

G12 ECZ CHEMISTRY 2016 SPECIMEN P1 SOLUTIONS

Grade 12 ECZ Chemistry 2016 Specimen Paper 1 (5070/1)

Worked solutions — 40 multiple-choice questions

The full specimen paper appears first — worked answers are at the end.

Preamble for Chemistry (5070)

The Examinations Council of Zambia has made adjustments to the assessment of **Chemistry** at Grade 12 level so as to be in line with the revised **Chemistry** Senior Secondary School Syllabus of 2013 developed by Curriculum Development Centre (CDC) of the Ministry of General Education.

Assessment Objectives (AO)

Candidates will be assessed against the following objectives:

Knowledge with Understanding

1. state and explain chemistry phenomena, facts, concepts, terminologies, theories and laws
2. understand and use scientific symbols, conversions, quantities and units
3. demonstrate knowledge of chemistry instruments and apparatus, and their safe operation
4. state and determine quantities in chemistry
5. demonstrate knowledge of technological applications of chemistry with their social, economic and environmental relevance.

Handling Information and Solving Problems

1. locate, select, organise and present information from a variety of sources
2. translate information from one form to another
3. manipulate numerical and other data
4. identify patterns and draw inferences from information
5. explain phenomena, patterns and scientific relationships
6. make predictions and propose hypotheses
7. solve problems using chemistry principles

Experimental and Investigative Skills

1. follow a sequence of instructions
2. use techniques, apparatus, measuring devices and materials effectively and safely
3. make and record observations, measurements, calculations and estimates with due regard to precision, accuracy and units
4. interpret, evaluate and report upon observations and experimental data
5. identify problems, design/plan and carry out investigations, including the selection of techniques, apparatus, measuring devices and materials
6. evaluate methods and suggest possible improvements

Test Design

The examination will be made up of three papers, namely Chemistry Paper 1, Chemistry Paper 2 and Chemistry Paper 3.

The examination will be structured as in the table below:

Paper	Code	Paper type	Number of Questions	Total Marks	Duration	Weighting
1	5070/1	Theory	40	40	1 hour	25%
2	5070/2	Theory	12	80	2 hours	50%
3	5070/3	Practical	2	40	1 hour 30 minutes	25%
Total					160	100%

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Chemistry

5070/1

Paper 1 Multiple Choice

Additional Information:

Electronic calculator (non programmable) and / or Mathematical tables

Multiple Choice Answer Sheet

Soft clean eraser

Soft pencil (type B or HB is recommended)

Time 1 hour

Instructions to Candidates

Do not open this question paper until you are told to do so.

Look at the left hand side of your answer sheet. Ensure that your name, the school/centre name and subject paper are **printed**. Also ensure that the subject code, paper number, centre code, your examination number and the year are printed and shaded. Do not change the already printed information.

There are **forty** questions in this paper. Answer all questions. For each question there are four possible answers, **A, B, C** and **D**. Choose the one you consider correct and record your choice in **soft pencil** on the separate answer sheet provided.

Read very carefully the instructions on the Answer Sheet.

Information for Candidates

Each correct answer will score one mark.

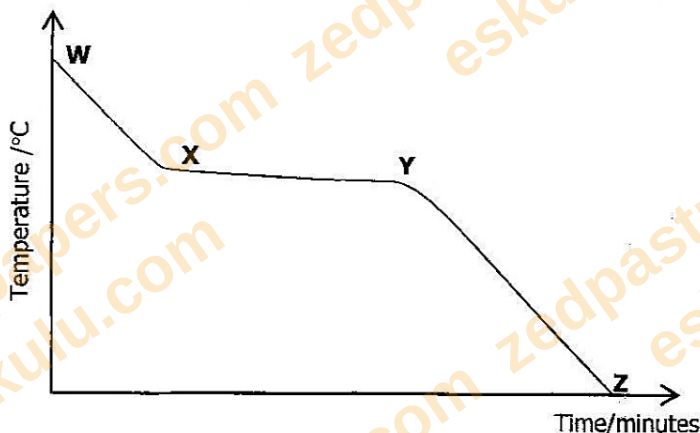
Any rough working should be done in this question paper.

