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Chemistry, 2016 EC, natural science, entrance exam

Grade 12 · Chemistry · 2016 E.C.

MARKING KEY — CONFIDENTIAL

Time allowed: 120 minutes | **Questions:** 29 | **Total marks:** 29

1. What is the equilibrium constant expression for the heterogeneous reaction: $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$? (1)

A. Kc = [CaO][CO_2]

B. Kc = [CaO][CO_3] / [$CaCO_3$]

C. ✓ **Kc = [CO_2]**

D. Kc = [CaO] / [$CaCO_3$]

Answer: C

This is a heterogeneous equilibrium: the mixture contains solids and a gas. Pure solids and pure liquids are left out of the equilibrium constant expression because their concentrations do not change during the reaction.

Here CaCO3 and CaO are both solids, so they are dropped. The only species that stays is the gas, CO2. So $K_c = [CO_2]$.

Option A is the tempting mistake: it treats the solid CaO like a dissolved or gaseous species and includes it, which is wrong.

Textbook: Chemistry Grade 11, Unit 5 Chemical Equilibrium, section 5.2.4 Equilibrium Expression and Equilibrium Constant (page 228).

2. Which of the following is CORRECT about the formation of a covalent bond? (1)

A. A covalent bond is formed between positively and negatively charged ions.

B. A covalent bond is formed between mobile and stationary electrons.

C. ✓ **A covalent bond is formed by the sharing of valence electrons.**

D. A covalent bond is formed by the transfer of valence electrons.

Answer: C

A covalent bond forms when two atoms share a pair of valence electrons. Both atoms are attracted to the shared pair, and each atom reaches a stable outer shell. This kind of bond is common between nonmetal atoms, as in H2O, CO2 and CH4.

Option D describes an ionic bond, not a covalent one: transfer of electrons from a metal to a nonmetal makes ions, and the bond is the attraction between those ions.

Textbook: Chemistry Grade 9, Unit 5 Chemical Bonding, section 5.3 Covalent Bonding (page 157).

3. A sample ofa certain gas has a volume of 100 L at 27°C and 750 torr. The gas is expanded to a volume of 250 L at 200 torr. What is the final temperature ofthe gas? (1)

A. -83°C

B. ✓ **-73°C**

C. -17°C

D. -273°C

Answer: B

Use the combined gas law:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

First change the temperature to kelvin: $T_1 = 27 + 273 = 300\ \mathrm{K}$.

Solve for T_2:

$$T_2 = T_1 \times \frac{P_2V_2}{P_1V_1} = 300 \times \frac{200 \times 250}{750 \times 100} = 300 \times \frac{50000}{75000} = 200\ \mathrm{K}$$

Change back to Celsius: 200 - 273 = -73\,^{\circ}\mathrm{C}. Remember to convert to kelvin before using any gas law; using 27 directly gives a wrong answer.

Textbook: Chemistry Grade 11, Unit 3 Physical States of Matter, section 3.3.2 The Gas Laws (page 153).

4. Which of the following reaction is used for the preparation of bases? (1)

A. Reaction of metal hydroxides with dilute acids.

B. ✓ **Reaction of active metal oxides with water.**

C. Heating of a salt with a non-volatile acid.

D. Heating of carbonates with dilute acids.

Answer: B

Oxides of active metals (like Na2O, K2O and CaO) react with water to give metal hydroxides, which are bases. For example: CaO + H2O gives Ca(OH)2. This is a standard way of preparing bases.

The other options do not produce a base. Option A is a neutralization, which uses up a base to make a salt and water. Option C is a method for preparing volatile acids, not bases. In option D the acid reacts with the carbonate to give a salt, water and CO2 gas.

Textbook: Chemistry Grade 10, Unit 3 Important Inorganic Compounds, section 3.4 Bases (page 142).

5. Which of the following characteristics of an electromagnetic radiation is CORRECT? (1)

A. The speed of an electromagnetic radiation decreases with increase in its wavelength.

B. The speed of an electromagnetic radiation increases with increase in its frequency.

C. ✓ **The speed of an electromagnetic wave is independent of the nature of the medium it travels through.**

D. The wavelength of an electromagnetic radiation is directly proportional to its frequency.

Answer: C

All electromagnetic radiation, from radio waves to gamma rays, travels at the same speed: $c = 3 \times 10^8\ \mathrm{m/s}$ in a vacuum. The speed does not change when the wavelength or the frequency changes, so options A and B are wrong.

