This question paper consists of 40 Multiple choice Questions (1 x 40 = 40 marks)

Instructions to candidates

1.Answer all questions.
2. Use a **pen** (not a pencil) to mark your answers.
3. Choose the most correct answer to each question and mark a cross over the answer on the **given answer sheet**. Any answer with more than one cross will not be counted.
4. Each **correct answer** will carry 1 marks.1/6 th of a mark will be deducted for each **incorrect answer.**

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1. 1 bar is a pressure equal to

(1) $1.013325 \times 10^5 \, Nm^{-2}$ (2) $10^5 \, Pa$ (3) 10^5 atmospheres   (4) 76cm of Hg   (5) 1 standard atmosphere

2. Which of the following is **not** a thermodynamic property?

(1) q   (2) H   (3) V   (4) P   (5) T

3. Which of the following is an **extensive** property?

(1) density   (2) temperature   (3) melting point   (4) heat   (5) boiling point

4. Which of the following statements regarding the kinetic-molecular theory of ideal gases is **incorrect**?

(1) gas molecules collide elastically.
(2) gases molecules are in random motion .
(3) the average kinetic energy is constant if T is constant.
(4) the kinetic energy of all the molecules is the same.
(5) attractive and repulsive forces can be neglected .

5. Van der Waals constant, <u>a</u>, that appears in the relationship

$$\left(P + \frac{an^2}{V^2} \right) (V - nb) = nRT$$

corrects for:

(1). The average speed of the gas molecules.
(2) the density of gas molecules.
(3) variation in the gas constant,R.
(4) the volume occupied by the gas molecules.
(5) the attractive forces between gas molecules.

6. Which graph best represents the distribution of molecular speeds for the gases argon and methane, CH_4, when both are in the same flask with a total pressure of 600 mm Hg and a partial pressure of 450 mm Hg for the argon? [Note: The vertical lines on each curve represent the root mean square velocity, X axis – molecular speed; Y axis – number of molecules
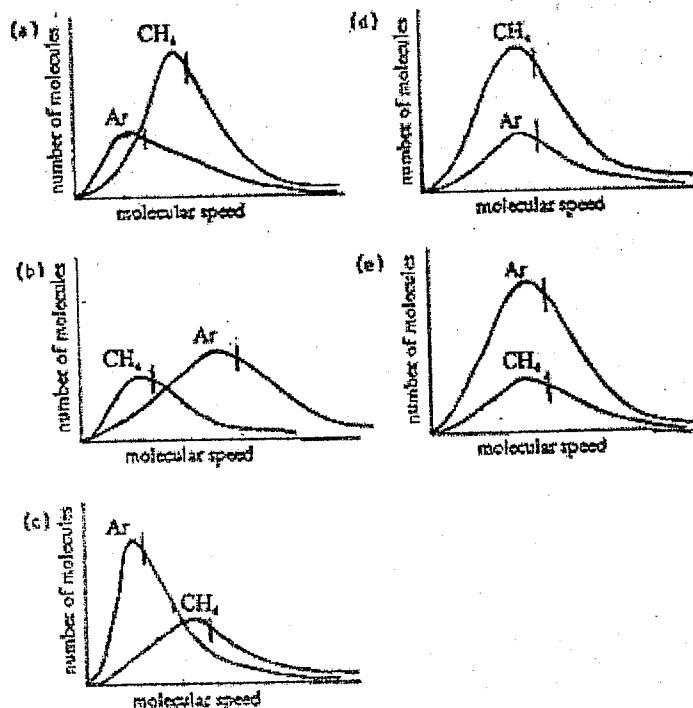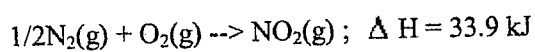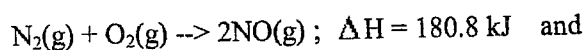

7. All of the following have standard enthalpy of formation values of zero at 25°C except

(1). $Cl_2(g)$ (2). $O_2(g)$ (3). $Na(g)$ (4). $F_2(g)$ (5). $N_2(g)$

8. The ΔH_f° value for $C_2H_6(g)$ refers to:

(1). $2C(graphite) + 3H_2(g) \rightarrow C_2H_6(g)$
(2). $2C(graphite) + 3H_2(g) \rightarrow C_2H_6(l)$
(3). $C(graphite) + 3/2H_2(g) \rightarrow 1/2C_2H_6(g)$
(4). $C_2H_6(g) \rightarrow 2C(graphite) + 3H_2(g)$
(5). $2C + 3H_2 \rightarrow C_2H_6$

9. Given the following data

$N_2(g) + O_2(g) \rightarrow 2NO(g)$; $\Delta H = 180.8$ kJ   and

$1/2N_2(g) + O_2(g) \rightarrow NO_2(g)$; $\Delta H = 33.9$ kJ

What will be the enthalpy change for the reaction $NO(g) + 1/2O_2(g) \rightarrow NO_2(g)$

(1). 214.7 kJ   (2). 146.9 kJ   (3). – 56.5 kJ   (4). 56.5 kJ   (5). –146.9 kJ

10. Nitrogen gas escapes through a pinhole in 68.4 seconds. Under the same conditions, a gaseous compound X with the empirical formula CH_2 escapes in 83.8 seconds. What is its molecular formula of X?