The **Periodic Table** is printed on page 12.

Cell phones are not allowed in the examination room.

- 1 A crystal of potassium permanganate is placed at the bottom of a beaker of water and the beaker left until no further change. What will be observed? A ...
- A colourless layer below a purple one.
 - B colourless liquid with the purple crystals at the bottom.
 - C deep purple solution.
 - D uniformly purple solution.

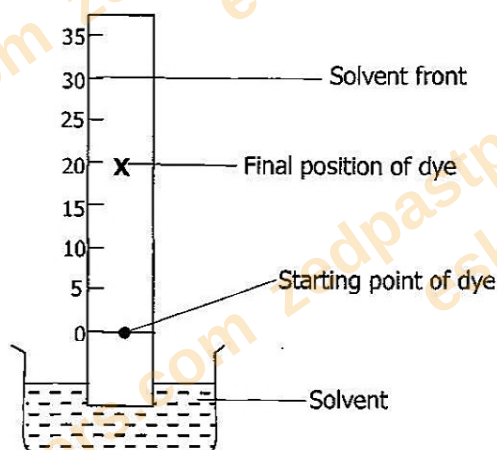
- 2 The diagram below shows the cooling curve of a substance.



During which part of the graph are particles most closely packed?

- A W to X
 - B X to Y
 - C Y to Z
 - D X to Z
- 3 Which method can be used to isolate oxygen from liquid air?
- A Chromatography
 - B Distillation
 - C Electrolysis
 - D Filtration

- 4 The diagram below shows the chromatogram for a dye.



Which fraction shows the R_f value for the dye?

- A 0.50
- B 0.67
- C 1.50
- D 2.00

5 An ion of formula X^- contains 10 electrons. If the relative atomic mass of X is 18, what is the composition of the nucleus of the ion?

- A 7 protons and 11 neutrons
- B 8 protons and 10 neutrons
- C 9 protons and 9 neutrons
- D 9 protons and 10 neutrons

6 Which of the following best explains why lead (II) bromide conducts electricity only in molten state? It's ...

- A electrons are delocalised.
- B electrons are localised.
- C ions are delocalised.
- D ions are localised.

7 Identify the formula of a molecule that has only four electrons involved in its covalent bonds.

- A CH_4
- B CS_2
- C H_2O
- D N_2

8 Which of the following compounds can react with aqueous solutions of both sodium hydroxide and hydrochloric acid?

- A CaO
- B FeO
- C MgO
- D ZnO

9 A man suffering from an excess of acid in the stomach has no indigestion tablets. Which substance could he take to lower his acidity?

- A Aspirin, pH 6.
- B Bicarbonate of Soda, pH 8.
- C Lemon juice, pH 5.
- D Salt water, pH 7.

10 Cold dilute hydrochloric acid will react readily with all of the following **except** ...

- A Ag.
- B Fe.
- C Mg.
- D Zn.

- 11** The table below shows the results of three tests carried out on separate portions of a solution of a salt **R**.

	Test	Observation
1	Acidified aqueous barium nitrate added.	White precipitate
2	Aqueous sodium hydroxide added.	White precipitate soluble in excess of aqueous sodium hydroxide.
3	Aqueous ammonia added.	White precipitate, soluble in excess of aqueous ammonia.

What could **R** be?

- A** Aluminium chloride
- B** Aluminium sulphate
- C** Zinc chloride
- D** Zinc sulphate

- 12** Excess zinc carbonate reacts with dilute hydrochloric acid according to the equation shown below.



What volume of carbon dioxide gas is produced at r.t.p. from 0.1 mole of the acid?