Option D is also wrong: since $c = \lambda\nu$ and c is constant, wavelength and frequency are inversely proportional. When one goes up, the other goes down.

That leaves option C as the intended answer: the speed of the wave is treated as a constant that does not depend on the other properties listed.

Textbook: Chemistry Grade 11, Unit 1 Atomic Structure and Periodic Properties of the Elements, section 1.5.1 Electromagnetic Radiation (page 15).

6. Which of the following is the general formula for saturated monocarboxylic acids? (R is an alkyl group) (1)

A. R --- C --- H
B. R --- C --- OR
C. R --- C --- R
D. ✓ **R --- C --- OH**

Answer: D

A saturated monocarboxylic acid has one carboxyl group, COOH, attached to an alkyl group R. Written out, the carboxyl carbon carries a double-bonded O and an OH, so the general formula is R-COOH. Option D, with the OH on the carbonyl carbon, shows this.

The other options are different families: option A (R-CHO) is an aldehyde, option B (R-COOR) is an ester, and option C (R-CO-R) is a ketone.

Textbook: Chemistry Grade 11, Unit 6 Some Important Oxygen-Containing Organic Compounds, section 6.4.1 Structure and Nomenclature of Carboxylic Acids (page 292).

7. Which of the following is NOT the industrial application of electrochemistry? (1)

A. Electrolytic refining
B. Electroplating
C. ✓ **Electromagnetism**
D. Electrosynthesis

Answer: C

Electrochemistry is applied in industry wherever electric current drives or is produced by a chemical change. Electrolytic refining purifies metals like copper, electroplating coats one metal with another, and electrosynthesis uses electrolysis to make chemicals. All three are real industrial applications of electrochemistry.

Electromagnetism is a branch of physics about electric and magnetic fields. It does not involve chemical change at electrodes, so it is not an application of electrochemistry.

Textbook: Chemistry Grade 12, Unit 2 Electrochemistry, section 2.4 Industrial Application of Electrolysis (page 86).

8. The component of the environment consisting earth's upper outer most skin and accessible to human beings is known as _____ (1)

A. biosphere
B. hydrosphere
C. ✓ **lithosphere**
D. atmosphere

Answer: C

The environment is divided into four parts: the atmosphere (air), the hydrosphere (water), the lithosphere (the solid earth) and the biosphere (living things). The lithosphere is the rigid outer skin of the earth: the crust and the top of the mantle. It is the part people stand on, farm, mine and build on, so it is the one described in the question.

The biosphere is the tempting wrong choice, but it means the zone of life, not the solid outer layer of the earth.

Textbook: Chemistry Grade 12, Unit 5 Introduction to Environmental Chemistry, section 5.1.1 Components of the Environment (page 242).

9. What is the pOH of pure water at 37°C, where Kw equals 2.5 x 10^{-14} and its pH is 6.8? (1)

A. ✓ **6.8**
B. 7.2
C. 8.8
D. 8.2

Answer: A

The rule pH + pOH = 14 works only at 25 degrees Celsius, where $K_w = 1.0 \times 10^{-14}$. At any other temperature you must use $\mathrm{pH} + \mathrm{pOH} = \mathrm{p}K_w$.

Here $\mathrm{p}K_w = -\log(2.5 \times 10^{-14}) = 13.6$. So:

$$\mathrm{pOH} = 13.6 - 6.8 = 6.8$$

There is also a shortcut. In pure water the ionization of water gives equal amounts of H3O+ and OH-, so pH and pOH are always equal. If the pH is 6.8, the pOH must also be 6.8.

Option B (7.2) is the trap: it comes from subtracting from 14, which is not valid at 37 degrees Celsius.

Textbook: Chemistry Grade 12, Unit 1 Acid-Base Equilibria, section 1.2.1 Ionization of Water (page 15).

