1 Which group of matters the particles are IONS?

A Polystyrene, Sulphur, Grafite
B Zink, Mercury, Sodium chloride
C Water, Ethanol, Benzene
D Argon, Helium, Diamond

2 Which particles are NOT bonded by secondary forces?

A Water molecules H_2O in ice.
B Helium atoms He in gaseous helium.
C Nitrogen and oxygen atoms in NO_3^- ions.
D Molecules of $CH_2{=}CH_2$.

3 What is the nature of particles in sulphur?

A S atoms.
B S_2 molecules.
C Sulphide ions S^{2-}.
D S_8 molecules.

4 Which of the following is NOT a primary bond?

A Hydrogen bond
B Elektrovalent bond
C Covalent bond
D Metallic bond

5 From state of matter point of view, what is the feature that make the difference in solid, liquid, and gaseous states of water?

A Mass of the particles.
B Inter-particle distance.
C Density of the particles.
D The strength of the inter-particle forces.

6 In a 0.5 L closed container, 0.6 g of nitrogen gas was sealed. What is the plausible figure to represent the ratio between the total volume of nitrogen molecules to the volume of the container.

A 1:1
B 1:10
C 1:100
D 1:10 000

7 One mole of each of the following matters are contained in identical containers. Which container is the heaviest?

A Chlorine gas container
B Hydrogen gas container
C Nitrogen gas container
D Helium gas container

8 A gas is quoted in mass (or weight). Which of the parameter of the gas that you firstly need in order to estimate its pressure?

A Temperature
B Molar mass
C Volume
D Universal gas constant

9 For an amount of gas at a constant temperature, data on the variation of pressure P and volume V were obtained. If the data were plot as PV versus V what would you expect the characteristic of the plot?

A A straight line of positive gradient passing through the origin.
B A straight line of negative gradient passing through the origin.
C A straight line parallel to the horizontal axis.
D A straight line of positive gradient and positive intercept (on vertical axis).

10 Which of these properties of gas is not a parameter in the gas state equation?

A Colour
B Molar mass
C Volume
D Pressure

11 What is the kinetic energy of 1 mol of a gas in 1 L volume under 1 atm pressure?

A 0.0152 J
B 0.15 J
C 1.5 J
D 152 J

12 In every collision between any two particles in an ideal gas,

A Activation energy is achieved.
B The energy of the particles before and after the collision are the same.
C The velocity of the particles after the collision is lower.
D Some of the energy of the particles before the collision is converted into heat after the collision which gives rise to the temperature of the gas.

13 What did van der Waals say about the pressure of a real gas in comparison if the gas were ideal?

A The pressure of a real gas is not affected by the interaction among particles of the gas.
B The pressure of a real gas is dependant only on the energy transfer in the collision of the particle with the wall of the vessel.
C The pressure of a real gas is lower than the ideal gas due to the interaction among particles of the gas.
D The pressure of a real gas is proportional to the interaction forces among the particles of the gas.

14 Which of the following is NOT an expression or a statement that formulate the Dalton's Law of partial pressure of mixing gases?

A $P = P_A + P_B + P_X$, when gases A, B, and X are mixed.
B The total pressure of mixture of gases A, B and X is the sum of the individual partial pressure of the gases.
C $P_A = x_A P$ where x_A is the mol fraction of gas A in a mixture, and P is the total pressure.
D The expression $P = P_A + P_B + P_X$, occurs when gases A, B, and X are miscible.

15 12 mol of CO gas under a pressure of 2900 kPa at 298 K was obseved to have a volume of 10 dm^3. Obviously this gas does not behave like an ideal gas. Why? [$R = 8.314$ $JKmol^{-1}$]

A The gas is under a very high pressure.
B The particle density is too high.
C There are too many particles of the gas to behave ideally.
D The data do not fit the PV = nRT relationship.