- A** 1.2dm³
- B** 2.4dm³
- C** 12dm³
- D** 24dm³

- 13** If 32g of an element **Y** combine with 48g of oxygen, what will be the empirical formula of the compound formed? (Relative atomic mass of **Y** = 32)

- A** Y₃O
- B** YO₃
- C** Y₂O₃
- D** Y₃O₂

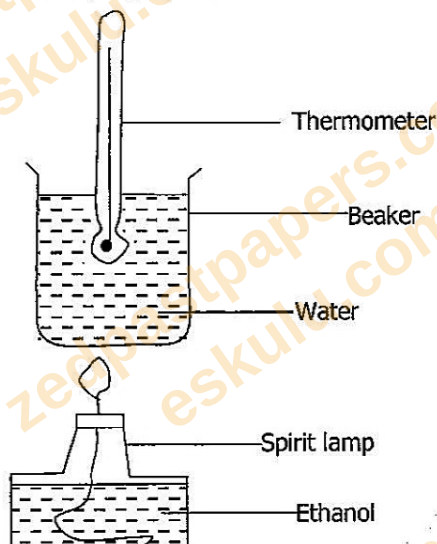
- 14** Find the relative formula mass of calcium phosphate, Ca₃(PO₄)₂.

- A** 135
- B** 175
- C** 230
- D** 310

- 15** Which of the following is true about 1 mole of water and 1 mole of carbon dioxide at r.t.p? They both ...

- A** contain the same number of molecules.
- B** contain the same number of oxygen atoms.
- C** have the same density.
- D** have the same mass.

- 16** The formula of a salt is represented as $X \cdot nH_2O$. What does n represent in this formula?
- A** Mass of water
 - B** Mass of X
 - C** Moles of water
 - D** Moles of X
- 17** A learner used the apparatus below to determine the enthalpy of combustion of ethanol, C_2H_5OH .



The mass of ethanol burnt was 0.92g and calculations showed that 27.2kJ of heat was absorbed by the beaker and the water. From these results what is the enthalpy of combustion of ethanol?

- A** -27.2KJ/mol
 - B** -1251.2KJ/mol
 - C** -1360KJ/mol
 - D** -2720KJ/mol
- 18** What is the oxidation state of chromium, Cr, in potassium dichromate, $K_2Cr_2O_7$?
- A** +12
 - B** +6
 - C** -6
 - D** -12

- 19 Nitrogen and hydrogen react in a closed vessel, according to the equation:

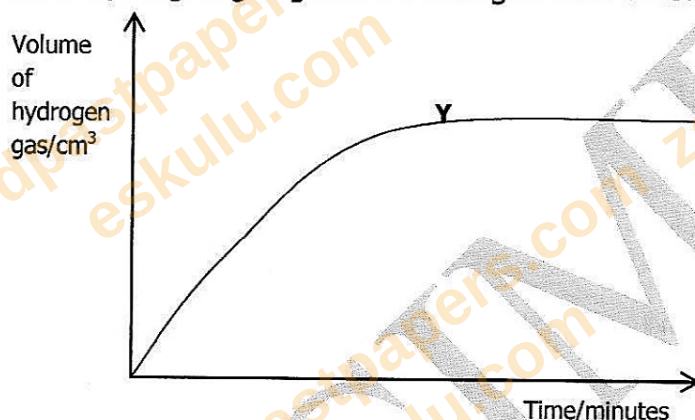


How do the speeds of the forward and reverse reaction change if pressure in the vessel is increased but temperature is kept constant?

