1. How many moles of carbon atom are there in 120 g of CH_3COOH?
(atomic mass of C=12, O=16, H=1)
A. 2 C. 3
B. 4 D. 6

2. The decomposition of HI into hydrogen and iodine on a gold surface is zero order in HI. The rate constant for the reaction is 0.050 s–1. If you begin with a 0.500 M concentration of HI, what is the concentration of HI after 5 seconds?
A. 0.250 M B. 0.500M C. 0.125M D. 1.25 M

3. Which of the following straight line plots correspond to a first order reaction?
A. [A] vs t with a slope of –k C. 1/[A] vs t with a spole –k
B. ln[A] vs t with a slop of +k D. ln[A] vs t with a slop of -k

4. Which of the following coud represent the units of the rate constant k for a reaction that is 3rd order overall?
A. M^2s^{-1} B. hr^{-1} C. $M^{-2}\ min^{-1}$ D. $M^{-1}\ days^{-1}$

5. Which of the following statement is false?
A. The half life of a first order reaction is independent of the concentration of the reactant.
B. The rate constant k is inversely related to the half life a second order reaction
C. The half life of zero order is directly proportional to the initial concentration of the reactant.
D. The half life of second order is inversely proportional to the initial concentration of the reactant

6. . The correct expression for a second-order reaction is
A. rate = 2k[A] C. rate = $k[A][B]^2$
B. rate = $k[A]^2$ D. rate =k

7. If we double the concentration of a reactant, the rate increase by four times, the reaction is: A. second-order B. zero-order C. first-order D. none

8. Rate law for the reaction A + 2B ⟶ C is found to be Rate = $k[A][B]$
If the concentration of reactant 'B' is doubled, keeping the concentration of 'A' constant, what will be the value of the rate constant?
A. The same B. halved C. quadrupled D. doubled

9. In the reaction Cu(s) + HNO3 (aq) ⟶ Cu(NO3)2(aq) + NO(g) + H2O(□).The total sum of coefficients in front of reactants and products would be:
A. 5 B. 20 C. 11 D. 12

10. The electrolysis of water be described as
A. Combination reaction C. Synthesis reaction
B. Replacement reaction D. Analysis reaction

11. Which statement best describes characteristics of an endothermic reaction?
A. The sign of ΔH is *positive*, and the products have *less* potential energy than the reactants.
B. The sign of ΔH is *positive*, and the products have *more* potential energy than the reactants.

C. The sign of ΔH is *negative*, and the products have *less* potential energy than the reactants.

D. The sign of ΔH is *negative*, and the products have *more* potential energy than the reactants.

12. In the reaction involving 3 g of ethane and 10g of chlorine 5.7g of ethyl chloride is produced. Calculate the percentage yield of ethyl chloride. The equation for the reaction is given below. (at.masses: C=12, H=1, Cl=35.5)

$C_2H_6 + Cl_2 \longrightarrow C_2H_5Cl + HCl$

A. 82.86% B. 76.42% C. 88.37% D. 96.60%

13. A gas in a balloon occupies 20.0 L at a temperature of $27c^0$ .If the pressure of a balloon kept constant, at what temperature the volume of gas is doubled?

A. 54 c^0 B .540 c^0 C. 54K D. 600 K

14. Which statement explains why the speed of some chemical reactions is increased when the surface area of the reactant is increased?

A. This change increases the density of the reactant particles.

B. This change increases the concentration of the reactant.

C. This change exposes more reactant particles to a possible collision.

D. This change alters the electrical conductivity of the reactant particles

15. Which one of the following chemical reactions only produces one product?

A. Combination reaction C. Double decomposition reaction

B. Single replacement reaction D. analysis reaction

16. If 8g of hydrogen and 32g of oxygen are mixed, what mass of water is produced according to the reaction bellow? (At mass of H=1, 0=16)

$2H_2+O_2 \longrightarrow 2H_2O$

A. 36g C. 54g

B. 72g D. 18g

17. In the reaction $CUO+H_2 \longrightarrow CU+H_2O$, the oxidizing agent in the above reaction is :

A. H_2 C. CU

B. CUO D. H_2O

18. How many moles of NO_2 gas are required to produce 6 moles of HNO_3 according to the following reaction?

$3NO_2+H_2O \longrightarrow 2HNO_3+NO$

A. 4 moles C. 3 moles

B. 6 moles D. 9moles

19. In a reaction, A+B → product, the rate is doubled when the concentration of B is 'doubled, and the rate increases by a factor of 8 when concentrations of both the reactants (A and B) are doubled, the rate law for the reaction can be written as:

