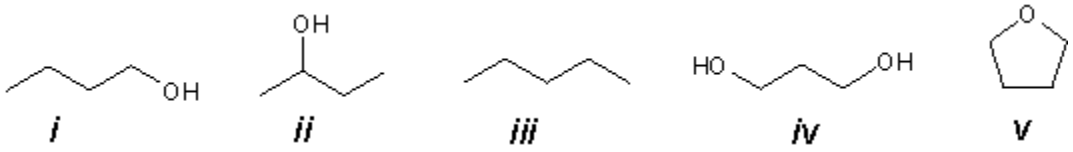
____ 25. Increased intermolecular forces (IMF) lead to:

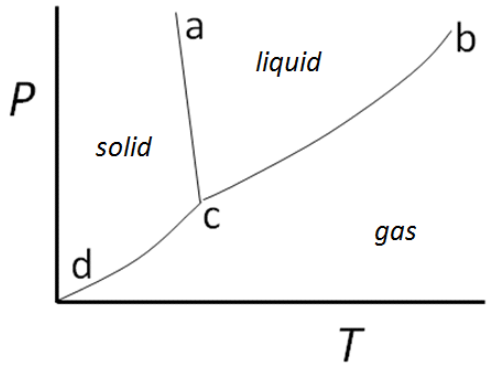
a. Increased melting point.
b. Decreased boiling point.
c. Increased molecular weight.
d. Decreased viscosity.
e. Increased vapour pressure.

____ 26. Place the following molecules in order from highest to lowest viscosity.



a. iii > v > ii > i > iv
b. iv > i > ii > v > iii
c. v > iv > ii > i > iii
d. iv > i > iii > ii > v
e. i > ii > iv > iii > v

____ 27. Indicate the <u>incorrect</u> statement about this phase diagram:



a. Along the line from **c** to **d**, solids can melt without evaporating.

b. At the point **c** all three phases can coexist.

c. The negative slope of the line from **a** to **c** indicates that the material expands upon freezing.

d. Along the line from **c** to **b**, the liquid and vapour phases are in equilibrium.

e. Point **b** indicates the critical point.

28. Indicate the <u>incorrect</u> statement concerning the properties of matter at the critical point:

a. As temperature and pressure increases toward the critical point, the gas-liquid interface becomes more clearly distinguishable.

b. At the critical point, the solid phase of the material is not present.

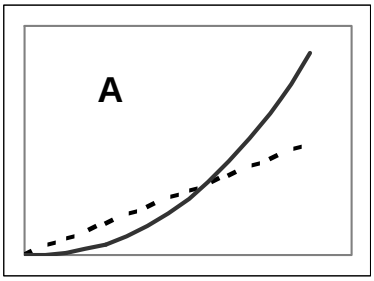
c. The viscosity of supercritical fluids is between that of the corresponding gas and liquid.

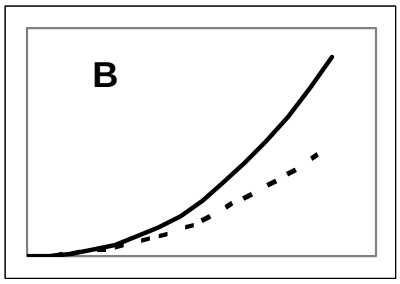
d. The surface tension of the liquid becomes zero at the critical point.

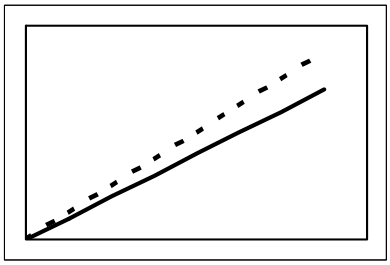
e. The densities of liquid and vapour phase become identical at the critical point.

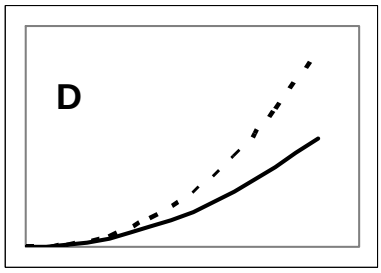
1. Which of the following graphs would **best represent the vapour pressure (y-axis) versus temperature (x-axis**) plot for both ammonia (NH_3; boiling point = -33ºC) and Water (H_2O; boiling point = 100ºC).

