Engineering Daily 26 [Set 04] EV

Environmental Chemistry

Total Marks: 50 **Negative Marks:** 0.25 **Time:** 1 Hour

MCQ 50 marks

1. How many atoms are there in total in 8.8 g of N_2O gas?

(A) 1.205×10^{23} (B) 2.409×10^{23}

(C) 3.614×10^{23} (D) 1.807×10^{24}

2. 6.2 L of air at 37°C and 98 kPa contains 21% O_2 by volume. What is the number of moles of O_2 in that air?

(A) 0.0495 mol (B) 0.4148 mol

(C) 0.2357 mol (D) 0.0581 mol

3. What is the volume of 22 g of CO_2 gas at 350 K and 0.75 atm?

(A) 10.78 L (B) 19.16 L (C) 38.31 L (D) 4.21 L

4. At the centre of a star the average molar mass of the gases is 1.6, the density is 1.2 kg m^{-3} and the pressure is 9.0×10^9 Pa. What is the temperature at the centre?

(A) 8.12×10^5 K (B) 1.44×10^9 K

(C) 1.46×10^{11} K (D) 1.44×10^6 K

5. A gas occupies 0.25 m^3 at 27°C and 2.0 bar. When it is compressed to 6.0 bar it occupies 0.10 m^3. What is the final temperature of the gas?

(A) 360°C (B) 87°C (C) 27°C (D) 32.4°C

6. What is the mass of methane occupying the same volume, under the same conditions, as 6.4 g of SO_2 gas at 40°C and 1.2 atm?

(A) 3.2 g (B) 25.6 g (C) 0.8 g (D) 1.6 g

7. A gas has a volume of 2.4×10^{-2} m^3 at 127°C and a certain pressure. What is its volume at −73°C and the same pressure?

(A) 0.6×10^{-2} m^3 (B) 1.38×10^{-2} m^3

(C) 1.2×10^{-2} m^3 (D) 4.8×10^{-2} m^3

8. A vessel of volume 820 mL at 47°C contains 1.2046×10^{22} N_2 molecules. What is the pressure of the gas in the vessel?

(A) 0.0941 atm (B) 0.6408 atm

(C) 1.2816 atm (D) 640.8 atm

9. The pressure of N_2 gas in a closed cylinder at 15°C is to be reduced by 20%. At what temperature must the cylinder be kept?

(A) 230.4°C (B) 72.6°C (C) 12.0°C (D) −42.6°C

10. If Boyle's law is obeyed, the slope of the log V versus log P graph and the angle it makes with the positive x-axis are respectively—

(A) −1 and 135° (B) 0 and 180°

(C) −1 and 45° (D) 1 and 45°

11. An evacuated vessel has a mass of 85.40 g. When filled with water (density 1.00 g mL^{-1}) its mass is 335.40 g, and when filled with an ideal gas at 27°C and 760 mmHg its mass is 85.85 g. What is the molar mass of the gas?

(A) 40.3 $gmol^{-1}$ (B) 48.7 $gmol^{-1}$

(C) 88.7 $gmol^{-1}$ (D) 44.3 $gmol^{-1}$

12. A gas has a volume of 2.0 dm^3 at 0°C and constant pressure. If its volume at 80°C is 2.5858 dm^3, what is the value of absolute zero on the Celsius scale based on these data?

(A) −273.13°C (B) −274.50°C

(C) −272.00°C (D) −280.15°C

13. At the same pressure and temperature, which gas will effuse most slowly through the same orifice?

(A) SO_2 (B) NH_3 (C) Cl_2 (D) CO_2

14. At the same temperature and pressure, the ratio of the effusion rates of an unknown gas and SO_2 through the same orifice is 4 : 3. If the vapour density of SO_2 is 32, what is the molar mass of the unknown gas?

(A) 56.9 (B) 36 (C) 24 (D) 18

15. Under the conditions in which 12 m^3 of nitrogen gas diffuses in 40 s, 18 m^3 of a gas X diffuses in 90 s. If the vapour density of nitrogen is 14, what is the vapour density of X?

(A) 63 (B) 21 (C) 9.33 (D) 31.5

16. At the same temperature and pressure, which pair of gases does NOT have equal rates of diffusion?

(A) N_2 and CO (B) NO and C_2H_4

(C) CO_2 and C_3H_8 (D) N_2O and CO_2

17. At a fixed temperature and pressure, 6.4 g of SO_2 takes 24 minutes to effuse through a fine orifice of a vessel. How long will 6.4 g of methane take under the same conditions?

