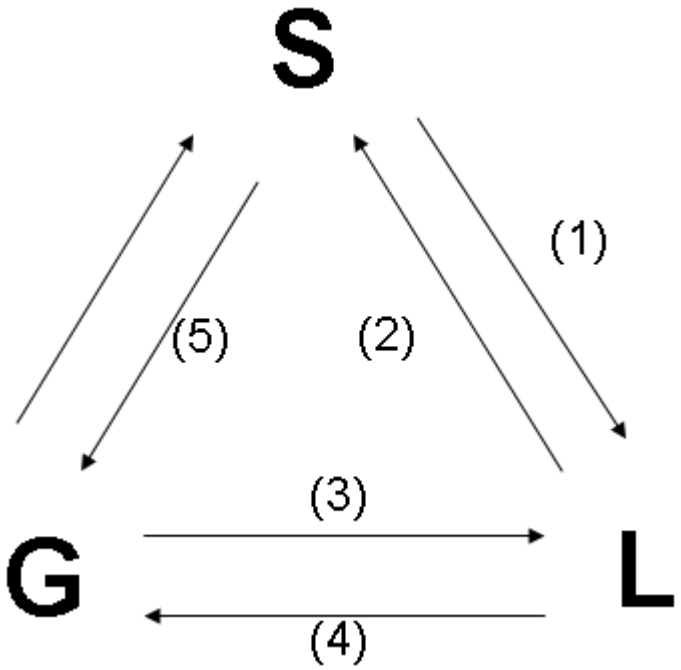
General Chemistry
Mr. MacGillivray
Test:
States of Matter

I. Label each of the 5 phase changes in the diagram below with the letter of the correct response. Not all of the letters get used.



