us the average volume of a red blood cell. The formula for Hct is

$$Hct = \frac{RC \cdot MCV}{10}$$

To answer the question as to whether the patient is anemic or not, the lab technician will need to solve for the mean cell volume. Solve the above equation for MCV.

Economics

12. Linear depreciation is one of several methods approved by the IRS for depreciating business property. If the original cost of the property is C dollars and it is depreciated linearly over N years, its value at the end of n years is given by $V = C\left(1 - \frac{n}{N}\right)$.

   A. Solve this equation for N in terms of V, C and n. A machine having an original cost of 10,000 is depreciated linearly over 20 years.

   B. When will its value be $6,500?

13. Given that S = C + Cm where S is the selling price, C is the cost to the retailer, and m is the mark-up rate, find m in terms of S and C.

14. Unit labor cost (ULC) is calculated as ULC=$\frac{W}{O}$ where O = Output per hour per worker and W= Total labor compensation per hour per worker. Find the total labor compensation in terms of the other variables.

Linear vs. Literal Equations

(1) $\frac{x}{3} - 7 = 9$

$+7 \quad +7$

$3\left(\frac{x}{3}\right) = 16(3)$

$\boxed{x = 48}$

(2) $8 - 3\left(\frac{8}{u}\right) = 2$

$-8 \quad -8$

$\frac{-3\left(\frac{8}{u}\right)}{-3} = \frac{-6}{-3}$

$u\left(\frac{8}{u}\right) = 2(u)$

$\frac{8}{2} = \frac{2u}{2}$

$\boxed{u = 4}$

(3) $-4(2x + 3) = 7$ use distributive property

$-8x - 12 = 7$

$+12 \quad +12$

$\frac{-8x}{-8} = \frac{19}{-8}$

$\boxed{x = -\frac{19}{8}}$

(4) $\frac{x}{3} - y = z$

$+y \quad +y$

$3\left(\frac{x}{3}\right) = (z + y)3$

$\boxed{x = 3(z+y) \text{ OR } x = 3z + 3y}$

(5) $x - 3\left(\frac{y}{u}\right) = r$

$-x \quad -x$

$\frac{-3(y/u)}{-3} = \frac{r - x}{-3}$

$u\left(\frac{y}{u}\right) = \left(\frac{r-x}{-3}\right)u$

dividing by a fraction- Multiply by the reciprocal!

$\frac{y}{\left(\frac{r-x}{-3}\right)} = \frac{\left(\frac{r-x}{-3}\right)u}{\left(\frac{r-x}{-3}\right)}$

$y \cdot \frac{-3}{r-x} = u$

$\boxed{\frac{-3y}{r-x} = u}$

(6) $-m(2x + 3) = l$

$-2mx - 3m = l$

$+3m \quad +3m$

$\frac{-2m(x)}{-2m} = \frac{l + 3m}{-2m}$

$\boxed{x = \frac{l + 3m}{-2m}}$

(7) $P = I^2 R$, $I = 2$, $R = 6$, $P = \boxed{?}$

$$P = (2)^2 (6)$$
$$P = 4 (6)$$
$$\boxed{P = 24}$$

(8) $P = I^2 R$, Solve for R

$$\frac{P}{I^2} = \frac{I^2 \cdot R}{I^2}$$

$$\boxed{R = \frac{P}{I^2}}$$

(9) L = length of the spring (linearly related to the amount of weight (w) for small weights)

L = 50 mm

W = 400 grams → stretches the spring an extra 30mm

→ new L = 80 m (from 50 mm + 30mm = 80mm)

$$y = mx + b$$

$$L = m(w) + b$$

$$(0, 50), (400, 80)$$

w_1, L_1 w_2, L_2

$$m = \frac{L_2 - L_1}{m_2 - m_1} = \frac{80 - 50}{400 - 0} = \frac{30}{400} = \frac{3}{40}$$

$$L = \frac{3}{40} w + b \qquad (0, 50) \rightarrow b = 50$$

$$\boxed{L = \frac{3}{40} w + 50}$$

(10) Find MAX HORIZONTAL RANGE of the stream

Nozzle diameter $= 1\frac{3}{8}'' = \left(\frac{11}{8}\right)''$

$\frac{3}{4}''$ nozzle → Change into 8 in denominator → $\frac{3(2)}{4(2)} = \frac{6}{8}$

To find actual nozzle diameter:

$\frac{11}{8} - \frac{6}{8} = \frac{5}{8}''$ larger than for the given formula.

Thus, for every $\frac{1}{8}''$ increase in nozzle diameter, the max horizontal range increases by 5 feet.

When N = 86 lbs. and the diameter of the nozzle is $1\frac{3}{8}''$

$$S = 0.5(86) + 26 + \left[\frac{5}{8} \Big/ \frac{1}{8}\right](5)$$

$$S = 0.5(86) + 26 + \left[\frac{5}{8} \cdot \frac{8}{1}\right](5)$$

$$S = 0.5(86) + 26 + [5](5)$$

$$S = 0.5(86) + 26 + 25$$

$$S = 43 + 26 + 25$$

$$S = 69 + 25$$

$$S = 94$$

Therefore, the streams maximum horizontal range is 94 ft.

(11) Solve for MCV

$$10\,(Hct) = \left(\frac{RC \cdot MCV}{10}\right)10$$

$$\frac{10\,Hct}{RC} = \frac{RC \cdot MCV}{RC}$$

$$\boxed{MCV = \frac{10 \cdot Hct}{RC}}$$

(12) (A) $V = c\left(1 - \frac{n}{N}\right)$ solve for N:

$$\frac{V}{c} = \frac{c}{c}\left(1 - \frac{n}{N}\right)$$

$$N\left(\frac{V}{c}\right) = \left(1 - \frac{n}{N}\right)N$$

$$c\left(\frac{NV}{c}\right) = (1 - n)\,c$$

$$\frac{NV}{V} = \frac{(1-n)c}{V}$$

$$\boxed{N = \frac{(1-n)c}{V}}$$

(B) C = 10,000
N = 20
V = 6,500
looking for n

$$\rightarrow 6500\,(20) = \left(\frac{(1-n)(10{,}000)}{6{,}500}\right)6{,}500$$

$$\frac{6500\,(20)}{10{,}000} = \frac{(1-n)(10{,}000)}{10{,}000}$$

$$13 = 1 - n$$
$$-1 \quad -1$$

$$12 = -n$$

$$\frac{12}{-1} = \frac{-n}{-1}$$

$$n = 12$$

(13) $S = C + Cm$, find m in terms of S and C.

$S = C(1+m)$

$\frac{S}{C} = \frac{C(1+m)}{C}$

$\frac{S}{C} = 1 + m$

$-1 \quad -1$

$\boxed{\frac{S}{C} - 1 = m}$

(14) $ULC = \frac{W}{O}$ → Total labor comp per hour per worker
→ output per hour per worker

Find the total labor compensation

$O(ULC) = \left(\frac{W}{O}\right)O$

$ULC(O) = W$ → $\boxed{W = ULC(O)}$