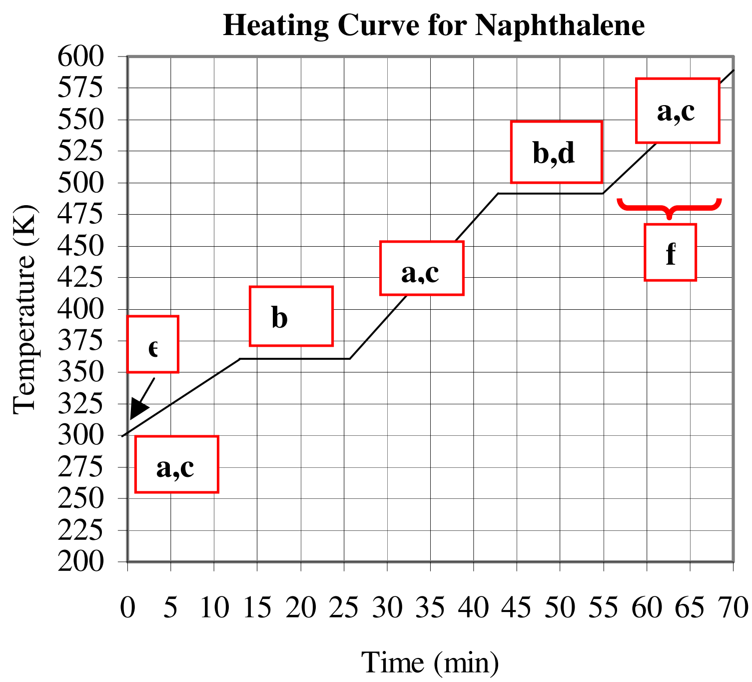
Gas Laws Practice Test

1.00 atm R = 0.0821	15.0 PSI R = 1.23	760 mmHg R = 62.36	760 Torr R = 62.36

1. On the heating curve for naphthalene:
a) write the letter "a" in all regions where potential energy (E_p) is essentially constant
b) write the letter "b" in all regions where kinetic energy (E_k) is constant
c) write the letter "c" in all regions where kinetic energy is increasing
d) write the letter "d" where naphthalene is boiling
e) write the letter "e" where E_k is the lowest
f) write the letter "f" where E_P is the highest

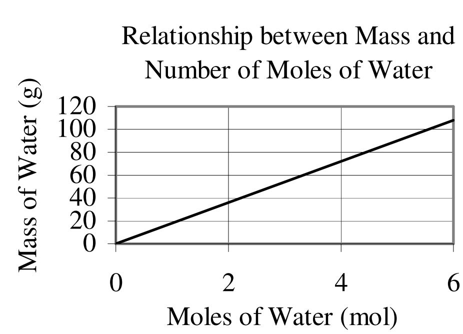


2. From the heating curve for naphthalene:
a) the freezing point of naphthalene is about **362K**
b) the melting point of naphthalene is about **362K**
c) the state of naphthalene at 445 K is **liquid**
d) the state of naphthalene at 277 ºC (550 K) is **gas**
e) at 800 K, naphthalene is a vapour — (T) or F
f) from 13 to 27 minutes, the kinetic energy is increasing — T or (F)
g) from 27 to 43 minutes, the potential energy of the particles is essentially constant — (T) or F
h) from 43 to 55 minutes, the particles have only translational motion — T or (F)
i) from 27 to 43 minutes, the particles are moving significantly further apart — T or (F)
j) from 0 to 13 minutes, the particles are gaining significant potential energy — T or (F)
k) from 43 to 55 minutes, the particles are sublimating — T or (F)
l) this sample of naphthalene is very pure — (T) or F
m) at 400K the particles have both vibrational and rotational motion — (T) or F

3. Write the proportionality statement **and** mathematical equation for the relationship shown in the graph to the right:

proportionality statement: **m α n**

equation: $\frac{m_1}{n_1} = \frac{m_2}{n_2}$



4. What are the temperature and pressure values for:
a) STP: **0º (273 K)** and **101.3 kPa** (or 15.0 PSI or 760 mmHg or 1.00 atm)
b) SATP: **25ºC (298 K)** and **100.0 kPa**

5. A 2.0 L sample of helium gas is heated at constant pressure, from 50ºC to 100ºC. The new volume of the gas at 100ºC is:

   a) 1.7 L   b) 2.0 L   (c) 2.3 L   d) 4.0 L

   don't forget to convert to Kelvins!