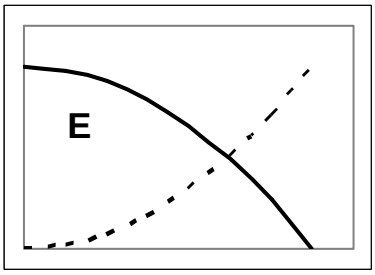
(------ Ammonia; ——— Water)











____ 29. Indicate the <u>incorrect</u> statement(s):

i. The triple point of water is the point in the phase diagram where ice can melt or sublime without input of energy.

ii. Critical point drying avoids phase boundaries and hence prevents structural collapse of fragile materials from capillary forces.

iii. IMFs affect phase transitions (solid to liquid; liquid to gas), as well as properties within condensed phases (solid, liquid) such as hardness and viscosity, but not typically properties in the vapour phase.

a. ii, iii
b. i, ii
c. ii
d. iii
e. i

1. Arrange the following compounds

HF, CO_2, HCl, Ne and H_2O

in order of **decreasing** intermolecular forces (from strongest forces to weakest).

(A) HCl > H_2O > HF > CO_2 > Ne

(B) H_2O > HCl > HF > CO_2 > Ne

(C) H_2O > HF > HCl > Ne > CO_2

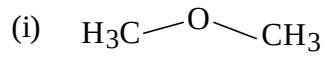
(D) HF > H_2O > HCl > Ne > CO_2

(E) H_2O > HF > HCl > CO_2 > Ne

2. The **greatest change in energy** for a substance is seen with which of the following processes?

(A) vaporization
(B) condensation
(C) fusion
(D) sublimation
(E) melting

3. Each of the following compounds is a liquid at –50 °C.

(i)  (ii) $CH_3CH_2CH_3$ (iii) $HOCH_2CH_2OH$

Place these liquids in order of **increasing vapour pressure** at a given temperature (from lowest vapour pressure to highest).

(A) i < ii < iii
(B) iii < ii < i
(C) i < iii < ii
(D) ii < i < iii
(E) iii < i < ii

4. Two unlabelled phase diagrams are shown below. Which one of the following statements is **FALSE** regarding the following pressure *versus* temperature phase diagrams?

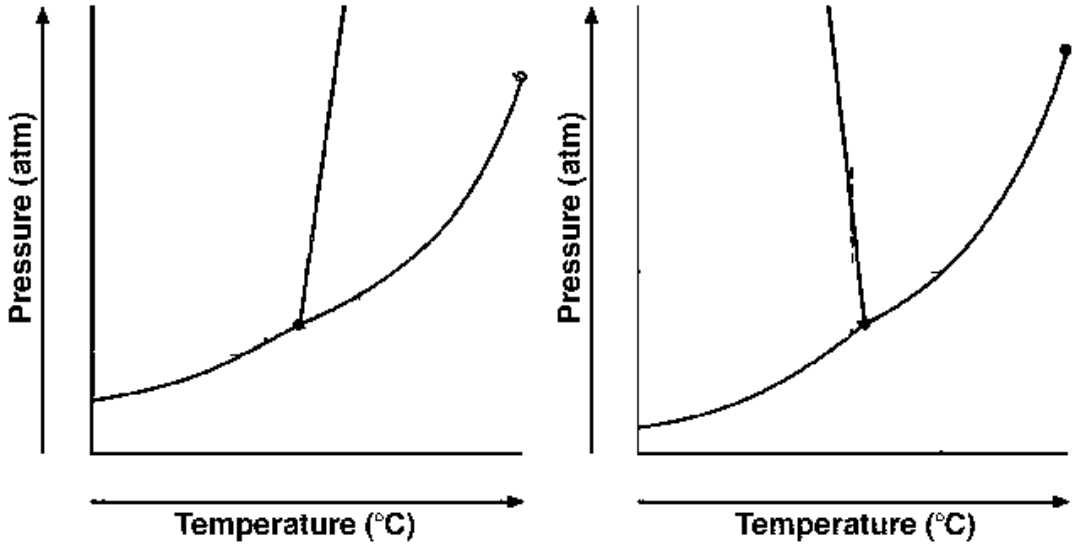
(A) The triple point temperature is always lower than the critical point temperature.