Forward Reaction

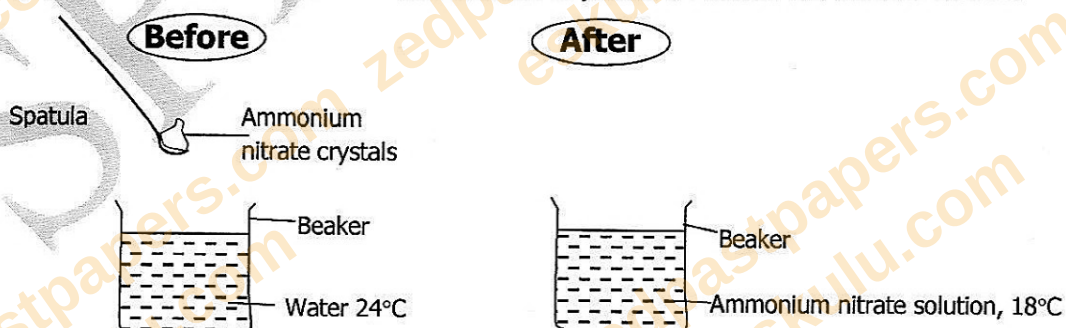
Reverse Reaction

- | | | |
|----------|-----------------|-----------------|
| A | Decreases | Increases |
| B | Does not change | Does not change |
| C | Increases | Increases |
| D | Increases | Does not change |
- 20 Zinc reacts with an excess of dilute sulphuric acid. The graph shows how the volume of hydrogen gas given off changed with time.



Why does the graph become horizontal at Y?

- A** All the zinc has reacted.
B All the sulphuric acid has reacted.
C Hydrogen is being produced at a constant rate.
D The reaction is beginning to slow down.
- 21 A pupil dissolved some ammonium nitrate crystals in water as shown below.



What type of reaction took place?

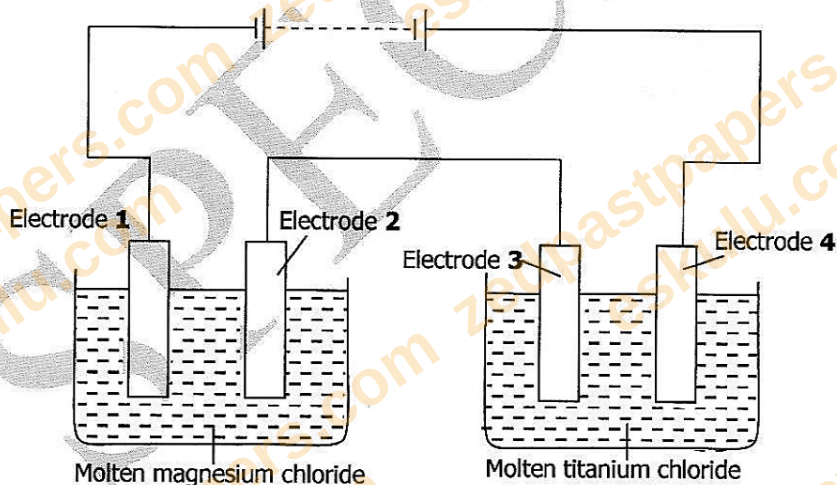
- A** Endothermic
B Exothermic
C Neutralisation
D Reduction

- 22 Which statement about catalysts is correct? Catalysts ...
- A are used in industry to reduce energy costs.
 - B are used up during a reaction.
 - C increase the activation energy of chemical reactions.
 - D of transition metals are not good.
- 23 The element with a proton number 17, has similar chemical properties to the element with the proton number ...
- A 7.
 - B 9.
 - C 16.
 - D 19.
- 24 Which pair of properties are both **not** correct for a typical transition element?

Property 1**Property 2**

- | | |
|----------------------------|--------------------|
| A Forms coloured compounds | High melting point |
| B High density | Low melting point |
| C High melting point | Float on water |
| D Low density | Low melting point |

