

Qesem Academy
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2018 E.C Grade 12 Chemistry Model Exam

Time Allowed: 2 hours 30 minutes

General Instructions

1. Read each question thoroughly before answering.
2. Each question has four options (A, B, C, D). Choose the correct one and write the letter of your choice on the answer sheet.
3. There are 80 questions. Plan your time so you can attempt all questions within 2 hours 30 minutes.
4. The use of textbooks, notes, calculators, or electronic devices is not allowed.
5. Ensure that all written answers are clear and legible. Illegible or incomplete answers will not be scored.
6. Check your answers carefully before submitting.
7. Any form of cheating will result in disqualification.

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1. Which subatomic particle determines the atomic number of an element?

A. Neutron
C. Electron
B. Nucleus
D. Proton

2. The region around the nucleus where electrons are most likely to be found is called:

A. Shell
C. Orbital
B. Orbit
D. Cell

3. Which pair represents isotopes of the same element?

A. ${}^{12}_{6}A$ *and* ${}^{14}_{7}A$
C. ${}^{24}_{12}X$ *and* ${}^{23}_{11}Y$
B. ${}^{32}_{16}Q$ *and* ${}^{34}_{16}P$
D. ${}^{35}_{17}M$ *and* ${}^{19}_{9}N$

4. When an electron moves from n=2 to n=4, the atom

A. Absorbs energy
C. Remains unchanged
B. Releases energy
D. Decreases in energy

5. Which electron configuration represents a one-electron exited state of a neutral magnesium atom? (Given: ${}^{24}_{12}Mg$)

A. $1s^2 2s^2 2p^6 3s^2$
C. $1s^2 2s^2 2p^6 3s^2 3p^1$
B. $1s^2 2s^2 2p^6 3s^1 3p^1$
D. $1s^2 2s^2 2p^6 3s^0 3p^2$

6. The increase in atomic radius down a group in the modern periodic table is primarily due to:

A. Increase in the number of neutrons
C. Increase in nuclear charge
B. Increase in the number of protons
D. Addition of electron shells

7. Which statement best explains why noble gases are chemically inert?

A. Their electron shells are full
C. Their nuclei are stable
B. They have small atomic radii
D. They form colorful flames

8. A student claims that magnesium is more metallic than aluminum. Which evidence supports this?

A. Mg has fewer isotopes
C. Al has lower melting point
B. Mg has lower electronegativity
D. Al has a larger radius

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9. A bond formed by the transfer of electrons between more electropositive and more electronegative elements is:

A. Covalent
B. Hydrogen
C. Metallic
D. Ionic

10. Which molecule has a tetrahedral molecular geometry?

A. CO_2
B. H_2O
C. NH_3
D. CH_4

11. Which elements are most likely to form a covalent compound?

A. Na and Br
B. Mg and O
C. H and Cl
D. K and F

12. What is the approximate bond angle in a trigonal pyramidal molecule such as NH_3?

A. Slightly less than 180°
B. Slightly greater than 120°
C. Slightly greater than109.5°
D. Slightly less than 109.5°

13. Which of the following characteristic best describes metallic bonding?

A. Electrons shared in pairs between atoms
B. Electrons transferred between ions
C. Positive ions in a sea of delocalized electrons
D. Covalent networks within molecules

14. A molecule with a trigonal planar shape must have

A. Three bonding pairs and no lone pair
B. Two lone pairs and one bond pair
C. Four bonding pairs and no lone pair
D. Two bonding and two lone pairs

15. Which explanation best describes why ionic compounds have high melting points?

A. The particles are neutral and larger in size
B. the molecules are neutral and small in size
C. Strong electrostatic forces hold ions together
D. The ions vibrate rapidly throughout the solid

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16. Which molecule is most polar due to molecular asymmetry and a large differences in electronegativity ?

A. CH_4
B. CO_2
C. O_2
D. NH_3

17. Which state of matter has particles vibrating in fixed positions?

A. Solid
B. Liquid
C. Gas
D. Plasma

18. Which of the following is the SI unit of pressure?

A. Joule
B. Newton
C. Pascal
D. Watt

19. According to Charles's law, the volume of a gas is directly proportional to which of the following?

A. Pressure
B. Mass
C. Density
D. Temperature

20. Which characteristic of a gas is observable when a balloon shrinks upon cooling?

A. Mass decreases
B. Gas contracts
C. Gas escapes
D. Volume increases

21. Which gas law explains the inverse relationship between pressure and volume, assuming temperature is constant?

A. Boyle's law
B. Charles' law
C. Avogadro's law
D. Combined gas law

22. A substance with strong intermolecular forces is most likely to have which of the following properties?

A. Low boiling point
B. Weak bonds
C. High compressibility
D. High boiling point

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23. Why do gases diffuse more rapidly than liquids?

