Engineering Daily 26 [Set 03] EV

Environmental Chemistry

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

MCQ 50 marks

1. What is the mass of CO_2 gas occupying 1.68 L at STP?

(A) 3.3 g (B) 1.65 g
(C) 6.6 g (D) 2.2 g

2. 7 g of a gas occupies 22.4 L at 273°C and 0.5 atm. The gas is—

(A) O_2 (B) N_2 (C) NH_3 (D) CO_2

3. The density of N_2 at 0°C and 760 mmHg is 1.25 g L^{-1}. What is its density at 91°C and 1140 mmHg?

(A) 1.11 gL^{-1} (B) 1.88 gL^{-1}
(C) 1.41 gL^{-1} (D) 0.94 gL^{-1}

4. A room measures 15 m in length, 8 m in width and 4 m in height. How much air is present in the room at 27°C and 750 mmHg? [Average molar mass of air = 29]

(A) 498.49 kg (B) 612.89 kg
(C) 565.16 kg (D) 557.73 kg

5. The volume of 120 cm^3 of a gas is increased by 30% at constant pressure. If the initial temperature is 27°C, what is the final temperature?

(A) 35.1°C (B) 117°C
(C) 390°C (D) 81°C

6. At 27°C the total volume of a gas together with a solid object is 150 cm^3. When the temperature is raised to 87°C and the pressure is doubled, the total volume including the solid becomes 100 cm^3. What is the volume of the solid?

(A) 25 cm^3 (B) 30 cm^3 (C) 20 cm^3 (D) 50 cm^3

7. If the pressure of a gas is reduced to one-third of its initial value at constant temperature, the density of the gas—

(A) will increase 3 times (B) will decrease 9 times
(C) will decrease 3 times (D) will remain unchanged

8. A 1 L flask is filled with the vapour of a volatile liquid at 87°C and 1 atm and sealed; its mass is 25.4420 g. Under the same conditions, the flask filled with air has a mass of 24.6500 g. If the density of air under these conditions is 0.981 g L^{-1}, what is the molar mass of the liquid?

(A) 39.7 $gmol^{-1}$ (B) 23.4 $gmol^{-1}$
(C) 75.2 $gmol^{-1}$ (D) 52.4 $gmol^{-1}$

9. At 27°C and 1 atm, what volume does a single N_2 molecule occupy on average?

(A) 4.089×10^{-20} dm^3 (B) 3.719×10^{-23} dm^3
(C) 4.089×10^{-23} dm^3 (D) 4.089×10^{-26} dm^3

10. 60 mL of H_2 gas is collected over water in a eudiometer at 32°C and 752 mmHg. The vapour pressure of water is $p = 5.901\, e^{0.0506x}$ mmHg, where x is the temperature in °C. What is the number of moles of H_2 collected?

(A) 2.277×10^{-4} (B) 2.371×10^{-3}
(C) 2.277×10^{-2} (D) 2.277×10^{-3}

11. For a fixed mass of a gas, the slopes of V versus T graphs drawn at three different constant pressures P_1, P_2 and P_3 are m, 2m and 3m respectively. What is $P_1 : P_2 : P_3$?

(A) 3 : 2 : 1 (B) 6 : 3 : 2
(C) 2 : 3 : 6 (D) 1 : 2 : 3

12. An open vessel is heated from −23°C to 127°C. What fraction of the initial amount of gas in the vessel escapes?

(A) $\frac{3}{5}$ (B) $\frac{2}{5}$ (C) $\frac{3}{8}$ (D) $\frac{5}{8}$

13. At the same temperature and pressure, in the time that 1 L of SO_2 effuses through an orifice, how many litres of He will effuse through the same orifice?

(A) 0.25 L (B) 4 L
(C) 16 L (D) 2 L

14. The rates of diffusion of gases A and B are 0.6 and 0.9 respectively. If the density of gas B is 20, what is the density of gas A?

(A) 45 (B) 13.33 (C) 30 (D) 8.89

15. At the same temperature and pressure, 400 mL of an unknown gas effuses through a fine orifice in 150 s and 300 mL of chlorine gas effuses in 135 s. What is the molar mass of the unknown gas?

(A) 102.2 (B) 49.3 (C) 87.7 (D) 59.2

16. It takes 25 min for a fixed volume of pure N_2 to effuse through a porous wall. Under the same conditions, how long will an equal volume of a mixture containing 40% CO_2 and 60% N_2 (by moles) take to effuse?

(A) 31.34 min (B) 30.71 min
(C) 22.55 min (D) 27.71 min

17. What is the ratio of the rates of diffusion of $^{235}UF_6$ and $^{238}UF_6$? [$M(^{235}UF_6) = 349$, $M(^{238}UF_6) = 352$]

(A) 1.0043 (B) 1.0086
(C) 1.0000 (D) 0.9957

18. A fixed volume of pure O_2 takes 60 s to effuse through a fine orifice. Under the same conditions, an equal volume of ozonised oxygen takes 66 s. What is the volume percentage of O_3 in the mixture?