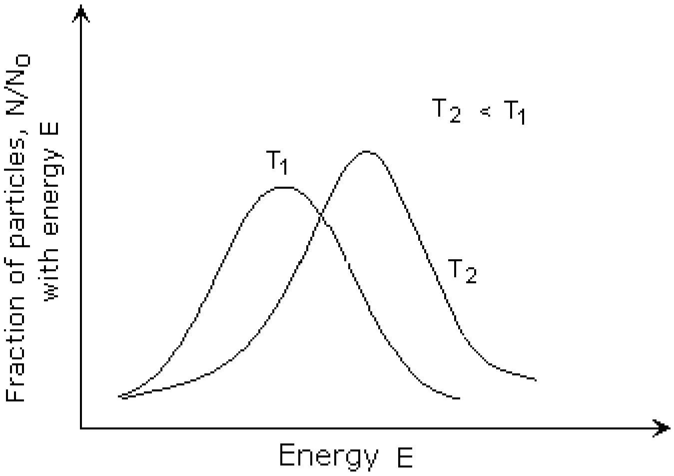

Figure 1

16 Figure 1 shows the distribution of energies of particles in a sample of a gas at two different temperature T_1 and T_2, where T_1 is higher than T_2. What is NOT right about the plot?

A The fraction of particles at peak energy for T_1 distribution should be lower than that of T_2 distribution.
B The peak energy for T_1 distribution should be at a higher temperature than that of T_2 distribution.
C The area under the curve for T_2 distribution should be loer than that of T_1 distribution.
D T_2 distribution curve should be broader than that of T_1 distribution.

17 n-Octane C_8H_{18} has a lower vapour pressure than n-hexane C_6H_{14} although both have very similar molecular nature. What is the possible explanation?

A Hexane molecules are more spherical than octane molecules.
B The heavier octane molecules have less kinetic energy.
C Hexane molecules repel each other stronger than that of octane molecules.
D Octane has a higher molecular mass, thus has higher van der Waals forces among the molecules.

18 The lowest level of sense of smell of H_2S in human is 0.15 ppb (part per billion). This level MOST PLAUSIBLY means,

A In every hundred billions (100 000 000 000) of particles in the air, 15 particles are H_2S.
B In every ten billions (10 000 000 000) mol of air, 15 mol are H_2S.
C In every billion (1 000 000 000) g of air, 15 g are H_2S.
D In every billion (1 000 000 000) cm^3 of air, 15 cm^3 are H_2S.

19 On average, 3 mg of helium is found in every ton (1000 kg) of earth crust. In term of ppm (part per million), it is,

A 0.003 ppm
B 3.00 ppm
C 3000 ppm
D 3 000 000 ppm

20 The nitrogen content in the air is 75 percent by mass. In term of ppm (part per million), it is,

A 750 ppm
B 7500 ppm
C 75 000 ppm
D 750 000 ppm

21 An x% aqueous solution of a solute of M g mol^{-1} molar mass has a density of d g mL^{-1}. What is the *molarity* of the solution?

A $10d\left(\frac{M}{x}\right)$

B $\left(\frac{10M}{dx}\right)$

C $10d\left(\frac{x}{M}\right)$

D $\left(\frac{dM}{10x}\right)$

22 A glucose ($C_6H_{12}O_6$ = 180 g mol^{-1}) solution is 0.429 M in concentration with a density of 1.16 g mL^{-1}, when expressed in *molality* it is,

A 0.20 *m*
B 0.33 *m*
C 0.40 *m*
D 0.396 *m*

23 A solution of a substance with a molar mass M g mol^{-1} is m molal in concentration and d g mL^{-1}density. The concentration when expressed in *molarity* is,

A $\frac{1000md}{1000+mM}$

B $\frac{1000+md}{1000mM}$

C $\frac{md}{mM}$

D $\frac{1000md}{mM}$

24 A solution of a substance with a molar mass M g mol^{-1} is y% in concentration. The *molality* of the solution is,

A $\frac{1000y}{100M-y}$

B $\frac{1000(\frac{y}{M})}{100-y}$

C $\frac{1000y}{M-100y}$

D $\frac{(\frac{y}{M})}{100-y}$

25 A solution of phosphoric acid with a molar mass 98 g mol^{-1} is 35.4% in concentration. The *molality* of the acid is,

A 3.62 *m*
B 5.59 *m*
C 6.71 *m*
D 7.26 *m*

26 The widely used saline in hospital is a 0.9% solution of sodium chloride in distilled water. Assuming its density is 1 g mL^{-1}, what is the molarity of the solution? (Na = 23, Cl = 35.5)

A 0.17 M
B 0.15 M
C 0.0015 M
D 0.017 M

27 MOLAL solution is said to be "thermally-stable" because,

A Its concentration in molal (*m*) does not change when the temperature of the solution changes.
B Molal solution does not dissociate by a temperature change.
C Temperature does not affect the solubility of a solute.
D Thermal stability of a solution depends on its concentration.