A. Gases have higher density

B. Gases experience stronger intermolecular forces

C. Gases experience weaker intermolecular forces

D. Gases consists of larger particle size

24. Which factor best explains the difference in diffusion rates of NH_3 and HCl gases?

A. Molar mass

B. Container size

C. Pressure difference

D. Temperature alone

25. Which statement correctly defines the rate of a chemical reaction?

A. Amount of product per mole

B. Change in concentration per unit time

C. Temperature change per Kelvin scale

D. Mass lost per unit time

26. A catalyst increases the rate of chemical reaction by:

A. Increasing product mass

B. Lowering activation energy

C. Raising temperature

D. Changing reactants

27. Which of the following is a result of increasing the concentration of reactants?

A. Slows the reaction

B. Stops collisions

C. Increases collision frequency

D. Lowers activation energy

28. For an endothermic reaction, what is the effect of increasing the temperature?

A. Decreases the reaction rate

B. Stops the reaction

C. Has no effect on the reaction rate

D. Increases the reaction rate

29. A reaction proceeds faster when reactants are in powdered form because:

A. They weigh less

B. Surface area is increased

C. They absorb heat

D. Their mass increases

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30. A reaction speeds up when the surface area of a reactant increases because

A. More collisions occur
B. Heat is released
C. Mass increases
D. Catalysts are formed

31. A student increases the temperature of a reaction and observes that the rate doubles. The best explanation is

A. Catalysts formed as byproduct
B. Molecules exceed the activation energy
C. Collisions of particles stop
D. Pressure of particle decreases

32. A reaction rate remains constant when the concentration of reactants changes. The reaction is

A. Zero order
B. First order
C. Second order
D. Catalytic

33. At chemical equilibrium, what happens to the concentrations of reactants and products?

A. Change rapidly
B. Become zero
C. Remain constant
D. Change continuously

34. The equilibrium constant (Kc) depends on which of the following variable?

A. Pressure
B. Catalyst
C. Concentration
D. Temperature

35. For the reaction A ⇌ B, if product B is removed, the equilibrium will:

A. Shift left
B. Shift right
C. Stop
D. Reverse completely

36. Increasing the concentration of a reactant in a chemical reaction cause the equilibrium to

A. Shift right
B. Shift left
C. Stop
D. Remain unchanged

37. For the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3 + Heat$, which change will shifts the equilibrium to right?

A. Increase temperature
B. Add NH_3
C. Decrease temperature
D. Remove N_2

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38. Which one of the following describes the effect of a catalyst in a reversible reaction?

A. Increases product concentration
B. Decreases reactant concentration
C. Changing the value of K
D. Speeds both directions equally

39. Why does pressure affect equilibrium only in gaseous reactions?

A. Gas particles have mass
B. Gas particles are compressible
C. Liquids are incompressible
D. Solids are incompressible

40. A student observes that the equilibrium constant K increases when temperature increases. Which conclusion is correct?

A. Reaction is endothermic
B. Reaction is exothermic
C. Reaction stops
D. Reaction forms fewer products

41. The functional group –COOH belongs to which class of compounds?

A. Alcohol
B. Ester
C. Aldehyde
D. Carboxylic acid

42. Which of the following compound is an ester functional group?

A. CH_3COOH
B. CH_3OH
C. CH_3COOCH_3
D. CH_3CHO

43. Which of the following product is produced in the dehydration of an alcohol?

A. Ketone
B. Alkene
C. Carboxylic acid
D. Polymer

44. In the hydrogenation of an unsaturated fat, which of the following is formed?

A. Alcohol
B. Ketone
C. Saturated fat
D. Polyamide

45. Oxidation of a secondary alcohol produces which of the following compounds?

A. Ketone
B. Ester
C. Aldehyde
D. Ether

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46. The IUPAC name of $CH_3CH_2CH_2OCH_2CH_3$ is