(A) 21% (B) 40% (C) 10% (D) 42%

19. Equal masses of H_2, He and CH_4 gases are placed in a vessel. Which gas has the highest partial pressure?

(A) He

(B) H_2

(C) CH_4

(D) All gases have equal partial pressures

20. At 20°C, 600 mL of N_2 at 300 mmHg, 400 mL of O_2 at 650 mmHg and 200 mL of He at 760 mmHg are mixed in an empty 2.0 L vessel. What will be the pressure of the mixture at 40°C?

(A) 296.0 mmHg (B) 632.4 mmHg

(C) 316.2 mmHg (D) 592.0 mmHg

21. NH_3 and HBr gases are introduced simultaneously from the two ends of a 120 cm long glass tube. Where will the white ring of NH_4Br form?

(A) 82.3 cm from the NH_3 end

(B) 99.2 cm from the NH_3 end

(C) Exactly at the middle of the tube

(D) 37.7 cm from the NH_3 end

22. A mixture of 56 g of N_2 and 71 g of Cl_2 has a total pressure of 9 atm. What is the partial pressure of N_2 in the mixture?

(A) 3 atm (B) 6 atm (C) 2 atm (D) 4.5 atm

23. At 27°C a 10 L vessel containing 5.6 g of N_2 is connected by a narrow tube to another 6 L vessel containing 9.6 g of O_2. If both vessels are raised to 57°C, what is the partial pressure of O_2 in the mixture?

(A) 1.355 atm (B) 0.847 atm

(C) 0.462 atm (D) 0.508 atm

24. At a certain place the atmospheric pressure is 100 kPa, of which 2.4 kPa is due to water vapour. If dry air contains 21% O_2, 78% N_2 and 1% Ar by volume, what is the partial pressure of O_2?

(A) 20.50 kPa (B) 21.00 kPa

(C) 21.50 kPa (D) 76.13 kPa

25. Equal masses of He and O_2 gases are kept in a closed vessel at 27°C. What fraction of the total pressure is the partial pressure of O_2?

(A) $\frac{1}{8}$ (B) $\frac{8}{9}$ (C) $\frac{1}{9}$ (D) $\frac{1}{2}$

26. If the density of a gas is ϱ and the root mean square speed of its molecules is C, then according to kinetic theory the pressure of the gas is—

(A) $P = \frac{1}{3}\varrho C$ (B) $P = 3\varrho C^2$

(C) $P = \frac{2}{3}\varrho C^2$ (D) $P = \frac{1}{3}\varrho C^2$

27. The root mean square speed of a gas at 127°C is 476.2 m s^{-1}. The gas is—

(A) CO_2 (B) O_2 (C) SO_2 (D) NH_3

28. What is the total kinetic energy of the molecules of 56 g of N_2 gas at 77°C?

(A) 17459.4 J (B) 1920.5 J

(C) 5819.8 J (D) 8729.7 J

29. At what temperature will the root mean square speed of SO_2 equal the root mean square speed of O_2 at 47°C?

(A) 640°C (B) 94°C

(C) 367°C (D) −113°C

30. When 200 L of room air at 300 K and 100 kPa is passed through KOH solution, the mass of the solution increases by 0.11 g. If the vapour density of air is 14.4, what is the percentage by mass of CO_2 in the air?

(A) 0.0476% (B) 0.476%

(C) 0.0728% (D) 0.0312%

31. The density of a gas at STP is 1.964 g L^{-1}. What is the root mean square speed of its molecules at 87°C and 600 mmHg?

(A) 401.4 ms^{-1} (B) 393.4 ms^{-1}

(C) 416.2 ms^{-1} (D) 451.8 ms^{-1}

32. Five particles have speeds of 3, 5, 6, 8 and 10 m s^{-1} respectively. What is the root mean square speed of the particles?

(A) 6.00 ms^{-1} (B) 6.40 ms^{-1}

(C) 6.84 ms^{-1} (D) 7.65 ms^{-1}

33. The average speed of N_2 molecules at T_1 K and their root mean square speed at T_2 K are both 600 m s^{-1}. The values of T_1 and T_2 are respectively—

(A) 476.1 K and 404.1 K (B) 404.1 K and 476.1 K

(C) 606.2 K and 404.1 K (D) 476.1 K and 606.2 K

34. If the total kinetic energy of 2 mol of He gas at 47°C is 7.98×10^3 J, what is the value of the molar gas constant R?

