Learning Outcome:
This lesson explores properties of exponents, use of the properties to generate equivalent expressions, and solving problems using relations.
8.EE.A.1

Your basic ideas of exponents helped you to bring success to Prochips.
Now practice some more challenges on exponents.

1 Find the missing numbers:

$\frac{3}{4}, \frac{5}{4}, \boxed{\frac{7}{4}}, \frac{9}{4}, \boxed{\frac{11}{4}}, \frac{13}{4}$

2 Arrange the given expressions in the ascending order: $\frac{3^9}{3^6}$, $3^5 \times 3^{-5}$, $\frac{3^3}{3^6}$, 3^7

$3^3 = 27$, $3^0 = 1$, $3^{-3} = \frac{1}{27}$, 3^7

$\frac{3^3}{3^6}$ | $3^5 \times 3^{-5}$ | $\frac{3^9}{3^6}$ | 3^7

3 How long would sunlight take to reach Earth, if Earth is 15×10^7 km away from the Sun and light travels through space at the speed of 3×10^5 km/sec? [Time = Distance/Speed]

$= \frac{15 \times 10^7 \text{ km}}{3 \times 10^5 \text{ km/sec}}$

$= 5 \times 10^{7-5}$ sec

5×10^2 sec = 500 seconds

4 Match the expressions given on the left side with its simplest form on the right.

$\frac{5^8}{5^{12}}$	5^{10}
$5^4 \times 5^6$	10^8
5^0	5^{-4}
$2^8 \times 5^8$	1

5 Find the area of a playground, whose length is 2^7 yards and width is 2^5 yards.

rect shape

Area of p.g. = $l \times w$

$= 2^7 \times 2^5 = 2^{12}$ sq. yards

6 Find the simplest form of the expression $\frac{(m+n)^2}{(m^2-n^2)}$.

$\frac{(m+n)^2}{(m+n)(m-n)} = \frac{m+n}{m-n}$

☐ $\frac{(m-n)}{(m+n)}$ ☑ $\frac{(m+n)}{(m-n)}$ ☐ $(m+n)(m-n)$ ☐ $(m+n) + (m-n)$

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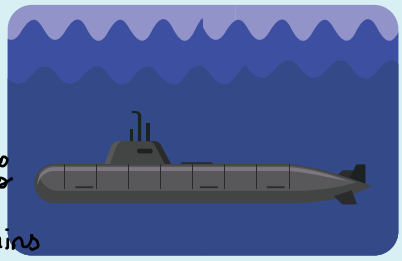
You have become an expert in using exponents. Your contribution to Prochips was awesome. With that wide knowledge, explore more on exponents by answering the following questions:

1 A submarine begins its descent from the surface of the water and it dives 20 feet for each minute. What would be the depth of the submarine after $\frac{2}{3}$ hours?



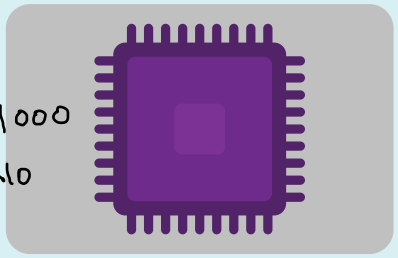
20 feet/min

$\frac{2}{3}$ hrs $\rightarrow \frac{2}{3} \times 60$

$\rightarrow 40$ mins

$x = 20 \times 40 = 800$ feet

2 After research, it was decided that the weight of the chip shouldn't exceed 0.4×10^7 g. If they used x transistors, each weighing 0.002 g to meet the requirement, find the maximum value of x.



$0.4 \times 10^7 \text{ g} \times 1000$

$0.002 \text{ g} \times 10$

2×10^9

2×10^9 transistors

3 A chip that can house 10^7 transistors per sq.mm is fabricated such that it covers an area of 1 sq cm. Find the total number of transistors that it'll have.

