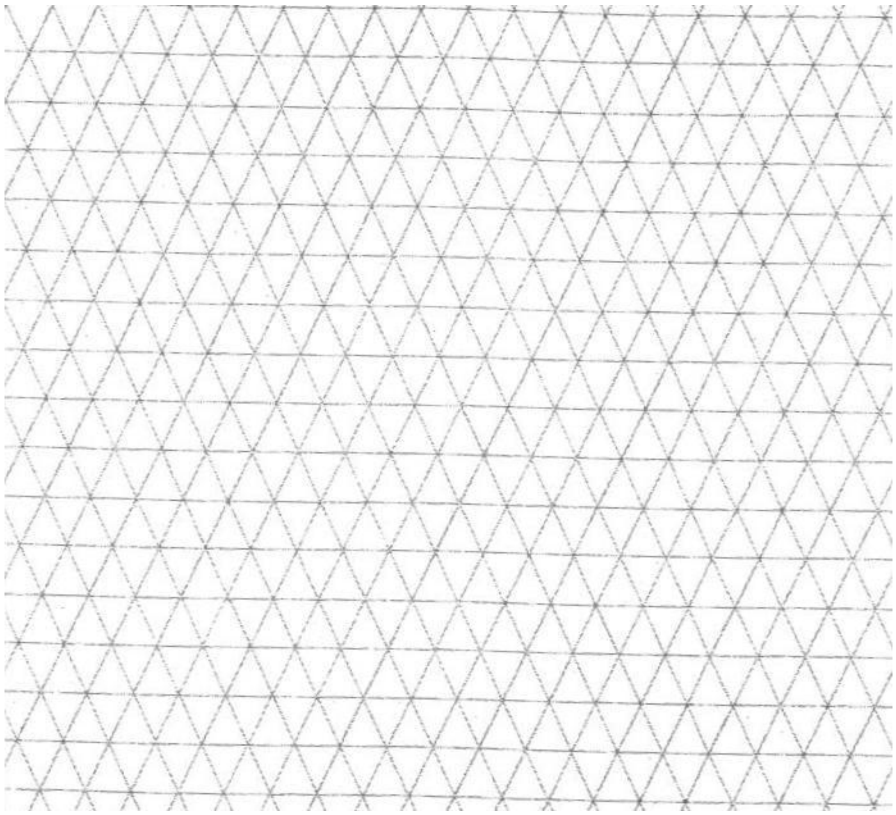
STE Review Exercise **Name____________________________**

1. **A)** **Cubane** (C_8H_8) is a synthetic hydrocarbon molecule that consists of eight carbon atoms arranged at the corners of a cube.

   Use the following isometric paper to draw a cube and then show the correct number of bonds for carbon and hydrogen in the C_8H_8molecule.



b) Assume that the oxidation (reaction with oxygen) of cubane produced only carbon dioxide and water. Write a balanced equation to represent this **exothermic reaction**. Show heat on the correct side of the equation. Pretend that 3000 kJ are released for every mole of C_8H_8 that burns.

$$C_8H_8 + 10\ O_2 \rightarrow 8\ CO_2 + 4\ H_2O + 3000\ kJ$$

c) What total mass of greenhouse *gases* in kg will be released for every 1.0 kg of C_8H_8 that is oxidized?

1000 g/(104g/mole) = 9.61 moles C_8H_8

9.61 moles C_8H_8(8 CO_2/1 C_8H_8) = 76.88 moles CO_2

76.88 moles CO_2(44 g/mole) = 3382.72 g =3.38272 kg

But water is also a powerful greenhouse gas. We just don't worry about our input because we add very little water vapour compared to what is already present.