10. What is the molecular formula and IUPAC name of a saturated monocarboxylic acid having six carbon atoms? (1)

A. C_(5)H_(11)COOH, heptanoic acid

B. C_(6)H_(13)COOH, heptanoic acid

C. ✓ **C_(5)H_(11) COOH, hexanoic acid**

D. C_(6)H_(13)COOH, hexanoic acid

Answer: C

Count all six carbons, including the carbon of the COOH group itself. The chain is CH3(CH2)4COOH: five carbons in the alkyl part plus one in the carboxyl group. So the condensed formula is C5H11COOH, which is C6H12O2 in total.

The IUPAC name comes from hexane (six carbons) with the ending -oic acid: hexanoic acid.

Option B is the trap: C6H13COOH has seven carbons in total, so it is heptanoic acid, not a six-carbon acid.

Textbook: Chemistry Grade 11, Unit 6 Some Important Oxygen-Containing Organic Compounds, section 6.4.1 Structure and Nomenclature of Carboxylic Acids (page 292).

11. Which of the following is the core electron configuration of the metal ion in ferric sulfate, Fe_2 (S04)3? (Atomic Number of Fe = 26) (1)

A. [Ar] 4s^2 3d^6

B. [Ar] 4s^2 3d^5

C. ✓ **[Ar] 3d^5**

D. [Ar] 3d^6

Answer: C

First find the charge on iron. In Fe2(SO4)3 each sulfate ion is SO4 with a 2- charge, so three of them carry 6-. The two iron ions must balance this, so each iron is Fe3+ (this is what "ferric" means).

Neutral Fe (Z = 26) has the configuration [Ar] 4s2 3d6. When a transition metal forms an ion, the 4s electrons leave first. Removing three electrons takes the two 4s electrons and one 3d electron, leaving $[\mathrm{Ar}]\ 3d^5$.

Option D ([Ar] 3d6) is the trap: it is the configuration of Fe2+, not Fe3+.

Textbook: Chemistry Grade 11, Unit 1 Atomic Structure and Periodic Properties of the Elements, section 1.7 Electronic Configurations and Orbital Diagrams (page 41).

12. A 250 mL solution is formed from 24.5 g of sulfuric acid (H_2SO_4). What is the normality of this solution? (Molecular weight of H_2SO_4 = 98 g/mol) (1)

A. 4.00N

B. ✓ **2.00N**

C. 0.250N

D. 0.125N

Answer: B

Normality is the number of equivalents per litre of solution. Work step by step:

- Moles of H2SO4: $24.5 \div 98 = 0.25$ mol.
- H2SO4 gives 2 H+ per molecule, so each mole is 2 equivalents: $0.25 \times 2 = 0.5$ equivalents.
- Volume: 250 mL = 0.250 L.
- Normality: $0.5 \div 0.250 = 2.00\ \mathrm{N}$.

A quick check: the molarity is 1.00 M, and for a diprotic acid the normality is twice the molarity. Choosing 4.00 N (option A) usually means the factor of 2 was applied twice.

Textbook: Chemistry Grade 12, Unit 1 Acid-Base Equilibria, section 1.5.2 Equivalents of Acids and Bases (page 44).

13. A water molecule has two bond pairs and two lone pairs of electrons. Which of the following is CORRECT about these pairs of electrons? (1)

A. The repulsion between the two bonding pairs is greater than the repulsion between the two lone pairs.

B. ✓ The repulsion between the two lone pairs is greater than the repulsion between the two bonding pairs.

C. Bonding pair - lone pair repulsion is greater than lone pair - lone pair repulsion.

D. Lone pair - lone pair repulsion is exactly identical with bonding pair - bonding pair repulsion.

> **Answer:** B
> In the VSEPR model, lone pairs sit closer to the central atom and spread out more than bonding pairs, so they push harder on their neighbours. The order of repulsion strength is:
>
> lone pair with lone pair > lone pair with bonding pair > bonding pair with bonding pair.
>
> So in water the strongest repulsion is between the two lone pairs, which is option B. This extra push is why the H-O-H angle is squeezed from the ideal 109.5 degrees down to about 104.5 degrees.
>
> **Textbook:** Chemistry Grade 11, Unit 2 Chemical Bonding, section 2.3.1 Molecular Geometry (page 100).