A. Rate = k[A] [B] B. Rate = $k[A][B]^2$ C. Rate = $k [A]^2 [B]$ D. Rate = $k [A]^2 [B]^2$

20. The mechanism of a reaction is shown is shown below.

$HOOH + I^- \rightarrow HOI + OH^-$ (slow)

$HOI + I^- \rightarrow I_2 + OH^-$ (fast)

$2OH^- + 2H_3O^+ \rightarrow 4H_2O$ (fast)

What is the rate law based on this mechanism?

A. Rate = k [HOOH] $[I^-]$ C. Rate = k [HOOH] $[I^-]^2$

B. Rate = k [HOOH]^2 $[I^-]$ D. Rate = k [HOOH]

21. The half life for the first order decomposition of nitro methane, CH_3NO_2, at 500k is 650 seconds. If the initial concentration of CH_3NO_2 is 0.500M, what will its concentration be(M) after 1300 seconds have elapsed?

A. 0.125 B. 0.140 C. 0.250 D. 0.425

22. In a zero- order reaction for every 10^0 rise of temperature, the rate is doubled. If the temperature is increased from 10^0c to 100^0C, the rate of the reaction will become

A. 64times B. 128 times C. 256 times D. 512 times

23. The kinetic data below are for the reaction:

A + B → C

[A]	[B]	Initial Rate (mol dm^{+3} sec^{-1})
0.1	0.1	$1x10^{-5}$
0.1	0.2	$4x10^{-5}$
0.2	0.1	$1x10^{-5}$

A. order of A = 1 order of B = 0 C. order of A = 0 order of B = 4

B. order of A = 0 order of B = 2 D. order of A = 1 order of B = 2

24. What is a valid rate expression for the following reaction?

$2NO + 2H_2 \rightarrow N_2 + 2H_2O$

A. $\frac{1}{2}\frac{\Delta[NO]}{\Delta t}$ B. $-\frac{1}{2}\frac{\Delta[H_2o]}{\Delta t}$ C. $-\frac{1}{2}\frac{\Delta[NO]}{\Delta t}$ D.- $\frac{\Delta[N_2]}{\Delta t}$

25. For the reaction:

$2A + B \longrightarrow C$

The following experimental results were obtained:

Experiment	[A]	[B]	Rate (mol $L^{-1}s^{-1}$)
1	0.50	0.50	0.300
2	0.50	0.25	0.075
3	0.25	0.25	0.075

What is the value of the rate constant?

A. 0.6mol $L^{-1}s^{-1}$ B. 0.6Lmol^{-1}s^{-1} C. 1.2Lmol^{-1}s^{-1} D. 2.4mol$L^{-1}s^{-1}$

26. Increase in temperature of a reaction also increase the rate of a given reaction is due to the increase in the:

A. Extent of molecular dissociation

B. Frequency of collision of the reacting species

C. Activation energy of the reaction

D. Numerical value of the rate constant of the reaction

27. What is the half-life, t 1/2 for a zero order reaction A → B, (K is rate constant)?

A. In2K B. $[A]/2K$ C. Ink$[A]$ D. In2$[A]$K

28. The reaction $2X + Y \longrightarrow Z$ was studied and the following data were obtained

Expt	[X]	[Y]	Rate (mole L^{-1}-s^{-1})
1	3.0	3.0	1.8
2	3.0	1.5	0.45
3	1.5	1.5	0.45

What is the proper rate expression?

A. Rate = K[X] B. Rate = K[X] [Y] C. Rate = K$[Y]^2$ D.^{2}Rate = K[X]2 [Y]

29. The reaction between NO and I_2 is second order in NO and first- order in I_2. What change occurs in the rate of the reaction if the concentration of NO is doubled and I_2 left unchanged?