(A) 48 min (B) 6 min

(C) 12 min (D) 96 min

18. In a mixture of gases A and B the ratio of their masses is 2 : 1. If the ratio of their rates of diffusion (moles/time) from the mixture is 54 : 1, what is the ratio of molar masses $M_A : M_B$?

(A) 1 : 27 (B) 1 : 3

(C) 1 : 9 (D) 9 : 1

19. At a certain place the total pressure of dry air is 101 kPa and the partial pressure of oxygen in it is 21.21 kPa. What is the percentage of oxygen in the air by volume?

(A) 79% (B) 21% (C) 23% (D) 20%

20. A gas mixture of volume V at temperature T and pressure P is mixed with another mixture of volume 2V at the same T and P in a vessel of volume 3V. What will be the pressure of the mixture at temperature T?

(A) $\frac{2P}{3}$ (B) 3P (C) P (D) $\frac{P}{3}$

21. At STP, 2.4 L of He escapes from a vessel with a small hole in 4 min. What volume of CH_4 will escape from the same vessel in the same time?

(A) 4.8 L (B) 0.6 L (C) 9.6 L (D) 1.2 L

22. At 25°C, 0.40 m³ of hydrogen at 120 kPa and 0.30 m³ of methane at 90 kPa are transferred into a 0.80 m³ flask. If the flask temperature is raised to 50°C, what is the partial pressure of methane in the mixture?

(A) 65.03 kPa (B) 26.60 kPa

(C) 33.75 kPa (D) 36.58 kPa

23. Two volumes of hydrogen, three volumes of nitrogen and five volumes of CO_2 are mixed in a vessel. If the total pressure of the mixture is 1.5 atm, what is the partial pressure of nitrogen?

(A) 0.30 atm (B) 0.75 atm

(C) 0.45 atm (D) 0.90 atm

24. At a fixed temperature, 150 mL of oxygen at 1.2 atm, 250 mL of nitrogen at 0.9 atm and 100 mL of helium at 2.0 atm are mixed in a 0.50 L vessel. What is the total pressure of the mixture?

(A) 1.21 atm (B) 0.605 atm

(C) 1.37 atm (D) 4.10 atm

25. Several spherical balloons of diameter 0.80 m are to be filled with H_2 at STP. A cylinder of volume 0.5 m³ holds H_2 at 1500 kPa and 7°C. What is the maximum number of balloons that can be filled from this cylinder? [No more gas escapes once the cylinder pressure falls to atmospheric pressure]

(A) 27 (B) 26 (C) 15 (D) 25

26. The most probable speed of the molecules of a gas is —

(A) $\sqrt{\frac{8RT}{\pi M}}$ (B) $\sqrt{\frac{2RT}{M}}$ (C) $\sqrt{\frac{RT}{2M}}$ (D) $\sqrt{\frac{3RT}{M}}$

27. What is the root mean square speed of methane molecules at −23°C?

(A) 189.4 ms^{-1} (B) 509.7 ms^{-1}

(C) 19.74 ms^{-1} (D) 624.3 ms^{-1}

28. At a certain temperature the root mean square speed of the molecules of a gas is 500 m s^{-1}. What is the average speed of the molecules at that temperature?

(A) 408.2 ms^{-1} (B) 543.0 ms^{-1}

(C) 460.4 ms^{-1} (D) 500.0 ms^{-1}

29. A gaseous hydrocarbon of formula C_nH_{2n} at 77°C has an rms speed equal to that of O_2 at 127°C. What is the value of n?

(A) 3 (B) 4 (C) 1 (D) 2

30. What is the ratio of the total kinetic energies of the molecules of 1 g of CO_2 and 1 g of CH_4 at 30°C?

(A) 1 : 1 (B) 4 : 11

(C) 16 : 121 (D) 11 : 4

31. To what temperature (in °C) must a gas be heated from 27°C so that its root mean square speed becomes 1.5 times?

(A) 402°C (B) 177°C (C) 675°C (D) 40.5°C

32. At what temperature will the root mean square speed of helium gas be 1.5 km s^{-1}?

(A) 360.8°C (B) 87.8°C (C) 268.3°C (D) −32.4°C

33. Ideal gases A and B are kept in two vessels. The density of A is 3 times that of B, and the root mean square speed of A is half that of B. What is $P_A : P_B$?