(1). CH_2 (2). C_2H_4 (3). C_3H_6 (4). C_4H_8 (5). C_5H_{10}

11. Under which of the following set of conditions will a real gas most closely approximate to that of an ideal gas?

	Pressure /kPa	Temperature /K
(1)	9,000,000	78
(2)	100	78
(3)	100	2005
(4)	10,000	2005
(5)	10,000	300

12. Which of the following reactions could do work of expansion on the surroundings?

(1) $H_2O(g) \rightarrow H_2O(l)$
(2) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$
(3) $Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(s)$
(4) $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$
(5) $2N_2O(g) \rightarrow 2N_2(g) + O_2(g)$

13. When is $\Delta H_{sys} = \Delta E_{sys}$?

(1). When $q_v = q_p$
(2). In reactions involving only liquids and solids.
(3). In reactions where the moles of gas remain constant throughout the reaction.
(4). In reactions run under a vacuum (P=0).
(5). All of the above.

14. The molar heat capacity for NaCl is 50.50 J mol^{-1} K^{-1}. What is the specific heat?

(1). 0.4490 J g^{-1} K^{-1} (2). 0.5050 J g^{-1} K^{-1} (3). 0.8640 J g^{-1} K^{-1}

(4). 4.184 J g^{-1} K^{-1} (5). 50.50 J g^{-1} K^{-1}

15. When work is done by a system at constant temperature, which of the following is true?

(1). $q + w = 0$ (2). w is positive   (3). q is negative   (4). ΔE_{univ} is positive   (5). w is negative

16. A balloon is heated by adding 580 J of heat. It expands doing 320 J of work against the atmosphere. What is the change in internal energy?

(1). - 900 J   (2). - 260 J   (3). 0 J   (4). + 260 J   (5). + 900 J

17. An endothermic reaction causes the surroundings to:

(1). warm up   (2). gain heat   (3). loose heat   (4). cool down   (5). both (3) and (4)

18. At constant pressure:

(1) $w_P = 0$ (2) $\Delta H = q_P$ (3) $\Delta H = \Delta E$ (4) $q = 0$ (5) $q_P = 0$

19. A balloon contains 4.70×10^{-2} mol O_2 and 8.87×10^{-2} mol N_2 at a total pressure of 1.00 atm. What is the partial pressure of O_2 in the balloon?

(1) 0.65 atm   (2) 0.35 atm   (3) 0.95 atm   (4) 2.86 atm   (5) 0.23 atm

20. The specific heat of water is 4.18 J g^{-1} K^{-1} and that of stainless steel is 0.51 J g^{-1} K^{-1}. Calculate the heat that must be supplied to a 750.0 g stainless steel vessel containing 800.0 g of water to raise its temperature from 20.0°C to the boiling point of water.

(1) 2.98 kJ   (2) 6.98 kJ   (3) 29.8 kJ   (4) 69.8 kJ   (5) 298 kJ

21. The compressibility factor (Z) of a gas is given by the expression

(1) $Z = \dfrac{nRT}{PV}$ (2) $Z = \dfrac{PV^2}{nRT}$ (3) $Z = \dfrac{8}{3}$ (4) $Z = \dfrac{PV}{nRT}$ (5) $Z = \dfrac{3R}{8}$

22. The S.I unit for entropy is

(1) $J\,K^{-1}\,mol^{-1}$ (2) $J\,mol^{-1}$ (3) $J\,K$ (4) $K\,J^{-1}$ (5) $J\,K^{-1}$

23. The critical temperature of nitrogen gas is 126K.this means that,

(1) Nitrogen can be liquefied above 126K when high pressure is applied.
(2) Nitrogen cannot be liquefied above 126K however high pressure may be.
(3) Nitrogen behaves as an ideal gas only at 126K.
(4) The standard boiling point of nitrogen is 126K.
(5) Nitrogen forms diatomic molecules only at 126K.

24. For which one of the following reactions does the entropy of the system **INCREASE**?

(1) $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$ (2) $Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$
(3) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$ (4) $NH_3(g) + H_2O(l) \longrightarrow NH_4^+(aq) + OH^-(aq)$
(5) $2H_2 + O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$

25. A piston is used to compress a gas from 1.0 atm to 3.5 atm. If the volume changes from 1.5 L to 0.75 what is the final temperature, if it started at 300 K?

(1) 1050 K   (2) 700 K   (3) 525 K   (4) 300 K   (5) 150K

26. The significance of the Second Law of Thermodynamics is that for spontaneous processes the:

(1) Entropy of the universe is increasing.
(2) Entropy of the surroundings must decrease.
(3) Entropy is the driving force of all chemical reactions.
(4) Entropy of an ideal solid does not change.
(5) Absolute value for entropy can be calculated.