28 The following phenomena are colligative properties, EXCEPT,

A Freezing point depression of a solution
B Boiling point elevation of a solution
C Osmotic pressure
D Dialysis

29 Freezing point depression of a solution depends on the physical characteristics of the solute dissolve in it. That characteristic is,

A the freezing point of the solute
B the phase of the solute
C the molecular structure of the solute
D the number of particles of the solute.

30 Ebulioscopic constant of cyclohexane (boliling point, 80°C) is 3 K kg mol^{-1} (K m^{-1}). A solution X was made by dissolving 10 grams of X (of relative molar mass of 100) in 1 kg of cyclohexane. Solution Y was made by dissolving Y (of relative molar mass of 1000) in 1 kg of cyclohexane. What would be the mass of Y so that the solution Y boils at the same temperature as that of solution X?

A 1 g
B 10 g
C 50 g
D 100 g

31 An amount of n mol of a solid P was dissolved in a solvent Q at a temperatur T kelvin to give a V volume of an ideal solution. In terms of these data, this solution shows an osmotic pressure π equals to, [R, universal gas constant]

A $\frac{RT}{nV}$

B $\frac{RT}{V}\ln n$

C $\frac{nRT}{V}$

D $-\frac{nRT}{V}$

32 For a change (chemical or physical change) that had taken place in a system,

A The heat absorbed ΔQ by the system is independent of the path along which the change had taken place.
B The work done ΔW by the system is independent of the path along which the change had taken place.
C The change in internal energy ΔE is independent of the path along which the change had taken place.
D The sum of heat change ΔQ and the accompanying work ΔW is independent of the path along which the change had taken place.

33 During an endothermic chemical reaction,

A A system becomes warmer, and additional heat is gained from surroundings
B A system becomes warmer, and the chemical substances undergo an increase in potential energy
C A system becomes cooler, and the chemical substances undergo an increase in potential energy
D A system becomes cooler, and the chemical substances undergo a decrease in potential energy

34 For a chemical reaction taking place at a constant pressure. Which one of the following is NOT true?

A $\Delta E = E_f - E_i$
B $\Delta E = E_{product} - E_{reactants}$
C $\Delta E = q + w$
D $\Delta E = \Delta H + P\Delta V$

35 For the reaction, $A_2(g) + 2BC(g) \rightarrow B_2(s) + 2AC(g)$ taking place in an isolated system, the enthalpy of the product is lower than that of the reactants. Which one of the following statements is true for the system?

A The potential energy of the system decreases as the reactants are converted to products
B The kinetic energy of the system decreases as the reactants are converted to products
C The total energy of the system decreases as the reactants are converted to products
D The total mass of the system are not changes

36 At a constant-volume system, the change in internal energy of the system is

A $\Delta E = q_V$
B $\Delta E = C_V$
C $\Delta E = \Delta H$
D $\Delta E = 0$

37 A boundary that does permit energy transfer as heat is called

A adiabatic
B exothermic
C diathermic
D isolated

38 Which of the following statements is not true for the internal energy?

A The internal energy is the total energy of a system
B The internal energy is a state function
C The internal energy is measured in Joule (J)
D If no work is done on the process, the internal energy is equal to zero.

39 Use the thermochemical equation

$$O_3(g) + OH(g) \longrightarrow H(g) + 2O_2(g) \qquad \Delta H^o = 36.3\ \text{kJ}$$

What is ΔH^o for the reaction of 1.0 g of $O_3(g)$?

