Collision theory, Energy of activation and Arrhenius equation

1. A large increase in the rate of a reaction for a rise in temperature is due to

(a) The decrease in the number of collisions

(b) The increase in the number of activated molecules

(c) The shortening of the mean free path

(d) The lowering of the activation energy

2. Which of the following statements is not true according to collision theory of reaction rates

(a) Collision of molecules is a precondition for any reaction to occur

(b) All collisions result in the formation of the products

(c) Only activated collisions result in the formation of the products

(d) Molecules which have acquired the energy of activation can collide effectively

3. According to the collision theory of chemical reactions

(a) A chemical reaction occurs with every molecular collision

(b) Rate is directly proportional to the number of collisions per second

(c) Reactions in the gas phase are always of zero order

(d) Reaction rates are of the order of molecular speeds

4. According to the collision theory of reaction rates, rate of reaction increases with temperature due to

(a) Greater number of collisions

(b) Greater velocity of the reacting molecules

(c) Greater number of molecules have activation energy

(d) None of the above

5. The reaction rate at a given temperature becomes slower, then

(a) The free energy of activation is higher

(b) The free energy of activation is lower

(c) The entropy changes

(d) The initial concentration of the reactants remains constant

6. A rise in temperature increases the velocity of a reaction. It is because it results in

(a) An increased number of molecular collisions

(b) An increased momentum of colliding molecules

(c) An increase in the activation energy

(d) A decrease in the activation energy

7. The number of collisions depend upon

(a) Pressure

(b) Concentration

(c) Temperature

(d) All the above

8. If E_f and E_r are the activation energies of forward and reverse reactions and the reaction is known to be exothermic, then

(a) $E_f > E_r$

(b) $E_f < E_r$

(c) $E_f = E_r$

(d) No relation can be given between E_f and E_r as data are not sufficient

9. According to Arrhenius theory, the activation energy is

(a) The energy it should possess so that it can enter into an effective collision

(b) The energy which the molecule should possess in order to undergo reaction

(c) The energy it has to acquire further so that it can enter into a effective collison

(d) The energy gained by the molecules on colliding with another molecule

10. The energy of activation is

(a) The energy associated with the activated molecules

(b) Threshold energy – energy of normal molecules

(c) Threshold energy + energy of normal molecules

(d) Energy of products – energy of reactants

11. Which one of the following does not represent Arrhenius equation

(a) $k = Ae^{-E/RT}$

(b) $log_e\, k = log_e\, A - \frac{E}{RT}$

(c) $log_{10}\, k = log_{10}\, A - \frac{E}{2.303RT}$

(d) $k = AE^{-RT}$

12. On increasing the temperature, the rate of the reaction increases because of

(a) Decrease in the number of collisions
(b) Decrease in the energy of activation
(c) Decrease in the number of activated molecules
(d) Increase in the number of effective collisions

13. Energy of activation of a reactant is reduced by
(a) Increased temperature
(b) Reduced temperature
(c) Reduced pressure
(d) Increased pressure

14. The minimum energy a molecule should possess in order to enter into a fruitful collision is known as
(a) Reaction energy
(b) Collision energy
(c) Activation energy
(d) Threshold energy

15. Activation energy is
(a) The amount of energy to be added to the actual energy of a molecule so that the threshold energy is reached
(b) The amount of energy the molecule must contain so that it reacts
(c) The energy which a molecule should have in order to enter into an effective collision
(d) The average kinetic energy of the molecule

16. The reason for almost doubling the rate of reaction on increasing the temperature of the reaction system by 10^{oC} is
(a) The value of threshold energy increases
(b) Collision frequency increases
(c) The fraction of the molecule having energy equal to threshold energy or more increases
(d) Activation energy decreases

17. The activation energy for a simple chemical reaction $A \rightarrow B$ is E_a in forward direction. The activation energy for reverse reaction
(a) Is always double of E_a
(b) Is negative of E_a
(c) Is always less than E_a
(d) Can be less than or more than E_a

18. Arrhenius equation is
(a) $\frac{d\ ln\ K}{dT} = \Delta E^*/RT$
(b) $\frac{d\ ln\ K}{dT} = \Delta E^*/RT^2$
(c) $\frac{d\ ln\ K}{dT} = -\Delta E^*/RT^2$

(d) $\frac{d \ln K}{dT} = -\Delta E^*/RT$

19. Activation energy of any reaction depends on

(a) Temperature

(b) Nature of reactants

(c) Number of collisions per unit time

(d) Concentration of reactants

20. Relation between rate constant and temperature by Arrhenius equation is

(a) $log_e A = log_e K + \frac{E_a}{RT}$

(b) $log K = A\frac{E_a}{RT}$

(c) $log_e K = log_e A - \frac{E_a}{RT^2}$

(d) $log A = RT \ln E_a - \ln K$

21. An endothermic reaction $A \rightarrow B$ has an activation energy $15kcal/mole$ and energy of reaction $5kcal/mole$. The activation energy of the reaction $B \rightarrow A$ is