27. Given the following bond-dissociation energies:

H-H   435 kJ/mol ;   O=O   498 kJ/mol ;   O-H   464 kJ/mol, What will be the $\Delta H°$ for the reaction:

$$2H_2(g) + O_2(g) \dashrightarrow 2H_2O(g)$$
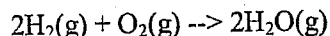
(1) +5.0 kJ/mol   (2) +440 kJ/mol   (3) +448 kJ/mol (4) - 448 kJ/mol (5) -923 kJ/mol

28. The normal boiling point of methyl chloride (CH_3Cl) is 249 K. Predict the signs of ΔH, ΔS, and ΔG when superheated CH_3Cl boils at 250 K and 1 atm:

$$CH_3Cl(l) \dashrightarrow CH_3Cl(g)$$
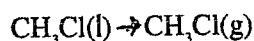
	ΔH	ΔS	ΔG
(1)	−	+	−
(2)	−	+	+
(3)	+	+	−
(4)	+	−	+
(5)	−	−	−

29. The rate of the elementary reaction aA+bB --> products is given by,

(1) Rate = k[A][B]   (2) Rate = k[B]^b (3) Rate = k[A]^a[B]^b (4) Rate=k[A]^a (5) Rate=k[A]^2[B]^2

30. When a catalyst is added to a reaction system, the potential energy of the activated complex:
   (1) Increases and the heat of reaction system increases
   (2) Decreases and the heat of reaction increases
   (3) Remains the same and the heat of reaction decreases
   (4) Decreases and the heat of reaction remains the same
   (5) Remains the same and the heat of reaction increases

31. What is the order for the overall reaction of, Rate $= k[NO]^2[Br_2]$?

(1). Zero order (2). First order (3). Second order (4). Third order (5) Not enough information

32. The rate law for the reaction, 2A + B --> products, is Rate $= k[A]^2$. What effect would adding additional B have on the reaction? (Assume no change in temperature or volume.)

(1).   Both the value of k and the reaction rate would decrease
(2).   Both the value of k and the reaction rate would increase
(3).   The value of k would remain constant, but the rate would decrease
(4).   The value of k would remain constant, but the rate would increase
(5).   Neither k nor the rate would change.

33. Chemical kinetics are used to study
   (a) The feasibility of a reaction   (b) The rate of a reaction
   (c) The reaction path   (d) The extent of a reaction

The correct answer is / are
   (1) a and b only   (2) b and c only   (3) c and d only   (4) a and d (5) a and c

34. Which of the following statements out of a,b,c is/are correct?

(a) An elementary reaction is a reaction occurs in a single step.
(b) Molecularity of the single step reaction $H_2 + I_2 \rightarrow 2HI$ is two.
(c) Molecularity and the order of a reaction will always be the same.
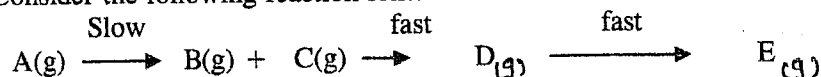
The correct answer/s is/are,
(1) a only   (2) b only   (3) a and b   (4) b and c   (5) All a,b and c

35. The rate of the elementary reaction $A + B \rightarrow C + D$ can be expressed by

(1) $\dfrac{d[A]}{dt}$ (2) $\dfrac{d[B]}{dt}$ (3) $-\dfrac{d[A]}{dt}$ (4) $-\dfrac{d[C]}{dt}$ (5) $-\dfrac{d[D]}{dt}$

36. Consider the following reaction scheme.

$$A(g) \xrightarrow{\text{Slow}} B(g) + C(g) \xrightarrow{\text{fast}} D_{(g)} \xrightarrow{\text{fast}} E_{(g)}$$

The rate-determining step of the reaction will be

(1) A(g) to B(g)   (2) B(g) to C(g)   (3) A(g) to B(g) and C(g)   (4) D(g) to E(g)
(5) none of the above since it is a gaseous reaction.

37. Which of the following statements regarding catalysts *in a reaction* is not true?

(1). they can either be homogenous or heterogeneous.
(2). Increase the rate by lowering the activation energy.
(3). Decrease the rate only.
(4). Change the rate of a reaction.
(5). Enzymes are proteins playing part of catalysts in our bodies.

38. The rate of reaction is $k[A]^0[B]$. The units of k is

(1) mol dm^{-3} (2) dm mol^{-1} (3) s^{-1} (4) s   (5) mol s^{-1}

39. $2H_2O_2 \longrightarrow 2H_2O + O_2$

The reaction is first order for H_2O_2 and has a half-life of 18.0 minutes. If an H_2O_2 solution that was initially 0.80 M is allowed to decompose for 72 minutes, what will the concentration be at that time?

(1) 0.80 M   (2) 0.40 M   (3) 0.20 M   (4) 0.10 M   (5) 0.05 M

40. $2A_{(g)} + B_{(g)} \rightarrow C_{(g)}$;   Rate = $k[A]^2[B]$

As this reaction proceeds at constant temperature,
(a) The rate of the reaction decreases
(b) The effectiveness of collisions between reactant molecules remains the same
(c) The frequency of collisions between reactant molecules remains the same

The correct statement/s is/are
(1) a only   (2) b only   (3) a and b only   (4) b and c only   (5) none of the above