a) Vaporization

b) Sublimation

c) Melting

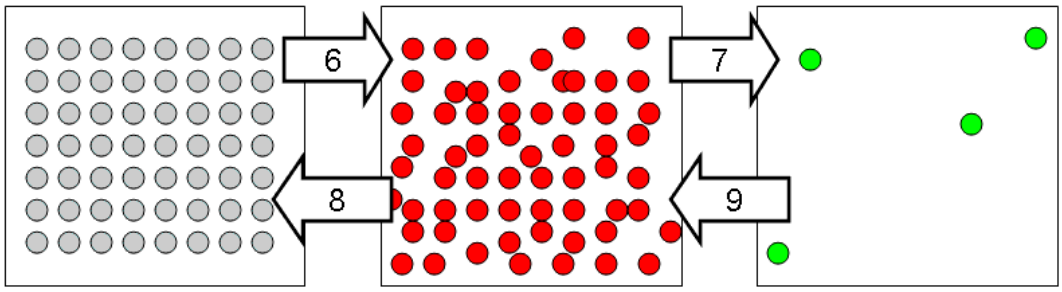
d) Freezing

e) Deposition

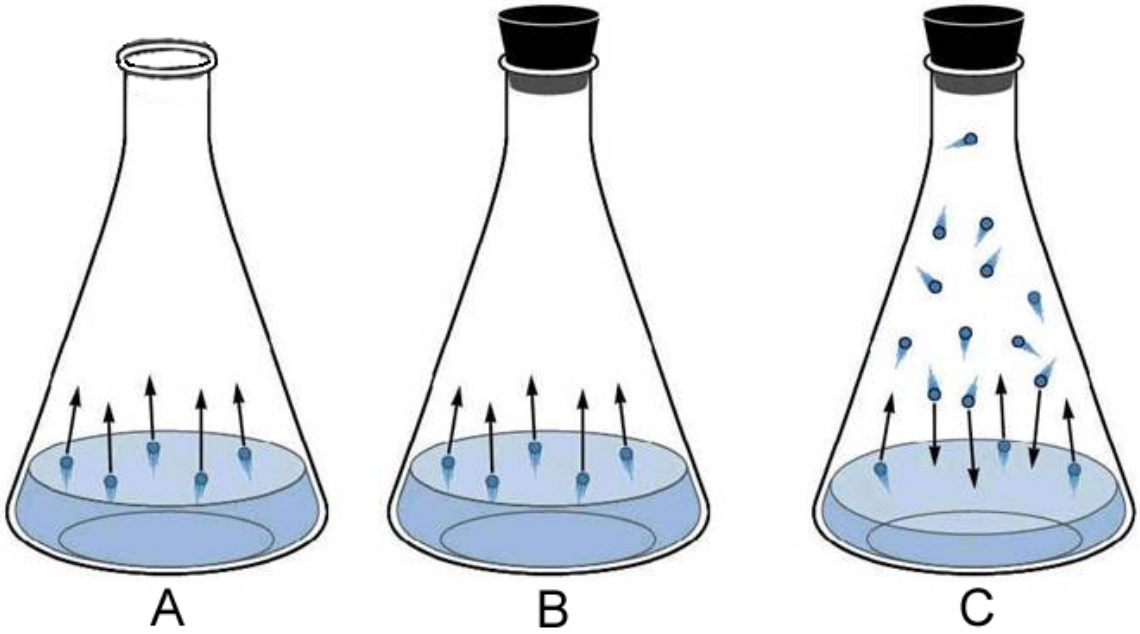
f) Condensation

II. Label each of the blanks below as either “energy required” or “energy released”.

A= ENERGY REQUIRED B= ENERGY RELEASED



III. The diagram below shows three different flasks. The substance in the flasks is H_2O. Match each description with the letter of the appropriate flask in the diagram.



10) Which of the flasks shows a liquid that has reached equilibrium with its vapor?

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12) Which of the pictures shows a flask in which the liquid WILL NOT reach equilibrium with its vapor?

IV. The atmospheric pressure in Denver, Colorado on a particular day is 658 mm Hg. The table below lists the vapor pressure of water at various temperatures. Use this table to determine the approximate temperature at which water will boil in Denver, CO on this day.

Vapor Pressure of Water (mm Hg)																	
T(ºC)	**P**		**T(ºC)**	**P**		**T(ºC)**	**P**		**T(ºC)**	**P**		**T(ºC)**	**P**		**T(ºC)**	**P**
-10	2.1		11	9.8		32	35.7		53	107.2		74	277.2		95	633.9
-9	2.3		12	10.5		33	37.7		54	112.5		75	289.1		96	657.6
-8	2.5		13	11.2		34	39.9		55	118.0		76	301.4		97	682.1
-7	2.7		14	12.0		35	42.2		56	123.8		77	314.1		98	707.3
-6	2.9		15	12.8		36	44.6		57	129.8		78	327.3		99	733.2
-5	3.2		16	13.6		37	47.1		58	136.1		79	341.0		100	760.0
-4	3.4		17	14.5		38	49.7		59	142.6		80	355.1			
-3	3.7		18	15.5		39	52.4		60	149.4		81	369.7		102	815.9
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-1	4.3		20	17.5		41	58.3		62	163.8		83	400.6		104	875.1
0	4.6		21	18.7		42	61.5		63	171.4		84	416.8			
1	4.9		22	19.8		43	64.8		64	179.3		85	433.6		106	937.9
2	5.3		23	21.1		44	68.3		65	187.5		86	450.9			
3	5.7		24	22.4		45	71.9		66	196.1		87	468.7		108	1004
4	6.1		25	23.8		46	75.7		67	205.0		88	487.1			
5	6.5		26	25.2		47	79.6		68	214.2		89	506.1		110	1075
6	7.0		27	26.7		48	83.7		69	223.7		90	525.8			
7	7.5		28	28.3		49	88.0		70	233.7		91	546.1		112	1149
8	8.0		29	30.0		50	92.5		71	243.9		92	567.0			
9	8.6		30	31.8		51	97.2		72	254.6		93	588.6		114	1227
10	9.2		31	33.7		52	102.1		73	265.7		94	610.9			

13) a) 100 °C b) 105 °C c) 96 °C d) 106 °C e) 0 °C

14. Order the intermolecular forces (dipole-dipole, London dispersion, and hydrogen bonding) from <u>weakest</u> to <u>strongest</u>.

[A] dipole-dipole, London dispersion, hydrogen bonding
[B] London dispersion, dipole-dipole, hydrogen bonding
[C] hydrogen bonding, dipole-dipole, London dispersion
[D] London dispersion, hydrogen bonding, dipole-dipole

15. The intermolecular forces called hydrogen bonding will **<u>not</u>** exist between molecules of
[A] NH_3 [B] H_2 [C] HF [D] H_2O [E] any of these

16. At 1 atm of pressure and a temperature of 0°C, which phase(s) of H_2O can exist?
[A] ice and water vapor [B] water only [C] ice only [D] ice and water
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17. The normal freezing point of water is
[A] 0°F [B] 32°C [C] 273 K [D] 373°C [E] none of these

18. The normal boiling point of water is
[A] 373 K [B] 0°F [C] 32°F [D] 273 K [E] none of these

19. Calculate the quantity of energy required to change 3.00 mol of liquid water to steam at 100°C. The molar heat of vaporization of water is 40.6 kJ/mol.

