MULTIPLE CHOICE QUESTIONS
(2 marks each)

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1. Aluminum reacts with oxygen to produce aluminum oxide which can be used as an adsorbent, desiccant, or catalyst for organic reactions.

$$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$$

A mixture of 82.49 g of aluminum and 117.65 g of oxygen is allowed to react. Identify the limiting reactant and determine the mass of the excess reactant present in the vessel when the reaction is complete.

a) Oxygen is the limiting reactant; 19.81 g of aluminum remain.
b) Oxygen is the limiting reactant; 35.16 g of aluminum remain.
c) Aluminum is the limiting reactant; 16.70 g of oxygen remain.
d) Aluminum is the limiting reactant; 35.16 g of oxygen remain.
e) Aluminum is the limiting reactant; 44.24 g of oxygen remain.

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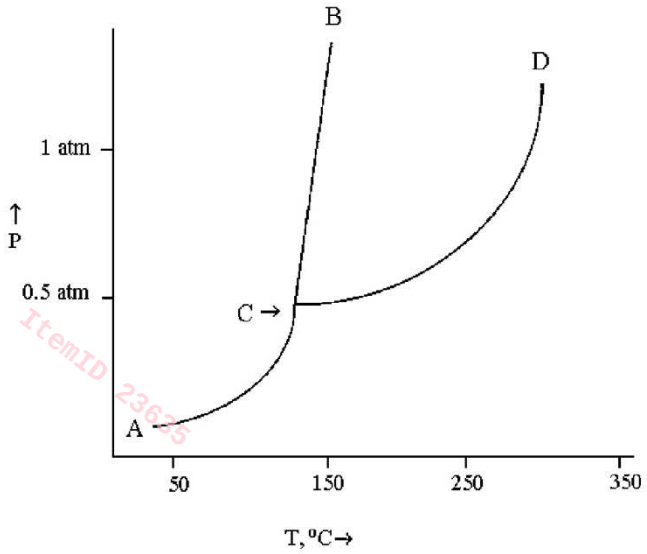
2. Which of the following statements is ***false*** for the phase diagram shown below?



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a) According to the phase diagram the liquid phase is less dense than the solid phase.
b) Melting occurs along the CB line.
c) The normal boiling point of the liquid is approximately 300 °C.
d) At 0.25 atm the boiling point of the substance is approximately 75 °C.
e) Above 2 atm and 350 °C the substance will be a supercritical fluid.

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3. According to the Bohr theory of the hydrogen atom, the minimum energy (in J) needed to ionize a hydrogen atom from the $n = 2$ state is?

a) 2.18×10^{-18} J
b) 1.64×10^{-18} J
c) 5.45×10^{-19} J
d) 3.03×10^{-19} J
e) *None of the above*

4. Which of the following statements is ***correct***?

a) This set of quantum numbers appropriately represent an electron in a 3*d* orbital: $n = 3$, $l = 3$, $m_l = +2$.
b) The energy of an electron in the hydrogen atom is determined by the principal quantum number alone.
c) The energy of an electron in a multi-electron atom is determined by the angular momentum quantum number alone.
d) The position and momentum of an electron within an atom can be described simultaneously with a high degree of accuracy.
e) The 1s orbital has two radial nodes.

5. An unknown liquid is vaporized in a 273-mL flask by immersion in a water bath at 99°C. The barometric pressure is 753 torr. If the mass of the vapor retained in the flask is 1.362 g, what is its molar mass?

a) 20.4 g/mol
b) 40.9 g/mol
c) 112 g/mol
d) 154 g/mol
e) 184 g/mol

6. The strongest intermolecular interactions between hydrogen sulfide (H_2S) molecules arise from

a) dipole-dipole forces
b) London dispersion forces
c) hydrogen bonding
d) ion-dipole interactions
e) ionic bonds