(A) 4 : 3 (B) 12 : 1 (C) 3 : 2 (D) 3 : 4

34. A 10 L vessel contains 128 g of SO_2 at 47°C. What is the average kinetic energy of each SO_2 molecule?

(A) 6.624×10^{-21} J (B) 1.325×10^{-20} J

(C) 7.981×10^{3} J (D) 9.729×10^{-22} J

35. The constant 'b' in the van der Waals equation is related to—

(A) Intermolecular attractive force

(B) Correction for the actual volume of the molecules

(C) Rate of collision of molecules with the container wall

(D) Correction for the temperature of the gas

36. A 1.5 L vessel contains 1.2 mol of NH_3 gas at 350 K (a = 4.17 atm L^2 mol^{-2}, b = 0.0371 L mol^{-1}). By how much is the pressure from the van der Waals equation lower than that from the ideal gas equation?

(A) 1.97 atm (B) 21.02 atm

(C) 2.67 atm (D) 0.70 atm

37. At room temperature, which of the following gases has a compressibility factor Z greater than 1 at all pressures?

(A) NH_3 (B) CO_2 (C) CH_4 (D) H_2

38. A gas of mass 24.0 g is contained in an 8.0 dm³ vessel at 27°C. If the pressure of the gas is 180 kPa and its compressibility factor is 0.92, what is its molar mass?

(A) 76.49 $gmol^{-1}$ (B) 35.18 $gmol^{-1}$

(C) 38.24 $gmol^{-1}$ (D) 41.57 $gmol^{-1}$

39. According to the van der Waals equation, what is the compressibility factor Z of 1 mol of gas at very high pressure?

(A) $Z = 1 + \frac{Pb}{RT}$ (B) $Z = 1 + \frac{RT}{Pb}$

(C) $Z = 1 - \frac{a}{VRT}$ (D) $Z = 1 - \frac{Pb}{RT}$

40. What is the acidity of $Ca(OH)_2$?

(A) 2 (B) 1 (C) 3 (D) 4

41. According to the Arrhenius theory, which of the following is an acid in aqueous solution?

Ⓐ CH_4 Ⓑ HCl Ⓒ BF_3 Ⓓ NH_3

42. According to which theory is $AlCl_3$ an acid?

Ⓐ Lewis theory Ⓑ Arrhenius theory

Ⓒ Lux-Flood theory Ⓓ Brønsted-Lowry theory

43. Which of the following reactions can be explained as an acid-base reaction by the Brønsted-Lowry theory but not by the Arrhenius theory?

Ⓐ $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

Ⓑ $KOH(aq) + HNO_3(aq) \rightarrow KNO_3(aq) + H_2O(l)$

Ⓒ $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

Ⓓ $Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$

44. Which of the following is a dibasic acid?

Ⓐ H_3PO_2 Ⓑ H_3PO_4 Ⓒ H_3PO_3 Ⓓ HNO_3

45. Which of the following is NOT a primary air pollutant?

Ⓐ CO Ⓑ O_3 Ⓒ NO Ⓓ SO_2

46. Rain is called acid rain when its pH is below which value?

Ⓐ 7.0 Ⓑ 4.0 Ⓒ 5.6 Ⓓ 6.5

47. Which pollutant is mainly removed from flue gas in an FGD plant?

Ⓐ SO_2 Ⓑ CO_2 Ⓒ CO Ⓓ CH_4

48. Analysis of 250 mL of water gave 0.0125 mg of lead (Pb). What is the concentration of lead in that water?

Ⓐ 0.005 ppm Ⓑ 0.5 ppm

Ⓒ 0.05 ppm Ⓓ 5.0 ppm

49. A water sample has a dissolved O_2 content of 6.4 ppm. In the Winkler method, titrating the liberated iodine from a 500 mL sample requires 12.8 mL of $Na_2S_2O_3$ solution. What is the concentration of the $Na_2S_2O_3$ solution?

Ⓐ 0.00781 M Ⓑ 0.01562 M

Ⓒ 0.0625 M Ⓓ 0.03125 M

50. Which of the following is NOT a method of reducing the TDS of water?

Ⓐ Deionisation Ⓑ Chlorination

Ⓒ Distillation Ⓓ Reverse osmosis