

TEAMS Monthly High School Math Challenge, November 2016

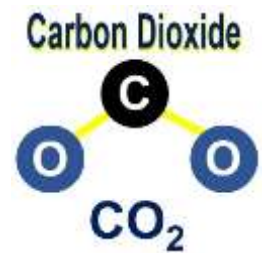
Directions: Copy and distribute to your students. Coaches may e-mail their student's answers to teams@tsaweb.org --subject line: HS Math Challenge. Make sure to include the student's name, your name, your school, city and state. Correct entries for that month will be placed in a drawing and one name will be randomly drawn on the 2nd Friday of the month following the challenge. The student whose name is drawn will be sent a \$25 Visa gift card via their TEAMS coach.

Rules:

- 1) E-mailed answers must be received by 11:59PM on the last day of the month.
 - 2) All parts to the monthly question must be answered correctly. If two questions are posed, both must be answered correctly.
 - 3) Answers submitted must be for the current month's posted problem.
 - 4) One entry per student per month allowed.
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Challenge 1

The global carbon dioxide concentration in the atmosphere in 2016 surpassed 400 parts-per-million (ppm) for the first time. While the unit ppm is often used to express the concentration of CO₂ in the atmosphere, it is also common to show the concentration as a percent of the atmospheric make up.



Math challenge question

What percent of the atmosphere is carbon dioxide if the concentration is 400 ppm?

Challenge 2

Air pollution is typically presented as a numerical Air Quality Index (AQI). The AQI is a piecewise linear function, or a function that can vary for given ranges of values. The AQI for the United States is as shown:

AQI	AQI
$I_{low} - I_{high}$	Category
0-50	Good
51-100	Moderate
101-150	Unhealthy for Sensitive Groups
151-200	Unhealthy
201-300	Very Unhealthy
301-400	Hazardous
401-500	

The equation to convert from concentration of an airborne pollutant to AQI is as follows:

$$AQI = \frac{I_{high} - I_{low}}{C_{high} - C_{low}} (C - C_{low}) + I_{low}$$

Where:

- AQI - the Air Quality Index for a given pollutant
- I_{high} – The index breakpoint for C_{high}
- I_{low} - the index breakpoint for C_{low}
- C_{high} – the concentration breakpoint that is $\geq C$
- C_{low} – the concentration breakpoint that is $\leq C$

The table of breakpoints from the EPA is:

O₃ (ppb)	O₃ (ppb)	PM_{2.5} (µg/m³)	PM₁₀ (µg/m³)	CO (ppm)	SO₂ (ppb)	NO₂ (ppb)	AQI	AQI
$C_{low} - C_{high}$ (avg)	$C_{low} - C_{high}$ (avg)	$C_{low} - C_{high}$ (avg)	$C_{low} - C_{high}$ (avg)	$C_{low} - C_{high}$ (avg)	$C_{low} - C_{high}$ (avg)	$C_{low} - C_{high}$ (avg)	$I_{low} - I_{high}$	Category
0-54 (8-hr)	-	0.0-12.0 (24-hr)	0-54 (24-hr)	0.0-4.4 (8-hr)	0-35 (1-hr)	0-53 (1-hr)	0-50	Good
55-70 (8-hr)	-	12.1-35.4 (24-hr)	55-154 (24-hr)	4.5-9.4 (8-hr)	36-75 (1-hr)	54-100 (1-hr)	51-100	Moderate
71-85 (8-hr)	125-164 (1-hr)	35.5-55.4 (24-hr)	155-254 (24-hr)	9.5-12.4 (8-hr)	76-185 (1-hr)	101-360 (1-hr)	101-150	Unhealthy for Sensitive Groups
86-105 (8-hr)	165-204 (1-hr)	55.5-150.4 (24-hr)	255-354 (24-hr)	12.5-15.4 (8-hr)	186-304 (1-hr)	361-649 (1-hr)	151-200	Unhealthy
106-200 (8-hr)	205-404 (1-hr)	150.5-250.4 (24-hr)	355-424 (24-hr)	15.5-30.4 (8-hr)	305-604 (24-hr)	650-1249 (1-hr)	201-300	Very Unhealthy
-	405-504 (1-hr)	250.5-350.4 (24-hr)	425-504 (24-hr)	30.5-40.4 (8-hr)	605-804 (24-hr)	1250-1649 (1-hr)	301-400	Hazardous
-	505-604 (1-hr)	350.5-500.4 (24-hr)	505-604 (24-hr)	40.5-50.4 (8-hr)	805-1004 (24-hr)	1650-2049 (1-hr)	401-500	

Math challenge question

Calculate the AQI for a city with a measured 8-hour carbon monoxide concentration of 19.2 ppm. What AQI based level of health concerns should be reported?