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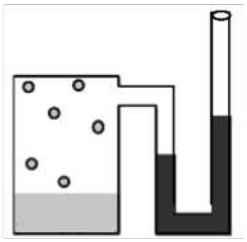
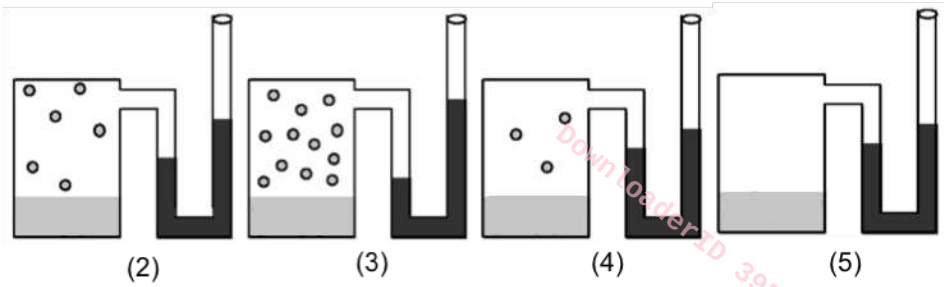
7. If figure (1) represents the vapour pressure of water at 25°C, which figure represents the vapour pressure of water at 45°C?



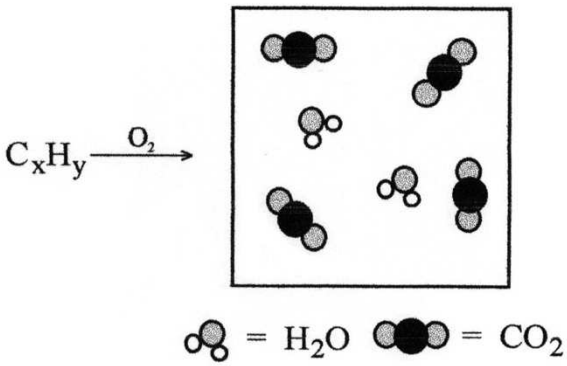
(1)



(2) (3) (4) (5)

a) Figure (2)
b) Figure (3)
c) Figure (4)
d) Figure (5)
e) Need more information.

8. A hydrocarbon of unknown formula C_xH_y was submitted to combustion analysis. The results are shown graphically to the right. What is the empirical formula of the hydrocarbon?



a) CH
b) C_2H
c) C_2H_4
d) C_2H_5
e) C_6H_{10}

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9. Considering the behaviour of ideal gases and the postulates of the kinetic-molecular theory, which of the following statements is ***false***?

   a) The average kinetic energy of gas molecules is proportional to the absolute temperature.
   b) A gas consists of tiny particles moving in random straight line motion.
   c) The volume occupied by the gas molecules is negligible compared to the volume of the gas itself.
   d) In a sample of nitrogen gas at 500K, all molecules have a higher speed than all molecules in a nitrogen gas sample at 300K.
   e) Collisions of gas particles are elastic and as a result total kinetic energy of the gas is constant.

10. Two aqueous solutions are prepared: 2.0 M $Cu(NO_3)_2$ and 2.0 M $(NH_4)_3PO_4$. Which of the following statements is ***true***? Assume complete dissociation of ions.

    a) The $Cu(NO_3)_2$ solution has a higher vapor pressure and lower osmotic pressure than the $(NH_4)_3PO_4$ solution.
    b) The $Cu(NO_3)_2$ solution has a higher vapor pressure and higher osmotic pressure than the $(NH_4)_3PO_4$ solution.
    c) The $Cu(NO_3)_2$ solution has a lower vapor pressure and lower osmotic pressure than the $(NH_4)_3PO_4$ solution.
    d) The $Cu(NO_3)_2$ solution has a lower vapor pressure and higher osmotic pressure than the $(NH_4)_3PO_4$ solution.
    e) None of the above statements are true.

11. At what temperature in kelvin is the average speed of helium atoms equal to that of oxygen molecules (O_2) at 300 K?

    a) 75 K
    b) 292 K
    c) 106 K
    d) 37.5 K
    e) 2400 K

12. The mole fraction of potassium nitrate (KNO_3) in an aqueous solution is 0.0194. The solution's density is 1.0627 g/mL. Calculate the molarity of the solution.

    a) 0.0194 *M*
    b) 0.981 *M*
    c) 1.05 *M*
    d) 1.96 *M*
    e) 19.4 *M*

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