[A] 300 kJ [B] 13.5 kJ [C] 122 kJ [D] 40.6 kJ [E] none of these

20. Calculate the quantity of energy required to change 26.5 g of liquid water to steam at 100°C. The molar heat of vaporization of water is 40.6 kJ/mol.
[A] 1.08×10^3 kJ [B] 59.8 kJ [C] 1.53 kJ [D] 27.6 kJ [E] none of these

21. The specific heat capacity of liquid water is 4.18 J/g°C. Calculate the quantity of energy required to heat 10.0 g of water from 26.5°C to 83.7°C.
[A] 572 J [B] 837 J [C] 239 J [D] 2.39×10^3 J [E] none of these

22. The molar heat of fusion of water is 6.02 kJ/mol. Calculate the energy required to melt 46.8g of water.
[A] 6.02 kJ [B] 7.77 kJ [C] 282 kJ [D] 2.32 kJ [E] none of these

23. The freezing point of helium is approximately −270°C. The freezing point of xenon is −112°C. Both of these are in the noble gas family. Which of the following statements is supported by these data?

[A] The London forces between the helium molecules are greater than the London forces between the xenon molecules.
[B] The London forces between the helium molecules are less than the London forces between the xenon molecules.
[C] As the molar mass of the noble gas increases, the freezing point decreases.
[D] Helium and xenon form highly polar molecules.
[E] none of these

24. Choose the state of water in which the water molecules are farthest apart on average.
[A] ice (solid) [B] steam (vapor) [C] all the same [D] liquid

25. The process of evaporation happens when which of the following occurs?
[A] A solid becomes a gas.
[B] A liquid becomes a solid.
[C] A solid becomes a liquid.
[D] A gas becomes a liquid.
[E] A liquid becomes a gas.

26. Which of the following processes must exist in equilibrium with the evaporation process when a measurement of vapor pressure is made?
[A] fusion [B] condensation [C] vaporization [D] boiling
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27. The vapor pressure for water at 100.0°C is
[A] 760 torr [B] More information is needed.
[C] 85 torr [D] 1 torr [E] 175 torr

28. As the temperature of a liquid increases, the vapor pressure of the liquid generally
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29. The boiling temperature of water is always 100°C. [A] True [B] False

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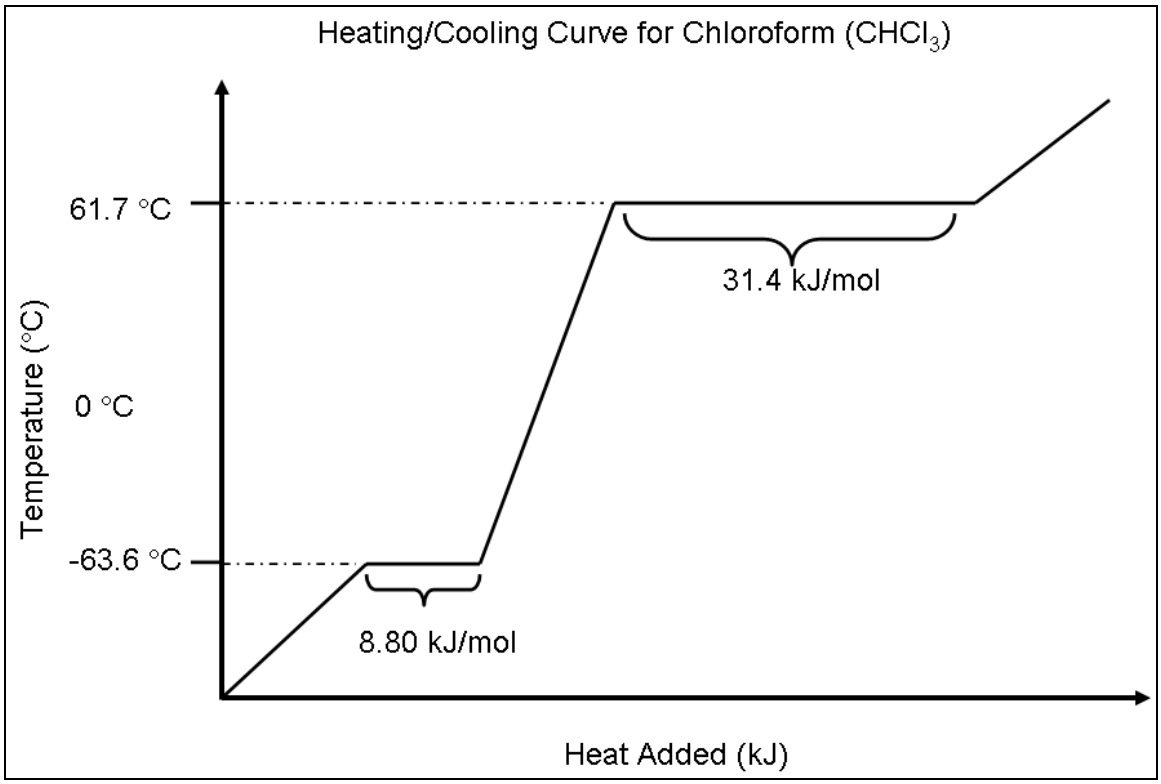
33. The heating/cooling curve of chloroform is shown below. What is the heat of fusion of chloroform?
[A] -63.6 °C [B] 61.7 °C
[C] 8.80 kJ/mol [D] 31.4 kJ/mol [E] none of these