A. Double B. Quadruple C. Eight times D. Three times

30. A reaction is 50% complete in 2 hours and 75%complete in 4 hours. What is the order of this reaction?

A. 0 B. 1 C. 2 D. 3

31. Which are the number of moles and the mass of a copper sample containing 5.00xl0^{20} atoms?

A. 3.8xlO-^{4}mol Cu and 5.2xlO-^{2}g Cu C. 5.2xlO-^{2} mol Cu and 8.3xlO-4_g Cu

B. 8.3xl0-4 mol Cu and 5.2xlO-^{2}g Cu D. 5.2xlO-^{2} mol Cu and 3.8xI0-4_g Cu

32. Given the following reaction, what mass of gaseous carbon dioxide can be absorbed by lkg of lithium hydroxide? $2LiOH(s) + CO_2(g) \rightarrow LiC0_3(s) + H_20$ (1)

A. 920g B. 1840g C. 2760g D. 3680g

33. If a sample containing 36g NH_2 is reacted with 180g of CuO, according to the following reaction, then what is the <u>limiting</u> reactant and how many grams of N_2 will be formed?

2NH3 (g) + 3CuO (s) → N2 (g) + 3Cu(s) + $3H_20$ (g)

A. NH_3; 10.6gN_2 B. NH_3;22.3gN_2 C. CuO; 22.3gN_2 D. CuO; 10.6gN_2

34. If the fermentation of sugar in an enzymatic solution, which is initially 0.2M, the concentration of the sugar is reduced to O.IM in 10hours and to 0.05M in 20 hours. What is the order of the reaction and the rate constant?

A. First order K= 1.92xlO-^{s}s-^{1} C. Second order K=1.38xl0-4M^{-1}s^{-1}

B. First order K= 3.85xI0-^{s}s-^{1} D. Second order K= 2.72xlO-4M-1s^{-1}

35. The reaction, 20_r-->30_2, proceeds through the mechanism given below:

$O_3 \rightarrow O_2 + O$, fast

$O + O_3 \rightarrow 2O_2$ slow.

What would be the rate law expression for the reaction?

A. Rate = K[0_3][0_2] B. Rate = K[O][O2]^2 C. Rate = K[0][O_2] D. rate = K[0_3]^2

36. Consider the following:

$2NO(g)+Cl_{2(g)} \rightarrow 2NOCl(g)$, $\Delta H = -78.38KJ$

Which of the following does NOT affect the rate of a chemical reaction?

A. Volume C. Surface area

B. Concentration of reactants D. Temperature

37. Each of the choices below gives a reaction and the corresponding rate law. Of these choices, which one could be an elementary process or individual step in a chemical reaction?

A. $2A \rightarrow$ P, rate = K[A]
B. $A+2B \rightarrow$ P, rate = K [A]
C. $A+B \rightarrow$ P, rate = K [A][B]
D. $A+B+C \rightarrow$P, rate = K [A][C]

38. Consider the reaction in which nitric oxide is oxidized to nitrogen dioxide:

$2NO(g)+O_2(g)-2NO_2(g)$

For which the rate law is rate = k [N0]2[02]' If this reaction takes place in a sealed vessel and the partial pressure of nitric oxide is doubled, what effect would this have on the rate of reaction?

A. The reaction rate would increase by a factor of four.
B. The reaction rate would increase by a factor of three.
C. The reaction rate would increase by a factor eight.
D. The reaction rate would increase by a factor of two.

39. A homogeneous liquid reaction mixture is often heated to increase the rate of reaction. This is best explained by the fact that raising the temperature:

A. Increases the heat of reaction.
B. Decrease the energy of activation.
C. Increases the vapor pressure of the liquid.
D. Increases the average kinetic energy of the reactants.

40. Considering the reaction below , in which of the following will the effect of concentration and temperature simultaneously cause an increase in the rate at which products are formed?

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CO_{2(g)} + CaCl_{2(aq)} + H_2O_{(l)} + \text{heat}$$

A. Decrease [HCl] and decrease temperature
B. Increase [HCl] and decrease temperature
C. Increase [HCl] and increase temperature
D. Grind up the $CaCO_3$ and decrease temperature

41. Considering the mechanism for a reaction below , which of the following statement is correct?

Step 1: $HBr + O_2 \rightarrow HOOBr$
Step 2 : $HBr + HOOBr \rightarrow 2HOBr$
Step 3 : $2HOBr + 2HBr \rightarrow 2Br_2 + 2H_2O$

A. Br_2 is reactant
B. HBr is a product
C. HOBr is a catalyst
D. HOOBr is a reaction intermediate

42. The reaction A + 3B = 2C + D is first order with respect to reactant A and second order with respect to reactant B . If the conc of A is doubled and the concentration of B is halved , the rate of the reaction would….by a factor of…

A. increase ,2
B. decrease ,2
C. increase, 4
D. decrease , 4

43. How many electrons will appear when the following half- reaction is balanced?

$$S_4O_6^{2-} \rightarrow S_2O_3^{2-}$$

A. 3
B. 2
C. 4
D. 1

44. The decomposition of carbon disulfide. CS_2 to carbon monosulfide, CS, and sulfur is first order with $K=2.8x10^{-7}S^{-1}$ at 1000^0C. What is the half-life of the reaction below at 1000^0C?