1 sq cm = 1 x 1

$= 10 \times 10 = 100$ sq mm

$10^7 \times 100$ sq mm $= 10^9$ transistors

4 Match each value with the most appropriate measurement.

2.6×10^2 meters	Depth of bathtub
2.5×10^5 miles	Length of memory chip
1.6×10^1 inches	Distance between two asteroids
7.8×10^0 millimeters	Height of a skyscraper

5 While renovating the bathroom, it was observed that the amount of water that flowed from a faulty showerhead was 24^{-1} liters per second. If a person takes 20 min on an average to take a shower, how much water would be used during this time?

$\frac{1}{24}$ L/s

20 min $= 20 \times 60 = 1200$ s

$\frac{1}{24} \times 1200 = 50$ L

6 Chip A is stacked up with 2020^2 transistors. Chip B is stacked up with 2019^2 transistors. What would be the ratio of number in transistors in chip A to chip B?

$A:B = \frac{A}{B} = \frac{2020^2}{2019^2} = \left(\frac{2020}{2019}\right)^2$

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We have sound coming from an external source up to the window of the room. At the time it reaches the window the level of the sound is about 20 dBA. We want to develop a soundproof window so that by the time the sound reaches inside the room it should be less than 2 dBA. When sound travels through air, its intensity reduces. The intensity is inversely proportional to the square of the distance from source.

For sound traveling through air, intensity $I = \frac{P \times 0.08}{r^2}$, where P is the original intensity of sound at source, I is the intensity of sound at the destination at a distance r from source.

We can use a sheet of wood, foam, and glass to develop the soundproof window. (Each has a different level of sound absorption.)

- Wood -> intensity $I_1 = \frac{P_1 \times 0.7}{r_1^2}$ $= \frac{14}{r_1^2}$
- Foam -> intensity $I_2 = \frac{P_2 \times 0.05}{r_2^2}$ $= \frac{0.7}{(r_1 r_2)^2}$
- Glass -> intensity $I_3 = \frac{P_3 \times 0.95}{r_3^2}$ $= \frac{0.665}{(r_1 r_2 r_3)^2}$

20

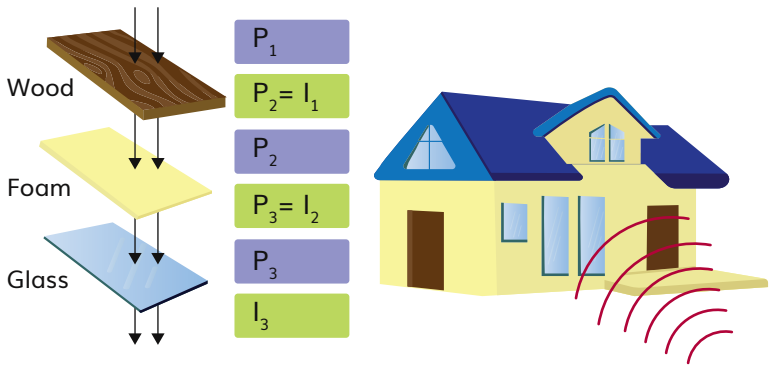
required 2

You decide to have a sheet of wood, foam, and glass one after the other as shown below.

$(r_1 r_2 r_3)^2 = \frac{0.665}{2} = 0.3325$

$r_1 \cdot r_2 \cdot r_3 = 0.57$

P_1 = P (Intensity outside room 20dBA)



$I = I_3$ (Intensity inside room 2 dBA)

- P - Intensity outside and same as P_1
- Sound travels through wood, intensity reduces to I_1 - same as P_2
- Sound travels through foam, intensity reduces to I_2 - same as P_3
- Sound travels through glass, intensity reduces to I_3 - same as the intensity of sound inside the room

What should be the thickness (the value of r in each case in inches) of each layer made of wood, foam, and glass so that the level of the sound is reduced from 20 dBA to just 2 dBA?

Assuming $r_1 = 1$, we get values of r_2 & r_3.

Wood			Foam			Glass		
P_1	r_1	I_1	P_2	r_2	I_2	P_3	r_3	I_3
20	1	14	14	0.5	2.8	2.8	1.14	2

exact = 2.0467