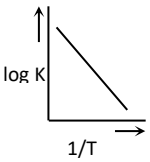
(a) 20 *kcal/mole*

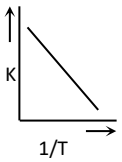
(b) 15 *kcal/mole*

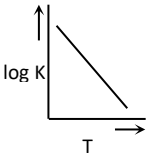
(c) 10 *kcal/mole*

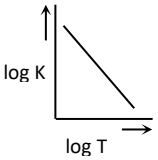
(d) None of these

22. Which of the following plots is in accordance with the Arrhenius equation

(a) 

(b) 

(c) 

(d) 

23. The Arrhenius equation expressing the effect of temperature on the rate constant of a reaction is

(a) $k = e^{-E_a/RT}$

(b) $k = E_a/RT$

(c) $k = log_e \frac{E_a}{RT}$

(d) $k = Ae^{-E_a/RT}$

24. For a reaction, activation energy $(E_a) = 0$ and rate constant $(K) = 3.2 \times 10^6 s^{-1}$ at 300 *K*. What is the value of the rate constant at 310 *K*

(a) $3.2 \times 10^{-12} s^{-1}$ (b) $3.2 \times 10^6 s^{-1}$

(c) $6.4 \times 10^{12} s^{-1}$ (d) $6.4 \times 10^6 s^{-1}$

25. Activation energy is given by the formula

(a) $log \frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$

(b) $log \frac{K_1}{K_2} = -\frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$

(c) $log \frac{K_1}{K_2} = -\frac{E_a}{2.303R}\left[\frac{T_1 - T_2}{T_1 T_2}\right]$

(d) None of these

26. A reaction having equal activation energies for forward and reverse reaction has

(a) $\Delta H = 0$

(b) $\Delta S = 0$

(c) Zero order

(d) None of these

27. Collision theory is applicable to

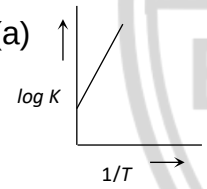
(a) First order reactions

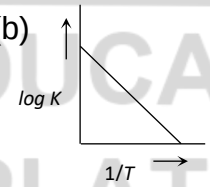
(b) Zero order reactions

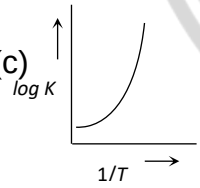
(c) Bimolecular reactions

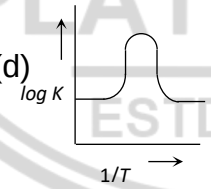
(d) Intra molecular reactions

28. A graph plotted between log *K* vs 1/*T* for calculating activation energy is shown by

(a) 

(b) 

(c) 

(d) 

29. The rate constant of a reaction at temperature 200*K* is 10 times less than the rate constant at 400 *K*. What is the activation energy (E_a) of the reaction (*R* = gas constant)

(a) 1842.4 *R* (b) 921.2 *R*

(c) 460.6 *R* (d) 230.3 *R*

30. In respect of the equation $k = Ae^{-E_a/RT}$ in chemical kinetics, which one of the following statement is correct

(a) *k* is equilibrium constant

(b) *A* is adsorption factor

(c) E_a is energy of activation

(d) *R* is Rydberg's constant

31. The rate constant is doubled when temperature increases from 27°*C* to 37°*C*. Activation energy in *kJ* is

(a) 34 (b) 54

(c) 100 (d) 50

32. The activation energy of a reaction is zero. The rate constant of this reaction

(a) Increases with increase of temperature

(b) Decreases with an increase of temperature

(c) Decreases with decrease of temperature

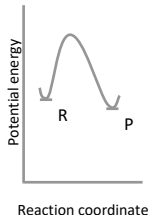
(d) Is independent of temperature

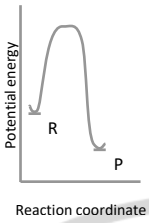
33. The rate constant is given by the equation $k = pze^{-E/RT}$. Which factor should register a decrease for the reaction to proceed more rapidly

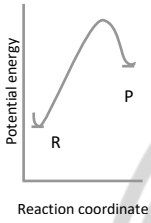
(a) T (b) Z

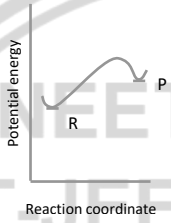
(c) E (d) p

34. An endothermic reaction with high activation energy for the forward reaction is given by the diagram:

(a) 

(b) 

(c) 

(d) 

35. Consider an endothermic reaction $X \rightarrow Y$ with the activation energies E_b and E_f for the backward and forward reactions, respectively, in general

(a) $E_b < E_f$

(b) $E_b > E_f$

(c) $E_b = E_f$

(d) There is no definite relation between E_b and E_f

36. Temperature dependent equation can be written as

(a) $ln\, k = ln\, A - e^{E_a/RT}$

(b) $ln\, k = ln\, A + e^{E_a/RT}$

(c) $ln\, k = ln\, A - e^{RT/E_a}$

(d) All of these