6. Compare the kinetic and potential energies of pure neon at 150 K and pure zinc at 700K.

- pure neon has lower kinetic energy because it has a lower temperature than zinc
- pure neon has higher potential energy because it is in the gas state while zinc is a liquid at 700 K (the melting point of zinc is 692.68K, from the Periodic Table)

7. The change of state when a solid becomes a gas is called: **sublimation**
8. The change of state when a gas becomes a liquid is called: **condensation**
9. True or False? "Gases expand to fill their container" is one of the statements of the KMT for gases.

- **False**, this is not one of the five statements of the KMT for gases (sneaky, huh? :)

10. A car tire purchased in the USA requires 32.5 PSI pressure. What is the equivalent pressure in kPa?

$$32.5 \text{ PSI} \times \frac{101.3 \text{ kPa}}{15.0 \text{ PSI}} = 219 \text{ kPa (3 sd)}$$

11. State Gay-Lussac's Law in words (be complete).

- the pressure of a gas varies directly with temperature (in Kelvins) when the number of moles and volume are held constant

12. 1.00 L of a Noble gas has a mass of 2.71 g at 3.00 atm and 0 ºC. What is the identity of the gas?

- you are only given one value for each volume, pressure and temperature, so this is a PV = nRT question

Givens:

P = 3.00 atm

V = 1.00 L

n = ?

R = 0.0821 (for pressure in atm)

T = 0 ºC + 273 = 273 K

$$PV = nRT$$

$$n = \frac{PV}{RT}$$

$$= \frac{3.00 \text{ atm} \times 1.00 \text{ L}}{0.0821 \times 273 \text{ K}}$$

$$= 0.13385 \text{ mol}$$

$$MM = \frac{m}{n}$$

$$= \frac{2.71 \text{ g}}{0.13385 \text{ mol}}$$

$$= 20.2 \text{ g/mol (3 sd)}$$

the gas is likely neon

13. What pressure (in mmHg) is exerted by 1.86×10^{21} molecules of NH_3 (g) in a 0.500 L container at 63ºC?

- you are only given one value for each volume, pressure and temperature, so this is a PV = nRT question

Givens:

P = ? (in mmHg)

V = 0.500 L

$$n = \frac{\#\text{molecules}}{6.02 \times 10^{23} \text{ molecules/mol}}$$

$$= \frac{1.86 \times 10^{21} \text{ molecules}}{6.02 \times 10^{23} \text{ molecules/mol}}$$

$$= 0.0030897 \text{ mol}$$

R = 62.36 (for pressure in mmHg)

T = 63 ºC + 273 = 336 K

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$= \frac{0.0030897 \text{ mol} \times 62.36 \times 336 \text{ K}}{0.500 \text{ L}}$$

$$= 129 \text{ mmHg pressure exerted}$$

14. Mrs. Patterson has a sealed balloon full of air at 23.5ºC and 99.5 kPa. The balloon has a volume of 3.12 L. She puts the balloon into liquid nitrogen at –196ºC and 118 kPa. What is the volume of the air in the balloon when it is in the liquid nitrogen?

- you are given two values for temperature and pressure, so this is a $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$ problem

Givens:

$V_1 = 3.12$ L	$V_2 = ?$
$P_1 = 99.5$ kPa	$P_2 = 118$ kPa
n_1 = assume constant	n_2 = assume constant
$T_1 = 23.5$ ºC + 273 = 296.5 K	$T_2 = -196$ºC + 273 = 77 K

$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$ or $P_1V_1T_2 = P_2V_2T_1$ (n can be ignored)

$$V_2 = \frac{P_1V_1T_2}{P_2T_1}$$

$$= \frac{99.5 \text{ kPa} \times 3.12 \text{ L} \times 77 \text{ K}}{118 \text{ kPa} \times 296.5 \text{ K}}$$

$= 0.683$ L or 0.68 L (you can report either 2 or 3 sd)