$CS_2 \rightarrow CS+S$

A. $5.0x10^{-7}S$ B. $4.7x10^{-6}S$ C. $3.8x10^{5}S$ D. $2.5x10^{6}S$

45. If we increase the concentration of a reactant , what happens to the collisions beteen particles?

A. There are more collisions B. There are fewer collisions

C. There are the same number of collisions

D. There are same number of collisions , but they have more energy

46. A drug decomposes by zero-order kinetics with a rate constant of 2mg mL^{-1} $month^{-1}$. If the initial concentration is 100 mg mL^{-1} , how long will it take for the drug to decompose by 10%?

A. 2 month B. 3 month C. 5month D. 4 month

47. For a first -order reaction , a plot of ---------- versus ---------- is linear.

A. $\frac{1}{[A]t}$,t B. Ln $\frac{1}{[A]t}$,t C. $[A]_t$,t D. Ln$[A]_t$,t

48. The rate law of the overall reaction A + B → C is: rate = K$[A]^2$ Which of the following will NOT increase the rate of the reaction?

A. Increasing the concentration of reactant A

B. Increasing the temperature of the reaction

C Increasing the concentration of reactant B D. Adding a catalyst for the reaction

49. Which of the following statement(s) is (are) applicable to a balanced chemical equation of an elementary reaction?

i. Order is the same as molecularity ii. Order is less than the molecularity

iii. Order is greater than the molecularity iv. Molecularity can never be zero

A. i B. i , ii C. i , iv D. i , iii

50. At high pressure, the following reaction is zero order

$2NH_{3(g)} \xrightarrow{11.30\ K, Pt} N_{2(g)} + 3H_{2(g)}$

i. Rate of reaction = rate constant

ii. Rate of reaction depends on the concentration of ammonia

iii. Rate of decomposition of ammonia remains constant until ammonia decomposes completely

iv. Further increase in pressure will change the rate of reaction

A. i B. i , iii, iv C. i, ii D. i ,ii iv

51. Which of the following expressions is correct for the rate of the reaction given below?

$5Br\ (aq) + BrO_3\ (aq) + 6H^+\ (aq) \rightarrow 3Br_2\ (aq) + 3H_2O(l)$

A. $\frac{\Delta[Br]}{\Delta t} = 5\frac{[\Delta H]}{\Delta t}$ B. $\frac{\Delta[Br]}{\Delta t} = 5/6\ \frac{[\Delta H]}{\Delta t}$ C. $\frac{\Delta[Br]}{\Delta t} = 6/5\frac{[\Delta H]}{\Delta t}$ D. $\frac{\Delta[Br]}{\Delta t} = 6\frac{[\Delta H]}{\Delta t}$

52. Rate for the reaction A + 2B ➜ C is found to be

Rate = K [A][B]

If the concentration of reactant ′ B′ is doubled , keeping the concentration 'A′ constant what will be the value of the rate constant?

A. the same B. doubled C. halved D. quadrupled

53. The oxidation of chloride by dichromate ($Cr_2O_7^{2-}$) in acidic solution can be written as follows:

$$6Cl^{-1}(aq) + Cr_2O_7^{2-}(aq) \rightarrow 3Cl_2(g) + 2Cr^{3+}(aq) + H_2O(l)$$

The reaction is first order in Cl^{-1} ,first order in $Cr_2O_7^{2-}$ and second order in H^+ . What is the change in initial rate if the concentration of Cl^{-1} and $Cr_2O_7^{2-}$ are halved ? The new rate will be have

A. rate $= \frac{1}{8}$ (initial rate) B. rate $= \frac{1}{2}$ (initial rate)

C. rate $= \frac{1}{4}$ (initial rate) D. no change

54. Consider the following gaseous reaction and its rate law given below

$$2A(g) + B(g) \rightarrow C(g)$$

$$Rate = K[A]^2[B]$$

In this reaction [A] = 2.0 M and the rate was recorded to be 0.048 mole $1^{-1}s^{-1}$. What will be the numerical value of the rate constant, K ?