14. Which of the following descriptions of the property of a covalent compound is CORRECT? (1)

A. ✓ Covalent compounds have low melting and boiling points.

B. Most covalent compounds are solids at room temperature.

C. Most covalent compounds are soluble in water.

D. Covalent compounds are non-volatile.

> **Answer:** A
> Covalent compounds are made of separate molecules held together by weak intermolecular forces. Only a little energy is needed to pull the molecules apart, so their melting and boiling points are low. That is option A.
>
> The other options describe ionic compounds better than covalent ones. Most covalent compounds are gases or liquids at room temperature (CO_2, CH_4, ethanol), many do not dissolve well in water, and because of their weak intermolecular forces many are volatile, not non-volatile.
>
> **Textbook:** Chemistry Grade 9, Unit 5 Chemical Bonding, section 5.3 Covalent Bonding (page 157).

15. A student is interested in determining the content of a leaf from his/her environment and performed the following steps: (1)

1) Dried the leaves up in sunlight,
2) Evaluated the work and drew conclusions,
3) Collected leaves from around his village,
4) Boiled the leaves and collected the leaves extract,
5) Analyzed the content of the leaves extract using an instrument.

Which of the following is the CORRECT procedure if a student developed an experimental skill?

A. Steps: 3 → 5 → 4 → 1 → 2
B. Steps: 3 → 4 → 1 → 5 → 2
C. ✓ **Steps: 3 → 1 → 4 → 5 → 2**
D. Steps: 3 → 1 → 5 → 4 → 2

Answer: C
Put the steps in the order a careful experiment would follow:

- Collect the leaves (step 3): you need the sample first.
- Dry them in sunlight (step 1): the sample is prepared before extraction.
- Boil and collect the extract (step 4): now the content is pulled out of the leaves.
- Analyze the extract with an instrument (step 5): measurement comes after extraction.
- Evaluate and draw conclusions (step 2): this is always last.

That order is 3, 1, 4, 5, 2, which is option C. Option A fails because it analyzes the leaves before any extract exists.

Textbook: Chemistry Grade 9, Unit 2 Measurements and Scientific Methods, section 2.2 Chemistry as Experimental Science (page 37).

16. What is the scientific notation for 0.000055? (1)

A. 55 x 10^(-7)
B. 5.5 x 10^(-6)
C. ✓ **5.5 x 10^(-5)**
D. 5.5 x 10^(-4)

Answer: C
In scientific notation a number is written as a value between 1 and 10 multiplied by a power of ten. Starting from 0.000055, move the decimal point to the right until you get 5.5. That takes 5 moves, and moving right for a small number gives a negative exponent:

$$0.000055 = 5.5 \times 10^{-5}$$

Option A is wrong because 55 is not between 1 and 10, and options B and D count the decimal moves incorrectly.

Textbook: Chemistry Grade 9, Unit 2 Measurements and Scientific Methods, section 2.1 Measurements and Units in Chemistry (page 20).

17. Upon standing long, 'Tella' or 'Tej' turns sour. Which of the following is the CORRECT explanation for the observed effect? (1)

A. The reduction of alcohol to an acid.

B. ✓ **The oxidation of alcohol to an acid.**

C. Addition reaction of alcohol with an acid.

D. . Decomposition reaction of alcohol.

Answer: B

Tella and Tej contain ethanol. When the drink stands open to air, bacteria use oxygen to oxidize the ethanol into ethanoic (acetic) acid, the acid found in vinegar. The acid gives the sour taste. In short:

$$\mathrm{CH_3CH_2OH} \xrightarrow{\text{oxidation}} \mathrm{CH_3COOH}$$

Option A says reduction, which is the opposite of what happens: going from an alcohol to an acid means gaining oxygen, and gaining oxygen is oxidation.

Textbook: Chemistry Grade 11, Unit 6 Some Important Oxygen-Containing Organic Compounds, section 6.2.5 Chemical Properties of Alcohols (page 277).