(A) 12.469 $Jmol^{-1}K^{-1}$ (B) 56.596 $Jmol^{-1}K^{-1}$

(C) 8.312 $Jmol^{-1}K^{-1}$ (D) 16.625 $Jmol^{-1}K^{-1}$

35. Under which conditions does the compressibility factor Z of a real gas deviate most from 1?

(A) Low pressure and high temperature

(B) High pressure and low temperature

(C) Low pressure and low temperature

(D) Z = 1 regardless of pressure and temperature

36. 1 mol of CO_2 is kept in a 500 mL vessel at 300 K. What is its pressure according to the van der Waals equation? [a = 3.59 atm L^2 mol^{-2}, b = 0.0427 L mol^{-1}]

(A) 39.50 atm (B) 34.90 atm

(C) 53.86 atm (D) 49.26 atm

37. The van der Waals constant a for Ar, CO_2, SO_2 and H_2 is 1.35, 3.59, 6.71 and 0.244 atm L^2 mol^{-2} respectively. Which gas can be liquefied most easily?

Ⓐ H_2 Ⓑ CO_2 Ⓒ Ar Ⓓ SO_2

38. 0.5 mol of methane gas in a 12 dm^3 vessel exerts a pressure of 101.0 kPa at 27°C. What is the compressibility factor of the gas?

Ⓐ 0.972 Ⓑ 0.486 Ⓒ 0.028 Ⓓ 1.029

39. Which is the van der Waals equation for 66 g of CO_2 gas?

Ⓐ $\left(P + \frac{2.25a}{V^2}\right)(V - 2.25b) = 1.5RT$

Ⓑ $\left(P + \frac{2.25a}{V^2}\right)(V - 1.5b) = 1.5RT$

Ⓒ $\left(P + \frac{a}{V^2}\right)(V - b) = 1.5RT$

Ⓓ $\left(P + \frac{1.5a}{V^2}\right)(V - 1.5b) = 1.5RT$

40. According to Lewis theory, which of the following is a base?

Ⓐ $AlCl_3$ Ⓑ BF_3 Ⓒ NH_3 Ⓓ Fe^{3+}

41. Which of the following pairs has the correct order of acid strength?

Ⓐ $HClO_4 > HClO_3$

Ⓑ $CH_3COOH > ClCH_2COOH$

Ⓒ $HF > HI$

Ⓓ $H_2CO_3 > H_2SO_3$

42. According to the Brønsted-Lowry theory, which of the following is NOT amphoteric?

Ⓐ HSO_4^- Ⓑ $H_2PO_4^-$

Ⓒ NH_4^+ Ⓓ HCO_3^-

43. Which of the following cannot behave as a Brønsted-Lowry acid?

Ⓐ $[Fe(H_2O)_6]^{3+}$ Ⓑ BF_3

Ⓒ $[Al(H_2O)_6]^{3+}$ Ⓓ NH_4^+

44. In the reaction $HSO_4^- + NH_3 \rightleftharpoons SO_4^{2-} + NH_4^+$, which is an acid and its conjugate base pair?

Ⓐ NH_3, SO_4^{2-} Ⓑ NH_4^+, SO_4^{2-}

Ⓒ HSO_4^-, NH_4^+ Ⓓ HSO_4^-, SO_4^{2-}

45. Which pair of acids is mainly responsible for acid rain?

Ⓐ H_2CO_3 and HCl

Ⓑ H_2SO_4 and HNO_3

Ⓒ CH_3COOH and HCOOH

Ⓓ H_3PO_4 and HNO_2

46. In an FGD plant, after flue-gas SO_2 is absorbed by limestone, which by-product is formed on oxidation?

Ⓐ CaS Ⓑ $CaCO_3$

Ⓒ $Ca(HSO_3)_2$ Ⓓ $CaSO_4 \cdot 2H_2O$

47. In the Winkler method, 8.4 mL of 0.0125 M $Na_2S_2O_3$ solution is required to titrate the iodine liberated from a 200 mL water sample. What is the DO of the sample?

Ⓐ 16.8 ppm Ⓑ 4.2 ppm

Ⓒ 8.4 ppm Ⓓ 2.1 ppm

48. A water sample contains 142 parts of $MgCl_2$ per 10^6 parts by mass. What is the hardness of the sample in terms of $CaCO_3$?

Ⓐ 100.0 ppm Ⓑ 134.9 ppm

Ⓒ 149.5 ppm Ⓓ 142.0 ppm

49. What is the maximum COD value of drinking water permitted by WHO?

Ⓐ 6 ppm Ⓑ 500 ppm

Ⓒ 4 ppm Ⓓ 10 ppm

50. Which compounds are responsible for the permanent hardness of water?

Ⓐ $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$

Ⓑ $CaSO_4$ and $MgCl_2$

Ⓒ Na_2CO_3 and NaCl

Ⓓ $CaCO_3$ and $MgCO_3$