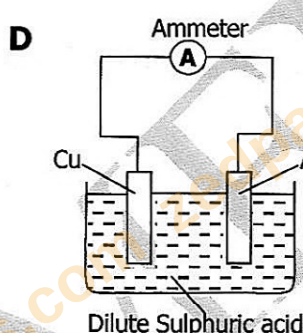
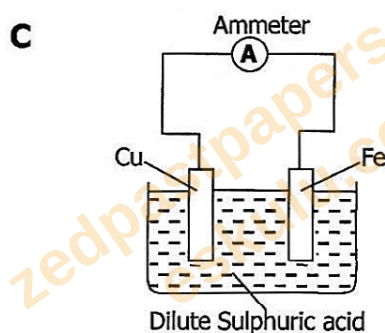
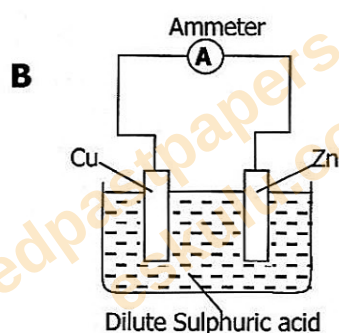
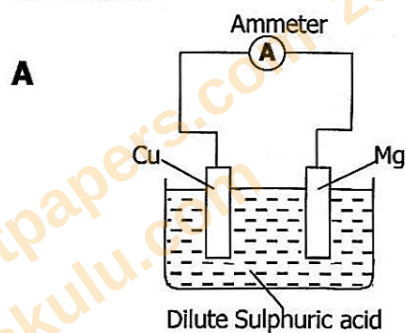
- 25 The diagram shows two electrolytic cells connected in series involving molten magnesium chloride, MgCl_2 and molten titanium chloride, TiCl_x .



After some time, 4.8g of magnesium is deposited at electrode 1, while 4.8g of titanium is deposited at electrode 3. What is the value of x in TiCl_x ?

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

- 26** An ammeter can be used to measure the flow of electric current in a circuit. Which of the following circuits **A**, **B**, **C** or **D** will produce the highest reading on the ammeter?



- 27** What are the products of the electrolysis of fused lead (II) bromide at the electrodes?

Anode

Cathode

A Bromine

Lead

B Bromine

Hydrogen

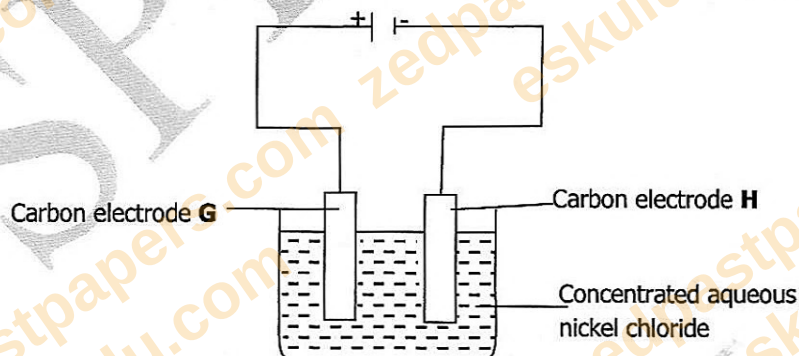
C Oxygen

Hydrogen

D Oxygen

Lead

- 28** The apparatus for electrolysis was set up as shown in the diagram.

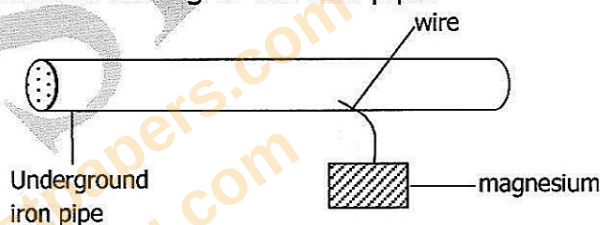


What occurred at electrode **G**?

- A** Chloride ions were oxidised.
- B** Chloride ions were reduced.
- C** Nickel ions were oxidised.
- D** Nickel ions were reduced.

- 29 Which of the following is **not** a commercial use of hydrogen gas?
- A Manufacture of ammonia
 - B Manufacture of margarine
 - C Formation of water
 - D As a rocket fuel
- 30 An element **Z**, necessary for plant growth can be added to the soil in the form of compounds which contain the ion ZO_4^{3-} . What is **Z**?
- A Potassium
 - B Phosphorus
 - C Nitrogen
 - D Hydrogen
- 31 A student read the following statements on an article about how carbon dioxide is formed?
- 1 from the fermentation of glucose
 - 2 when calcium carbonate reacts with dilute hydrochloric acid
 - 3 when methane burns in a limited supply of oxygen
- Which of these statements are correct?
- A 1, 2 and 3
 - B 2 and 3 only
 - C 1 and 3 only
 - D 1 and 2 only
- 32 Oxides of lead come from car exhausts and cause air pollution. What effects do oxides of lead have on the environment or on animals? They cause ...
- A acid rain.
 - B brain damage.
 - C respiratory diseases.
 - D skin cancer.