(B) There can be no liquid-gas phase equilibrium at pressures above the critical point pressure.

(C) Below the triple point pressure, decreasing pressure always decreases the sublimation temperature.

(D) Above the triple point pressure, increasing pressure always increases the melting temperature.

(E) Below the triple point pressure, cooling a gas sufficiently may result in deposition of the gas.



1. Find the **FALSE** statement regarding the phase diagram shown below.

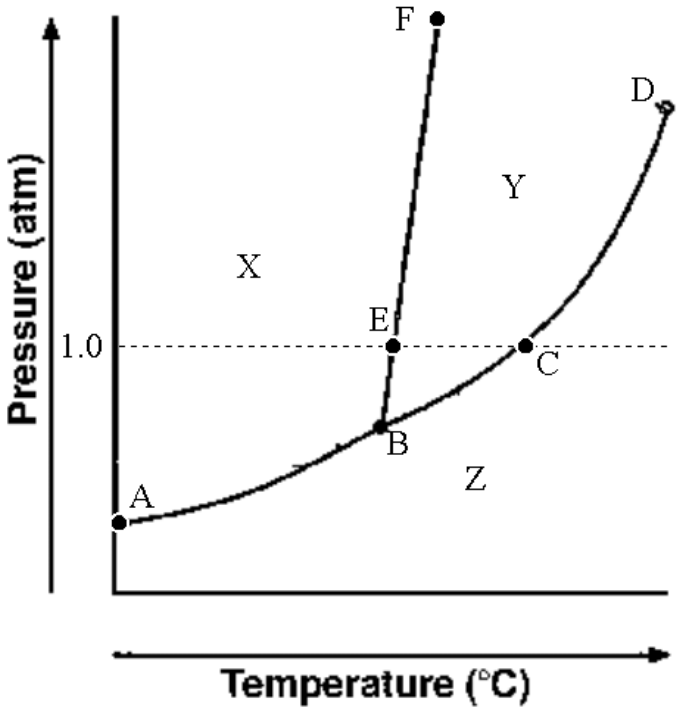
(A) Along curve A-B, the solid and gaseous phases are in equilibrium.

(B) Point B is a triple point; the only point at which the solid, liquid and gas phases are all in equilibrium.

(C) In region Y, the substance is a liquid.

(D) Point D is the critical point, beyond which no liquid-gas phase transitions are observed.

(E) Point E is the normal boiling point of the substance.



2. The liquids H_2O and CH_3CH_2OH are **miscible because of the**:

(A) strong intermolecular forces between H_2O molecules.

(B) strong intermolecular forces between CH_3CH_2OH molecules.

(C) hydrogen bonding between H_2O and CH_3CH_2OH molecules.

(D) weak dipole of the H_2O molecules.

(E) large difference in molar masses of H_2O and CH_3CH_2OH.

3. In pure samples of the following compounds, which ones exhibit **hydrogen bonding**?

(i) CH_2F_2

(ii) NH_2OH

(iii) HBr

(iv) CH_3OCH_3

(v) CH_3CH_2OH

(A) i, ii, iv

(B) i, iii

(C) iv, v

(D) ii, v

(E) iii, iv

4. Select the **TRUE** statements regarding physical properties and intermolecular forces:

(i) The boiling point of propanal is higher than that of propanol.

(ii) The vapour pressure of hexane is higher than that of hexanol.

(iii) Propanol has a higher boiling point than propane because of hydrogen bonding.

(iv) The dominant intermolecular force in methanol is the London dispersion force.

(v) Methyl benzoate can participate in hydrogen bonding with alcohols.

(A) i, iii, iv

(B) ii, iii, v

(C) i, iv

(D) ii, iv

(E) ii, iii