18. What are the molecular formulae of an alkene and alkyne containing seven carbon atoms, respectively? (1)

A. ✓ **C_(7)H_(14) and C_(7)H_(12)**

B. C_(7)H_(16) and C_(7)H_(14)

C. C_(7)H_(14) and C_(7)H_(16)

D. C_(7)H_(12) and C_(7)H_(14)

Answer: A

Use the general formulas. Alkenes have one double bond, so their formula is C_nH_{2n}. Alkynes have one triple bond, so their formula is C_nH_{2n-2}.

With n = 7:

- Alkene: C7H14 (2 x 7 = 14 hydrogens)
- Alkyne: C7H12 (2 x 7 minus 2 = 12 hydrogens)

So the pair is C7H14 and C7H12, option A. Option B starts with C7H16, which is the alkane (heptane), not an alkene.

Textbook: Chemistry Grade 10, Unit 6 Hydrocarbons and Their Natural Sources, section 6.3 Unsaturated Hydrocarbons: Alkenes, Alkynes and Aromatic Hydrocarbons (page 266).

19. A student collected the following information from the community on the preparation of the local alcoholic drink "ARAKI": (1)

Step 1: Distillation of the liquid mixture in traditional utensils.
Step 2: Adding a proportionalamount of water to liquidify the dough-like mixture and leaving for 1-2 days for further fermentation
Step 3: 'Bikel' preparation from barely, the starter ('Tinses') by mixing the Bikel with Gesho(Rhamnusprinoides) powder and fermentation of the starter for a few days
Step 4: Baking of bread from different ingredients and breaking down the bread and mixing with the fermented starter and leaving for fermentation for a couple of days

Which of the following is the correct procedure for the preparation of Araki?

A. Step 2 → Step 4 → Step 3 → Step 1
B. Step 2 → Step 3 → Step 4 → Step 1
C. ✓ **Step 3 → Step 4 → Step 2 → Step 1**
D. Step 4 → Step 3 → Step 2 → Step 1

Answer: C

Think about what each step needs before it can happen.

- Step 3 comes first: the Bikel and the Gesho starter (Tinses) must be prepared and fermented before anything else can ferment.
- Step 4 is next: the baked bread is broken up and mixed with that ready starter, then left to ferment.
- Step 2 follows: water is added to thin the dough-like mixture, and it ferments for one to two more days.
- Step 1 is last: the fermented liquid is distilled in traditional utensils to collect the Araki.

So the order is step 3, step 4, step 2, step 1, which is option C. Distillation must always come last, because there is no alcohol to collect until fermentation is complete.

Textbook: Chemistry Grade 12, Unit 3 Industrial Chemistry, section 3.4.8 Manufacturing of Ethanol (page 196).

20. Which of the following is the CORRECT structure of benzene? (1)

A. Hexagon with three double bonds at alternate positions
B. Hexagon with no double bonds
C. ✓ **Circle inside a hexagon**
D. Hexagon with alternating single and double bonds

Answer: C

Experiments show that all six carbon-carbon bonds in benzene are the same length, between a single and a double bond. This is because the six pi electrons are delocalized: they are spread evenly around the whole ring instead of sitting between fixed pairs of atoms. The structure that shows this is a hexagon with a circle inside, where the circle stands for the delocalized electrons.

Option D, the hexagon with alternating single and double bonds, is the tempting choice. It is the old Kekule drawing, but it wrongly suggests two different bond lengths, which real benzene does not have.

Textbook: Chemistry Grade 10, Unit 6 Hydrocarbons and Their Natural Sources, section 6.4 Aromatic Hydrocarbons: Benzene (page 288).

21. Which of the following is CORRECT about equivalents of acids and bases? (1)

A. The volume of an acid or base required to reach equivalence point during acid-base titration reaction.

B. The number of moles of an acid or base required to form a one molar aqueous acidic or basic solution.

C. It is the amount of a substance that is required to react with one mole of hydroxide ions in redox reactions.

D. ✓ **It is the amount of a substance that is required to react with one mole of hydrogen ions in acid-base reactions.**

Answer: D

One equivalent of an acid is the amount that supplies one mole of hydrogen ions (H+), and one equivalent of a base is the amount that reacts with one mole of hydrogen ions. So option D states the definition correctly.