- 33 The diagram below shows the connections of an iron pipe and magnesium metal to prevent rusting of the iron pipe.



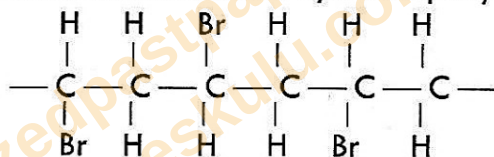
Which statement is false concerning the diagram above?

- A Magnesium oxidises
- B Magnesium corrodes
- C Magnesium is a reducing agent
- D Magnesium gains electrons

- 34** Which metal can be extracted by heating an ore containing its oxide with carbon?
- A** Aluminium
 - B** Calcium
 - C** Lead
 - D** Magnesium

- 35** Which of the following metals occurs both as a native metal and a compound in nature?
- A** Aluminium
 - B** Copper
 - C** Gold
 - D** Iron

- 36** A new product on the Zambian market known as poly (vinyl bromide) PVB, has been manufactured by a company. The structure of PVB an addition polymer is



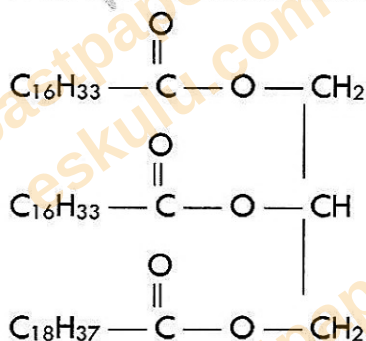
What is the structure of vinyl bromide?

- | | |
|---|---|
| <p>A</p> $\begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H} - \text{C} = \text{C} - \text{C} - \text{H} \\ & & \\ & & \text{H} \end{array}$ | <p>C</p> $\begin{array}{c} \text{H} & \text{H} \\ & \\ \text{Br} - \text{C} - \text{C} - \text{H} \\ & \\ \text{H} & \text{H} \end{array}$ |
| <p>B</p> $\begin{array}{c} \text{H} & \text{H} \\ & \\ \text{Br} - \text{C} = \text{C} - \text{H} \end{array}$ | <p>D</p> $\begin{array}{c} \text{H} & \text{H} \\ & \\ -\text{C} - \text{C}- \\ & \\ \text{Br} & \text{H} \end{array}$ |

- 37** Methanoic acid is a member of an homologous series of compounds called carboxylic acids. It is characteristic of any homologous series that all the members have the same ...

- A** general formula.
- B** physical properties.
- C** relative molecular mass.
- D** structural formula.

- 38** A fat that has been extracted from a bird has the following structure.



Which of the following is **not** true about this fat? It ...

- A** produces glycerol on hydrolysis.
- B** produces two fatty acids on hydrolysis.
- C** is non-biodegradable.
- D** is a condensation polymer.

39 Which catalysts is used in the preparation of ethyl ethanoate from ethanol and ethanoic acid?

- A** Concentrated sulphuric acid
- B** Nickel
- C** Phosphoric acid
- D** Yeast

40 Which of the processes below can be used to obtain amino acids from proteins?

- A** Condensation
- B** Decomposition
- C** Hydration
- D** Hydrolysis

DATA SHEET

The Periodic Table of the Elements

Group																									
I	II																	III	IV	V	VI	VII	0		

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Question 1. A crystal of potassium permanganate is left at the bottom of a beaker of water for a long time. What is seen?

The coloured particles spread out by diffusion until they are evenly distributed, giving a uniformly purple solution.

Answer: D — uniformly purple solution.

Question 2. On the cooling curve (W→X cooling, X→Y flat freezing, