MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Gaseous mixtures _________.
   A) are all homogeneous
   B) are all heterogeneous
   C) can only contain molecules
   D) can only contain isolated atoms
   E) must contain both isolated atoms and molecules

2) Which of the following equations shows an incorrect relationship between pressures given in terms of different units?
   A) 0.760 atm = 578 mm Hg
   B) 1.0 torr = 2.00 mm Hg
   C) 152 mm Hg = 2.03 × 10^4 Pa
   D) 1.20 atm = 122 kPa
   E) 1.00 atm = 760 torr

3) How high a column of methanol (d = 0.79 g/mL) would be supported by a pressure that supports a 713 mm column of mercury (d = 13.6 g/mL)?
   A) 9.7 × 10^3 mm
   B) 713 mm
   C) 17 mm
   D) 41 mm
   E) 1.2 × 10^4 mm

4) The first person to investigate the relationship between the pressure of a gas and its volume was
   A) Lord Kelvin
   B) Joseph Louis Gay-Lussac
   C) Robert Boyle
   D) Jacques Charles
   E) Amadeo Avogadro

5) "Isothermal" means _________.
   A) at constant temperature
   B) at variable temperature and pressure conditions
   C) at constant pressure
   D) at ideal temperature and pressure conditions
   E) that ΔH_{rxn} = 0

6) The volume of an ideal gas is zero at _________.
   A) -363 K
   B) 0 °C
   C) -45 °F
   D) -273 K
   E) -273 °C

7) The molar volume of a gas at STP is ________ L.
   A) 14.7
   B) 1.00
   C) 22.4
   D) 62.36
   E) 0.08206
8) Of the following, only __________ is impossible for an ideal gas.

A) \( \frac{V_1}{V_2} = \frac{T_1}{T_2} = 0 \)
B) \( V_1T_1 = V_2T_2 \)
C) \( \frac{V_1}{V_2} = \frac{T_1}{T_2} \)
D) \( V_2 = \frac{T_2}{T_1}V_1 \)
E) \( \frac{V_1}{T_1} = \frac{V_2}{T_2} \)

9) How many moles of gas are there in a 45.0 L container at 25.0 °C and 500.0 mm Hg?

A) 18.4  B) 207  C) 6.11  D) 0.630  E) 1.21

10) The reaction of 7.75 kg of Sodiumbicarbonate with excess hydrochloric acid at 25.0 °C and 1.50 atm. will produce __________ L of CO\(_2\) ?

A) 1.50 x 10\(^3\)  B) 8.70 x 10\(^2\)  C) 1.82 x 10\(^3\)  D) 2.85 x 10\(^4\)  E) 1.82 x 10\(^4\)

11) The volume of a sample of gas (2.49 g) was 752 mL at 1.98 atm and 62 °C. The gas is __________.

A) SO\(_2\)  B) NO\(_2\)  C) NH\(_3\)  D) Ne  E) SO\(_3\)

12) 10.0 grams of argon and 20.0 grams of neon are placed in a 1200.0 ml container at 25.0 °C. The partial pressure of neon is __________ atm.

A) 8.70  B) 0.700  C) 5.60  D) 3.40  E) 20.4

13) Of the following gases, __________ will have the greatest rate of effusion at a given temperature.

A) CH\(_4\)  B) HCl  C) NH\(_3\)  D) Ar  E) HBr

14) A real gas will behave most like an ideal gas under conditions of __________.

A) high temperature and low pressure  B) low temperature and high pressure  C) STP  D) low temperature and low pressure  E) high temperature and high pressure

15) The van der Waals equation for real gases recognizes that __________.

A) gas particles have non-zero volumes and interact with each other  B) the molecular attractions between particles of gas decreases the pressure exerted by the gas  C) the non-zero volumes of gas particles effectively decrease the amount of "empty space" between them  D) molar volumes of gases of different types are different  E) all of the above statements are true

16) Which one of the following exhibits dipole-dipole attraction between molecules?

A) Br\(_2\)  B) PH\(_3\)  C) CO\(_2\)  D) C\(_{10}\)H\(_{22}\)  E) CCl\(_4\)
17) Which of the following is **not** part of the kinetic-molecular theory?
   A) Gases consist of molecules in continuous, random motion.
   B) Collisions between gas molecules do not result in the loss of energy.
   C) Attractive and repulsive forces between gas molecules are negligible.
   D) Atoms are neither created nor destroyed by ordinary chemical reactions.
   E) The volume occupied by all of the gas molecules in a container is negligible compared to the volume of the container.

18) Together, liquids and solids constitute ________ phases of matter.
   A) the compressible
   B) all of the
   C) the fluid
   D) the disordered
   E) the condensed

19) The strongest interparticle attractions exist between particles of a ________ and the weakest interparticle attractions exist between particles of a ________.
   A) liquid, solid
   B) solid, liquid
   C) liquid, gas
   D) gas, solid
   E) solid, gas

20) The predominant intermolecular force in (CH₃)₂NH is ________.
    A) ion-dipole forces
    B) dipole-dipole forces
    C) London dispersion forces
    D) hydrogen bonding
    E) ionic bonding

21) Hydrogen bonding is a special case of ________.
    A) ion-ion interactions
    B) London-dispersion forces
    C) ion-dipole attraction
    D) dipole-dipole attractions
    E) none of the above

22) Of the following substances, only ________ has London dispersion forces as its only intermolecular force.
    A) HCl  B) NH₃  C) CH₄  D) CH₃OH  E) H₂S

23) Of the following substances, ________ has the highest boiling point.
    A) F₂  B) HOCH₂CH₂OH  C) C₂H₆  D) CH₃CH₂OH  E) N₂
24) Which of the following molecules has hydrogen bonding as its only intermolecular force?
   A) NH₃
   B) C₃H₇OH
   C) HOCH₂CH₂OH
   D) H₂O
   E) None, all of the above exhibit dispersion forces.

25) ________ is the energy required to expand the surface area of a liquid by a unit amount of area.
   A) Capillary action
   B) Volatility
   C) Surface tension
   D) Meniscus
   E) Viscosity

26) Which statements about viscosity are true?
   (i) Viscosity increases as temperature decreases.
   (ii) Viscosity increases as molecular weight increases.
   (iii) Viscosity increases as intermolecular forces increase.
   A) (i) only
   B) (ii) and (iii)
   C) (i) and (iii)
   D) none
   E) all

27) The shape of a liquid’s meniscus is determined by ________.
   A) the type of material the container is made of
   B) the relative magnitudes of cohesive forces in the liquid and adhesive forces between the liquid and its container
   C) the amount of hydrogen bonding in the liquid
   D) the viscosity of the liquid
   E) the volume of the liquid