For example, one mole of HCl is one equivalent, but one mole of H2SO4 is two equivalents because it can give two H+ ions.

Option A confuses the equivalent with the equivalence point of a titration: the equivalence point is a stage in an experiment, not an amount of substance. Option C is wrong because it mixes in redox reactions and hydroxide ions.

Textbook: Chemistry Grade 12, Unit 1 Acid-Base Equilibria, section 1.5.2 Equivalents of Acids and Bases (page 44).

22. Which of the following CORRECTLY describes conjugate acids and conjugate bases? (1)

A. Conjugate acid is a species formed after a removal of a proton from a base whereas conjugate base is formed after addition of proton to an acid.

B. ✓ **Conjugate base is a species formed after removal ofa proton from an acid whereas conjugate acid is formed after addition of a proton to a base.**

C. Conjugate acid has one fewer hydrogen and one more minus charge than the corresponding acid.

D. Conjugate base has one more hydrogen and one fewer minus charge than the corresponding base.

Answer: B

In the Bronsted-Lowry theory, an acid is a proton (H+) donor and a base is a proton acceptor. When an acid gives away its proton, what remains is its conjugate base. When a base accepts a proton, the new species is its conjugate acid. That is exactly option B.

Example: $\mathrm{NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-}$. Here NH4+ is the conjugate acid of the base NH3, and OH- is the conjugate base of the acid H2O.

Option A states the two definitions in reverse, which is the common trap.

Textbook: Chemistry Grade 12, Unit 1 Acid-Base Equilibria, section 1.1.2 Bronsted-Lowry Concept of Acids and Bases (page 5).

23. Which of the following is the general formula of alkenes? (1)

A. C_(n)H_(2n—2)

B. C_(n)H_(2n+2)

C. C_(n)H_(n)

D. ✓ **C_(n)H_(2n)**

Answer: D

Alkenes are hydrocarbons with one carbon-carbon double bond. The double bond removes two hydrogens compared with an alkane, so the general formula is C_nH_{2n}. For example, ethene is C2H4 and propene is C3H6.

The other formulas belong to other families: C_nH_{2n+2} (option B) is for alkanes and C_nH_{2n-2} (option A) is for alkynes.

Textbook: Chemistry Grade 10, Unit 6 Hydrocarbons and Their Natural Sources, section 6.3 Unsaturated Hydrocarbons: Alkenes, Alkynes and Aromatic Hydrocarbons (page 266).

24. A given element has atomic number of 55 and mass number of 133. Which of the following describes CORRECTLY the property of this element? (1)

A. The non-metallic character of the element is high.

B. ✓ **The metallic character of the element is high.**

C. The element has high electron affinity.

D. The element has high electronegativity.

> **Answer:** B
> The element with atomic number 55 is cesium (Cs). It sits in Group IA (the alkali metals) near the bottom of the periodic table.
>
> Metallic character grows as you move down a group and to the left across a period, because the outer electron gets farther from the nucleus and easier to lose. Cesium is far down and far left, so its metallic character is very high. It loses its single outer electron very easily.
>
> Options C and D fail for the same reason: electron affinity and electronegativity are high for nonmetals at the top right of the table, and cesium is at the opposite corner.
>
> **Textbook:** Chemistry Grade 9, Unit 4 Periodic Classification of Elements, section 4.4 The Major Trends in the Periodic Table (page 128).

25. Among the following which one is a ternary acid? (1)

A. HBr

B. HCl

C. ✓ **H_(2)SO_(4)**

D. H_(2)S

> **Answer:** C
> Acids are grouped by how many different elements they contain. A binary acid has two elements: hydrogen plus one other, like HBr, HCl and H2S. A ternary acid has three elements: hydrogen, oxygen and one more element.
>
> H2SO4 contains hydrogen, sulfur and oxygen, so it is a ternary acid (an oxyacid).
>
> H2S (option D) is the tempting choice because it has two hydrogens, but the count is about different elements, not the number of atoms. H2S has only hydrogen and sulfur, so it is binary.
>
> **Textbook:** Chemistry Grade 10, Unit 3 Important Inorganic Compounds, section 3.3 Acids (page 124).