A 0.57 kJ
B 0.76 kJ
C 18.15 kJ
D 36.30 kJ

40 Use the following thermochemical equations:

$$\tfrac{1}{2}Cl_2(g) + O_2(g) \longrightarrow ClO_2(g) \qquad \Delta H^o = 102.5 \text{ kJ}$$
$$\tfrac{1}{2}Cl_2(g) + \tfrac{3}{2}O2(g) \longrightarrow ClO_3(g) \qquad \Delta H^o = 155 \text{ kJ}$$
$$Cl_2(g) + \tfrac{7}{2}O2(g) \longrightarrow Cl_2O_7(g) \qquad \Delta H^o = 272.0 \text{ kJ}$$

to determine ΔH^o for $3ClO_3(g) \longrightarrow Cl_2O_7(g) + ClO_2(g)$

A -90.5 kJ
B 90.5 kJ
C 219.5 kJ
D 439.0 kJ

Table 1 The molar enthalpy of substances

Substance	**$\Delta_f H^o$ (kJmol^{-1})**
$CaO(s)$	-635.6
$CaCO_3(s)$	-1206.9
$C_2H_2(g)$	226.6
$CO_2(g)$	-393.5
$H_2O(l)$	-285.80
$O_2(g)$	0

41 Using the data in **Table 1**, calculate the heat of decomposition in the reaction,

$$CaCO3(s) \longrightarrow CaO(s) + CO_2(g)$$

A 42.66 kJ
B 1243.58 kJ
C 3588.62 kJ
D -1243.58 kJ

42 Calculate the heat of combustion of acetylene, CH≡CH from the standard enthalpies of formation listed in **Table 1**.

A 0.0 kJ
B -905.9 kJ
C -2598.8 kJ
D -9059.0 kJ

43 For a chemical reaction, ΔH is < 0 and ΔS is < 0 also. This meant that

A The reaction must be spontaneous regardless of temperature
B The reaction must be spontaneous at high temperature
C The reaction may or may not be spontaneous, but spontaneity is favoured at low temperatures
D We cannot make any conclusion about spontaneity from the limited information presented.

44 Of the species listed below, which one should possess the highest standard entropy (S^o)?

A $CH_4(g)$
B $COCl_2(g)$
C $C_2H_4(g)$
D $C_4H_{10}(g)$

45 The criterion for a spontaneous chemical reaction is

A $\Delta E > 0$
B $\Delta G < 0$
C $\Delta H > 0$
D $\Delta S < 0$

46 Which one of the following property in thermodynamics is not a state function

A enthalpy
B entropy
C internal energy
D work

47 Iron undergoes solid-solid transition at 911°C as it is heated from 25 °C to 1000 °C. Given $\Delta_{trs}H^o = 0.9$ kJmol^{-1}, calculate $\Delta_{trs}S^o$ for the changes?

A 0.76 JK^{-1}mol^{-1}
B 0.92 JK^{-1}mol^{-1}
C 0.99 JK^{-1}mol^{-1}
D 10.11 JK^{-1}mol^{-1}

48 Predict the enthalpy of fusion of iron at 1536°C if $\Delta_{fus}S^o$ is 9.2 JK^{-1}mol^{-1}.

A 5.1 kJmol^{-1}
B 9.2 kJmol^{-1}
C 14.1 kJmol^{-1}
D 16.6 kJmol^{-1}

49 Consider the reversible expansion of 1.0 mol of oxygen from 25 °C and 24.8 L to 427 °C and 38.8 L. Assuming ideal gas behaviour, calculate ΔS_{sys} for this process. (For $O_2(g)$; $C_{p,m} = 29.355$ JK^{-1}mol^{-1},$C_{v,m} = 21.041$ JK^{-1}mol^{-1})

A 17.97 JK^{-1}mol^{-1}
B 21.68 JK^{-1}mol^{-1}
C 28.79 JK^{-1}mol^{-1}
D 43.37 JK^{-1}mol^{-1}

50 Determine ΔG^o for the reaction

$$C(s) + CO_2(g) \longrightarrow 2CO(g)$$

Given ΔH^o = 172. 46 kJ and ΔS^o = 175.87 JK^{-1}

A 52.44 kJ
B 120.02 kJ
C 168.06 kJ
D 172.46 kJ

SELAMAT MAJU JAYA

1	2	3	4	5	6	7	8	9	10
B	C	D	A	B	D	A	B	C	A
11									
D	B	C	D	D	B	D	A	A	D
21									
C	D	A	B	B	B	A	D	D	D
31									
C	D	C	D	A	A	C	D	B	A
41									
A	C	C	D	B	D	A	D	B	B