9.61 moles C_8H_8(4 H_2O /1 C_8H_8) = 38.44 moles H_2O

38.44 moles H_2O(18 g/mole) = 691.9 g = 0.6919 kg H_2O

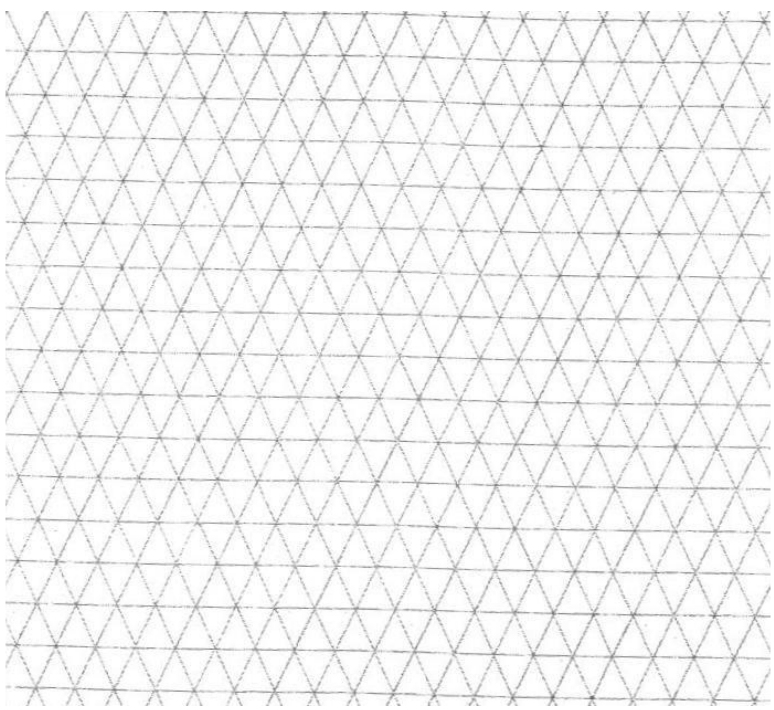
Total mass of greenhouse gases = 3.38272 kg + 0.6919 kg H_2O = 4.1 kg

d) Let's say that each C_8H_8molecule consisted of 6 atoms of ^{2}H and 2 atoms of ^{1}H. Calculate the molar mass for such a compound.

Weighted average for hydrogen in this compound = (2/(2+6))*1 + (6/(2+6))*2 = 1.75 g/mole

Molar mass of C_8H_8 with heavy hydrogen = 8(12) + 8(1.75) = 110 g/mole instead of the usual 104g/mole

2. A) Draw a cube on the isometric paper.



B) Imagine that each side of the cube was an electric wire. The (-) end of the battery is attached to a corner of the bottom of the cube, facing you. The (+) end is on top of the cube, diagonally across from the (-). Label the (+) and (-).

c) Draw three 15 Ω resistors on 3 separate wires, all attached to the (-) corner.(three resistors in all) If the voltage of the power source is 12 V, how much current is delivered by the power source?

It's equivalent to a parallel circuit.

$Req = (15^{-1} + 15^{-1} + 15^{-1}) = 5\ \Omega.$

$V/R = I$

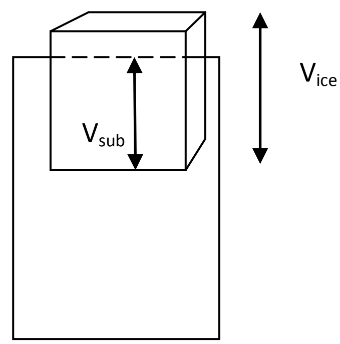
$12\ V/5\ \Omega = 2.4\ A$

d) If the other corner also had three 15 Ω resistors, what would be the equivalent resistance for the whole circuit?

The two parallel branches would be in series

$(15^{-1} + 15^{-1} + 15^{-1}) + (15^{-1} + 15^{-1} + 15^{-1}) = 10\ \Omega.$

3. What percent of a floating ice cube (density= 918 kg/m^3) is below the surface of water (density= 1000kg/m^3)?



To answer this question, you have to realize that
there are two forces that equal each other here:
the weight of the ice cube and the buoyant force of water,
which equals g multiplied by the mass of water displaced (m_{sub}) by the ice
(related to V_{sub} in diagram)

a) Write the equation which relates the two forces just mentioned.

b) Then use the densities to substitute for each of the masses,

c) and then solve to find the ratio V_{sub} / V_{ice} , from which you can find the percent of submerged ice.

Buoyant force = weight
$F_b = F_w$
$m_{sub} * g = m_{ice} * g$, where m_{sub} = mass of water displaced by the ice.
$m_{sub} = m_{ice}.$
$\rho_{H2O} V_{sub} = \rho_{ice} V_{ice},$ where ρ = density
$V_{sub}/ V_{ice} = \rho_{ice}/\rho_{H2O}$
$= 918\ kg/m^3/(1000\ kg/m^3)$
$=0.918$