A. Pentanol
C. Ethoxypropane
B. Proxyethane
D. Ethyl ester

47. Why do aldehydes oxidize more easily than ketones?

A. They have fewer atoms
C. They contain no oxygen
B. Carbonyl carbon has a hydrogen
D. They have higher mass

48. Which of the following reactions forms an ester?

A. Alcohol + acid
C. Ketone + acid
B. Alcohol + aldehyde
D. Ether + alcohol

49. Which of the following statements correctly describes a Bronsted-Lowry acid?

A. A substance that donates a H^+ in a reaction
B. A substance that accepts a H^+ in a reaction
C. A substance that donates an electron pair
D. A substance that can act as both an acid and a base

50. If the $[H^+]$ in a solution is 100×10^{-3} M, what is the pH of the solution?

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

51. Which of the following species is amphiprotic?

A. HCl
C. H_2O
B. NaOH
D. NH_4^+

52. Which of the following statements correctly describes the ionization of water?

A. Water fully dissociates into H^+ and OH^- ions
B. Water does not dissociate in aqueous solution
C. Water reacts with itself to form H_2 gas
D. Water partially dissociates into H^+ and OH^- ions

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58. What is meant by the hydrolysis of a salt?

A. Salt dissolves in water without ionizing
B. Salt completely dissociates into acid and base
C. Acid reacts with base to form pure water
D. Salt ions react with water to form acid or base

59. Which of the following salts produces an acidic solution when dissolved in water?

A. NaCl
B. NH_4Cl
C. KNO_3
D. CH_3COONa

60. Which of the following ions is responsible for the basic nature of an aqueous solution of CH_3COONa?

A. Na^+
B. H_3O^+
C. CH_3COO^-
D. Cl^-

61. Which of the following statements correctly describes an acid-base indicator?

A. A substance that reacts with acid to form a salt
B. A base that neutralizes an acid
C. A solution that maintains constant pH
D. A substance that changes color depending on pH

62. HCl is titrated with a NaOH. Which indicator would be most suitable to accurately determine the end point?

A. Methyl orange (pH transition 3.1–4.4)
B. Phenolphthalein (pH transition 8.3–10.0)
C. Bromothymol blue (pH transition 6.0–7.6)
D. Litmus (pH transition 4.5–8.3)

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53. The pH of a 0.20 M solution of a weak acid is 3.0. What is the Ka of the acid?

A. 3.0×10^{-4}
B. 5.0×10^{-6}
C. 2.0×10^{-6}
D. 4.0×10^{-4}

54. Which of the following expressions correctly represents the base dissociation constant K_b for a base B?

A. $K_b = \frac{[BOH]\,[H^+]}{[B]}$
B. $K_b = [H^+]\,[HO^-]$
C. $K_b = \frac{[BH^+]\,[HO^-]}{[B]}$
D. $K_b = [B]\,[HO^-]$

55. Which statement best explains why adding CH_3COONa to CH_3COOH suppresses the ionization of acetic acid?

A. Sodium acetate increases the acid dissociation constant
B. The acetate ion acts as a common ion in equilibrium
C. Acetic acid becomes a strong acid in solution
D. Sodium acetate completely neutralizes acetic acid

56. A buffer solution contains 0.25 M CH_3COOH and 0.15 M CH_3COONa. Given that $K_a = 1.8 \times 10^{-5}$, what is the pH of the buffer?

A. 4.52
B. 4.98
C. 4.74
D. 5.20

57. Which statement best justifies why the CH_3COOH/CH_3COONa buffer resists a change in pH when a small amount of HCl is added?

A. Acetic acid reacts with HCl to form a strong acid
B. Sodium acetate completely neutralizes all added acids
C. The acetate ion consumes added H^+ to form CH_3COOH
D. The pH is constant because the value of K_a increases

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63. Two titration curves are obtained: one for a strong acid-strong base titration and one for a weak acid-strong base titration. Which statement is correct?

A. The weak acid-strong base curve has equivalence at pH above 7
B. The weak acid-strong base curve has a steeper slope at equivalence
C. The strong acid-strong base curve has equivalence at pH below 7
D. Both curves have the same pH at half-neutralization

64. Which of the following defines a redox reaction?

A. A reaction in which acids react with bases
B. A reaction in which a solid forms
C. A reaction that occurs in a solution
D. A reaction involving the transfer of electrons

65. In the reaction below, which species is reduced?

$$\mathrm{Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)}$$

A. Zn (s)
B. Zn^{2+} (aq)
C. Cu^{2+} (aq)
D. Cu (s)

66. Consider the reaction:

$$\mathrm{2Mg(s) + O_2(g) \rightarrow 2MgO(s)}$$

Which of the following correctly identifies the oxidizing and reducing agents?