26. Which of the following is CORRECT about molten electrolytes and aqueous electrolytes? (1)

A. The possible half reactions in molten electrolytes are more compared to aqueous electrolytes.

B. Both molten and aqueous electrolytes involve preferential discharge of ions at each electrode.

C. An electrolyte that conducts electricity when dissolved in a certain liquid is molten electrolyte.

D. ✓ **During the electrolysis of a molten electrolyte, the reduction of cations occurs at the cathode.**

> **Answer:** D
> In any electrolysis, positive ions (cations) move to the cathode and gain electrons there. Gaining electrons is reduction, so reduction of cations at the cathode is always true, molten or aqueous. That is option D.
>
> Option B is the tempting one, but preferential discharge only makes sense in aqueous solutions, where water provides competing ions and the electrode must "choose" which ion to discharge. A molten electrolyte usually contains just one kind of cation and one kind of anion, so there is no competition. Option A is wrong for the same reason: aqueous electrolytes have more possible half reactions, not fewer. Option C describes a dissolved electrolyte, not a molten one; molten means melted by heat.
>
> **Textbook:** Chemistry Grade 12, Unit 2 Electrochemistry, section 2.2.2 Preferential Discharge (page 70).

27. Which of the following is the CORRECT method of preparation of alkenes in the laboratory? (1)

A. Alkylation of sodium acetylide with a primary alkyl halide.

B. Heating of sodium salt of an organic acid with soda lime.

C. Reaction of halogenated alkane with sodium.

D. ✓ **Dehydration of alcohols with concentrated sulfuric acid.**

Answer: D

The standard laboratory preparation of an alkene is dehydration of an alcohol: heating the alcohol with concentrated sulfuric acid removes a water molecule and creates the double bond. For example, ethanol heated with concentrated H_2SO_4 at about 180 degrees Celsius gives ethene and water.

The other options make different products. Alkylation of sodium acetylide (option A) builds larger alkynes. Heating a sodium salt of an organic acid with soda lime (option B) is decarboxylation, which gives an alkane. Reaction of a halogenated alkane with sodium (option C) is the Wurtz reaction, which also gives an alkane.

Textbook: Chemistry Grade 10, Unit 6 Hydrocarbons and Their Natural Sources, section 6.3 Unsaturated Hydrocarbons: Alkenes, Alkynes and Aromatic Hydrocarbons (page 266).

28. Which of the following is the product of fractional distillation of crude oil? (1)

A. Producer gas

B. Naphthalene

C. Water gas

D. ✓ **Kerosene**

Answer: D

Fractional distillation separates crude oil into fractions by boiling point. The main fractions include refinery gas, gasoline (petrol), kerosene, diesel oil, lubricating oil and bitumen. Kerosene is one of these fractions, so it is the product of fractional distillation of crude oil.

The wrong options come from other sources: producer gas and water gas are made by passing air or steam over hot coke, and naphthalene is obtained from coal tar.

Textbook: Chemistry Grade 10, Unit 6 Hydrocarbons and Their Natural Sources, section 6.5 Natural Sources of Hydrocarbons (page 293).

29. Given the following structure: (1)

What is the IUPAC name for the above structure?

 Question Diagram

A. Methyl ethanoate

B. Propyl formate

C. ✓ **Ethyl ethanoate**

D. Ethyl acetate

Answer: C

The structure is CH_3-CO-O-CH_2CH_3. To name an ester, split it at the oxygen:

- The alkyl group attached to the single-bonded oxygen is CH_2CH_3, an ethyl group. This gives the first word: ethyl.
- The acid part is CH_3-CO, which comes from ethanoic acid (two carbons). This gives the second word: ethanoate.

So the IUPAC name is ethyl ethanoate.

Option D, ethyl acetate, is the same compound, but acetate is the common name; the question asks for the IUPAC name. Option A, methyl ethanoate, would be CH_3-CO-O-CH_3, with only one carbon on the oxygen side, which does not match the drawing.

Textbook: Chemistry Grade 11, Unit 6 Some Important Oxygen-Containing Organic Compounds, section 6.5.2 Nomenclature (page 313).

— END OF MARKING KEY —