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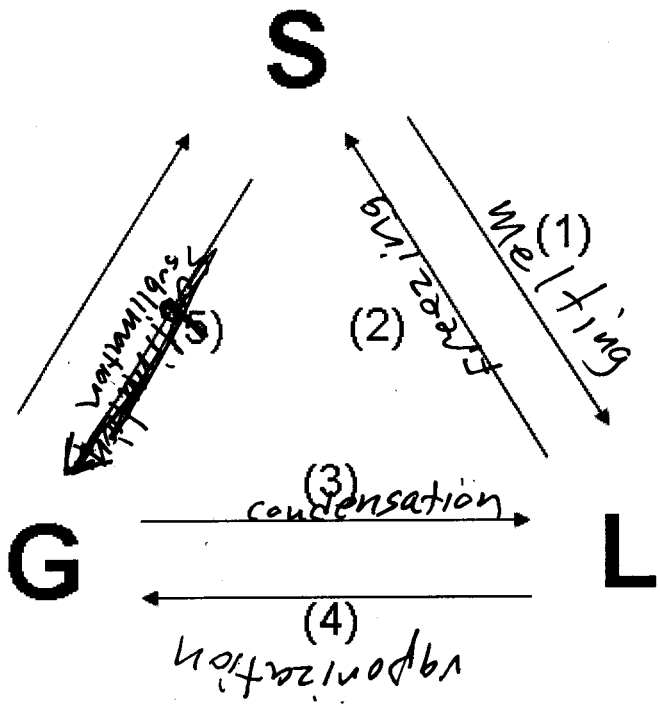

a) Vaporization 4
b) Sublimation 5
c) Melting 1
d) Freezing 2
e) Deposition
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II. Label each of the blanks below as either "energy required" or "energy released".

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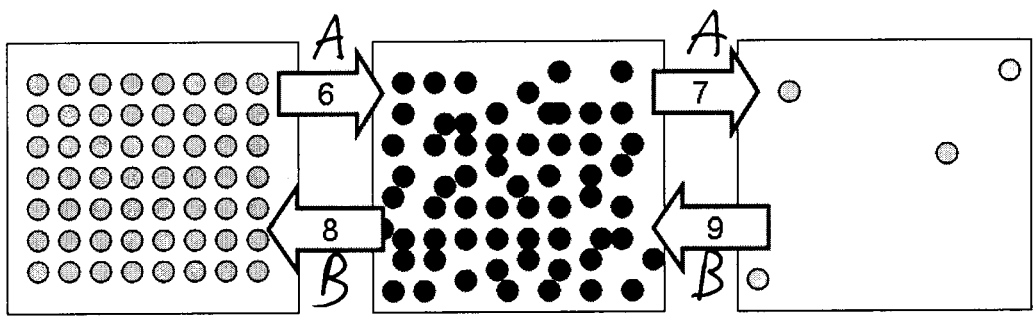