A. 8.O B. 6.0×10^{-3} C. 3.0×10^{-3} D. 1.5×10^{-3}

55. Given : $A + 3B \rightarrow 2C + D$

This reaction is first order with respect to reaction A and second order with respect to reactant B . If the concentration of A is doubled and the concentration of B is halved , the rate of the reaction would ---------- by a factor of-------

A. increase, 2 B. decrease , 2 C. increase , 4 D. decrease , 4

56. For zero order reactions ,which one of the following is true ?

A. The units of the rate constant (k) are time $^{-1}$

B. The half- life may be represented by the expression $t\frac{1}{2} = 0.693/k$

C. The rate of degradation is independent of the concentration of the reactant(s)

D. A plot of the concentration remaining against time is a straight line with a gradient of 1/k

57. If the reaction is zero order in A, tripling the concentration of A will cause the reaction rate to:

A. Increase by a factor of 27 C. Remain constant

B. Increase by a factor of 3 D. Increase by a factor of 9.

58. Which one of the following factor does NOT affect the rate of a chemical reaction?

A. Humidity B. Concentration C. Temperature D. Nature of reactants

59. What species of ions are present in a 0.1M solution of HCl and what will be their equilibrium concentration?

A. $[H_3O]^+ = 01M$; $[OH]^- = 0.1M$, $[Cl]^- = 0.1M$ C. $[H_3O]^+ = 0.1M$; $[OH]^- = 10^{-13}M$, $[Cl] = 0.1M$

B. $[H_3O]^+ = 0.1M$; $[OH]^- = 0.01M$, $[Cl]^- = 0.1M$ D. $[H_3O]^+ = 10^{-13}$; $[OH]^- = 0.1M$, $[Cl]^- = 0.1M$

60. The decomposition of a compound at 400^{o}c is first order with the half life of 1570seconds. What fraction of an initial amount of the compound remains after 4710seconds?

A. 1/12 B. 1/6 C. 1/8 D. 1/3

61. Which of the following is true regarding T1 and T2?
   A. T1=T2, fraction of molecules at both temperatures are equal.
   B. T1<T2, fraction of molecules at T1 is smaller.
   C. T2<T1, fraction of molecules at T2 is smaller.
   D. T1<T2, fraction of molecules at T1 is larger.

62. In three different experiments the following results were obtained for the reaction A products: $[A]_0$=1.00M, $t_{1/2}$ = 50min; $[A]_0$= 2.00M, $t_{1/2}$=25min; $[A]_0$=0.50M, $t_{1/2}$= 100min. what is the value of the rate constant for this reaction?
   A. $0.010 Lmol^{-1}min^{-1}$ C. $0.020 Lmol^{-1}min^{-1}$
   B. $0.030 Lmol^{-1}min^{-1}$ D. $0.040 Lmol^{-1}min^{-1}$

63. The reaction below takes place with all of the reactants and products in the gaseous phase. Which of the following is true of the relative rates of disappearance the reactants and appearance of the products? $2NOCl \longrightarrow 2NO + Cl_2$
   A. NO appears at twice the rate that NOCl disappears.
   B. NO appears at half the rate that NOCl disappears.
   C. NO appears at the same rate that NOCl disappears
   D. Cl_2 appears at the same rate that NOCl disappears

64. The proposed reaction mechanism between nitrogen monoxide and bromine is given below.
   $NO + Br_2 \longrightarrow NOBr_2$(fast)
   $NOBr_2 + NO \longrightarrow 2NOBr$(slow)
   Which of the following rate equations is consist with the proposed mechanism?
   A. $Rate=K[NO]^2$ C. $Rate=k[NO]^2[Br_2$
   B. $Rate=k[NO][Br_2]^2$] D. $Rate=k[NO][Br_2]$

65. The minimum energy required for an effective collision is called……?
A. activation energy B. Potential energy C. Free energy D. Kinetic energy

66. For the reaction, $N_2(g) + 3H_2(g)$ $2NH_3(g)$, the rate of disappearance of H2 is $0.01 molL^{-1}min^{-1}$. What is the rate of appearance of NH_3?
   A. $0.007 molL^{-1}min^{-1}$ C. $0.01 molL^{-1}min^{-1}$
   B. $0.02 molL^{-1}min^{-1}$ D. $0.002 molL^{-1}min^{-1}$

67. The appropriate unit for a first order rate constant is?
   A. 1/S B. 1/MS C. M/S D. $1/M^2S$