A. Mg is the oxidizing agent; O_2 is the reducing agent
B. Mg and O_2 are both oxidizing agents
C. Mg and O_2 are both reducing agents
D. Mg is the reducing agent; O_2 is the oxidizing agent

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67. Which statement best distinguishes electrolytic conductivity from metallic conductivity?

A. Electrolytic conductivity occurs by electrons, metallic by ions
B. Electrolytic conductivity occurs by ions, metallic by electrons
C. Both conductivities involve positive and negative ions
D. Electrolytic conductivity occurs in metals, metallic in solutions

68. During the electrolysis of molten NaCl, which species is discharged at the cathode?

A. Na^+ ions gaining electrons to form sodium metal
B. Cl^- ions gaining electrons to form Cl_2 gas
C. Na^+ ions losing electrons to form Na_2
D. Cl^- ions losing electrons to form chloride ions

69. Which setup will most likely result in a decrease in the mass of the anode during electrolysis of $CuSO_4$ solution?

A. $CuSO_4$ with copper electrodes
B. $CuSO_4$ with nickel electrodes
C. Dilute NaCl with inert electrodes
D. Dilute H_2SO_4 with platinum electrodes

70. A current of 2.0 A is passed through an electrolyte for 30 minutes. What is the total charge passed?

A. 3600 C
B. 60 C
C. 15 C
D 216, 000 C

71. Which of the following expressions correctly represents Faraday's second law of electrolysis?

A. $m \propto I$
B. $m \propto \frac{Q}{M}$
C. $m = I \times t$
D. $m \propto \frac{M}{Z}$

72. The same quantity of electricity is passed through solutions of $AgNO_4$ and $CuSO_4$. Which statement is correct?

A. More silver will be deposited because it has a higher equivalent mass
B. Equal masses of Ag and Cu will be deposited
C. More copper will be deposited because it has higher charge
D. More copper will be deposited because it has higher equivalent mass

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73. To obtain high-purity copper from impure copper for electrical wiring, which electrochemical process is most appropriate?

A. Electroplating, because it deposits copper on surfaces

B. Electrorefining, because it purifies copper at the cathode

C. Molten CuCl electrolysis, because it produces copper

D. Carbon reduction, because it extracts copper with impurities

74. What is the primary function of a salt bridge in a voltaic cell?

A. Maintains electrical neutrality

B. Increases cell potential

C. Allows electron flow

D. Prevents anode oxidation

75. A Zn-Cu galvanic cell is constructed using Zn^{2+}/Zn and Cu^{2+}/Cu half-cells. Which electrode acts as the anode?

A. Copper electrode

B. Salt bridge

C. Zinc electrode

D. Either electrode

76. Given the standard electrode potentials:

$Zn^{2+}/Zn = -0.76$ V and $Cu^{2+}/Cu = +0.34$ V.

Which statement correctly describes the Zn-Cu cell?

A. Zn is reduced and copper is oxidized

B. The reaction is non-spontaneous

C. Electrons flow from Cu to Zn

D. Zn is oxidized and Cu is reduced

77. Which statement correctly describes industrial chemistry?

A. Focuses on chemical reactions at laboratory scale

B. Involves large-scale chemical production

C. Applies chemistry in a school setting

D. Studies theoretical chemistry and its principles

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78. A factory uses limestone as a raw material to manufacture cement. Based on the raw material used, this factory is best classified as a:

A. Agro-based chemical industry
B. Petrochemical industry
C. Mineral-based chemical industry
D. Consumer-based industry

79. A chemical engineer proposes using water electrolysis instead of methane to produce hydrogen for the Haber process. Which evaluation is most correct?

A. Fully correct; electrolysis is more efficient industrially
B. Partially correct; electrolysis uses more energy than methane
C. Incorrect; nitrogen cannot be obtained from air by electrolysis
D. Incorrect; ammonia cannot form without recycling unreacted gases

80. You are tasked with designing an improved Haber process to maximize ammonia production while maintaining practical energy use. Which proposal demonstrates the most effective and innovative approach?

A. Operate at very high pressure and very low temperature without using a catalyst
B. Use a new catalyst, control pressure and temperature, and remove ammonia continuously
C. Use equal volumes of nitrogen and hydrogen without controlling pressure or temperature
D. Eliminate recycling of unreacted gases and increase gas flow in the reactor

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