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Inverse Functions

Idea: You can plug in a power cord
Inverse is to unplug the cord.

Example: $f(x) = 3x - 2$ is a function of x
Inverse is $f^{-1}(y) = (y + 2)/3$

General idea: The inverse of $y = f(x)$ is $x = f^{-1}(y)$
Solve for x in terms of y

Example again: $y = 3x - 2$ is a function $f(x)$
Inverse is $x = f^{-1}(y) = (y + 2)/3$

More Examples

Try these, clicking as you go...

Click	$y = f(x)$	$x = f^{-1}(y)$
(A)	$y = 5x$	$x = y/5$
(B)	$y = x + 7$	$x = y - 7$
(C)	$y = 3x - 4$	$x = (y + 4)/3$
(D)	$y = x^3$	$x = \sqrt[3]{y} = y^{1/3}$
(E)	$y = 10^x$	$x = \log(y)$

Converting Temperature

x = temperature in Celsius y = temperature in Fahrenheit

This table shows how to convert between Fahrenheit and Celsius.

$^{\circ}C$	0	10	20	30	40	50	60	70	80	90	100
$^{\circ}F$	32	50	68	86	104	122	140	158	176	194	212

There is a function f that converts the temperature x in Celsius to the temperature y in Fahrenheit: $y = f(x)$

Example $f(20) = 68$ means **20** $^{\circ}C$ is **68** $^{\circ}F$

The inverse function $x = f^{-1}(y)$ converts Fahrenheit back into Celsius

Example: $f^{-1}(68) = 20$

You can use a table of data two ways:

- Using it forwards gives you the function f
- Using it backwards gives you the inverse function f^{-1}

Find f and f^{-1} for Temperature

1. Find $y = f(x)$, the function that gives $y^\circ\text{F}$ from $x^\circ\text{C}$. **Ans:** C

(A) $y = 9x/5$

(B) $y = 9(x + 32)/5$

(C) $y = (9x/5) + 32$

(D) $y = (9x + 32)/5$

2. Find $x = f^{-1}(y)$, the function that gives $x^\circ\text{C}$ from $y^\circ\text{F}$. **A:** D

(A) $x = 5y/9$

(B) $x = (5y + 32)/9$

(C) $x = (5y/9) + 32$

(D) $x = 5(y - 32)/9$

3. What temperature is the same in both Celsius and Fahrenheit?

(A) -50°

(B) -40°

(C) -30°

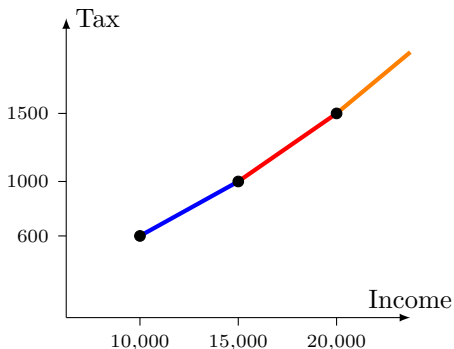
(D) -20°

(E) -10°

Answer: B

Tax Table

Income	\$10,000 to \$14,999	\$15,000 to \$19,999	\$20,000 and over
Tax	\$600+ 8% of amount over \$10,000	\$1,000+ 10% of amount over \$15,000	\$1,500+ 12% of amount over over \$20,000



There are 3 **tax brackets**

10K to 15K

15K to 20K

above 20K

Tax, continued

Income	<u>\$10,000 to \$14,999</u>	<u>\$15,000 to \$19,999</u>	<u>\$20,000 and over</u>
	\$600+	\$1,000+	\$1,500+
Tax	8% of amount over \$10,000	10% of amount over \$15,000	12% of amount over over \$20,000

4. If you earn \$12,500, how much tax do you pay? read page 27!

- (A) \$600 (B) \$700 (C) \$800 (D) \$900 (E) \$1,000

Answer: C

5. If you pay \$1,200 in tax, how much do you earn?

- (A) \$16,000 (B) \$17,000 (C) \$18,000 (D) \$20,000

Answer: B

Tax, continued some more

Income	<u>\$10,000 to \$14,999</u>	<u>\$15,000 to \$19,999</u>	<u>\$20,000 and over</u>
	\$600+	\$1,000+	\$1,500+
Tax	8% of amount over \$10,000	10% of amount over \$15,000	12% of amount over over \$20,000

If x = income and y = tax, then

- $y = f(x)$ is the function with input income and output tax
- The inverse function $x = f^{-1}(y)$ has input tax and output income

Bourne, Jason Bourne

13. The road from Santa Barbara (**SB**) to Palo Alto (**PA**) is 300 miles long. **Your** friend **Marie** leaves **SB** at noon driving at **60** mph to **PA**.

A **bad guy** leaves **PA** at 1pm driving along the same road at 60 mph.

At 2pm you find out and decide to save your friend. You drive at 80 mph from **SB**. Will you get to your friend before the bad guy does?

(A) Yes

(B) No

(C) The same time

B

Think – pair – share

There are many ways to work it out

Bourne (continued!)

14. You jump into your car. You need to catch up with Marie before the bad guy. How long until you get to her?

But... your name is Jason Bourne. You always have a plan.

- SB to PA is 300 miles.
- Marie leaves SB at noon driving at 60 mph to PA.
- The bad guy leaves PA at 1pm driving at 60 mph.
- At 2pm you drive at 80mph from SB. At 2:01 you call Marie and tell her to stop her car.

About how many hours before the bad guy do you get to Marie?

(A) 1

(B) $3/4$

(C) $1/2$

(D) at the same time

(E) after the bad guy

Answer: C