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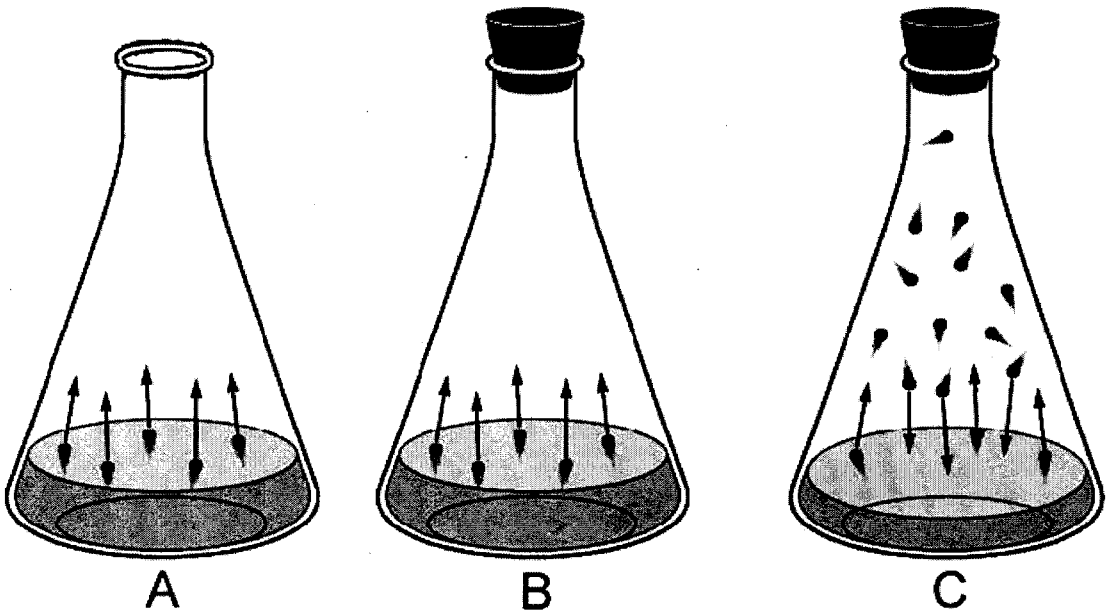

10) Which of the flasks shows a liquid that has reached equilibrium with its vapor? C

11) Which of the flasks depicts a liquid that will eventually reach equilibrium with its vapor? B

12) Which of the pictures shows a flask in which the liquid WILL NOT reach equilibrium with its vapor? A

IV. The atmospheric pressure in Denver, Colorado on a particular day is 658 mm Hg. The table below lists the vapor pressure of water at various temperatures. Use this table to determine the approximate temperature at which water will boil in Denver, CO on this day.

Vapor Pressure of Water (mm Hg)

T(°C)	P	T(°C)	P	T(°C)	P	T(°C)	P	T(°C)	P	T(°C)	P
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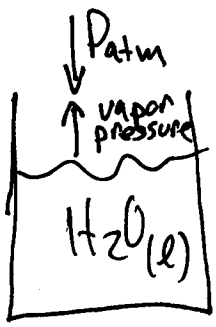

water boils when v. P. of water = Patm pushing down on water.
water will reach a vapor pressure of 658 mm Hg at 96 °C

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[A] dipole-dipole, London dispersion, hydrogen bonding
[B] London dispersion, dipole-dipole, hydrogen bonding
[C] hydrogen bonding, dipole-dipole, London dispersion
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15. The intermolecular forces called hydrogen bonding will **not** exist between molecules of
[A] NH_3 [B] H_2 [C] HF [D] H_2O [E] any of these

no unshared pairs

16. At 1 atm of pressure and a temperature of 0°C, which phase(s) of H_2O can exist?
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17. The normal freezing point of water is
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= 0°C

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19. Calculate the quantity of energy required to change 3.00 mol of liquid water to steam at 100°C. The molar heat of vaporization of water is 40.6 kJ/mol.

$3\,mol \times \frac{40.6\,kJ}{mol}$

[A] 300 kJ [B] 13.5 kJ [C] 122 kJ [D] 40.6 kJ [E] none of these

$= 121.8\,kJ$

$25.6\,g \times \frac{1\,mol}{18} = 1.42\,mol$

20. Calculate the quantity of energy required to change 26.5 g of liquid water to steam at 100°C. The molar heat of vaporization of water is 40.6 kJ/mol.
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21. The specific heat capacity of liquid water is 4.18 J/g°C. Calculate the quantity of energy required to heat 10.0 g of water ~~from 26.5°C~~ to 83.7°C.
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$q = mC\Delta T = (10)(4.18)(83.7 - 26.5) = 2391\,J$

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$46.8\,g \times \frac{1\,mol}{18\,g} = 2.6\,m$

$2.6\,mol \times \frac{6.02\,kJ}{1\,mol} = 15.7\,k$

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gas
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water Boils when $P_{atm} = V.P.$

27. The vapor pressure for water at 100.0°C is
[A] 760 torr [B] More information is needed.
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since 100°C is the normal B.P., the P_{atm} must be 760

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Only at P=1atm (standard pressure)

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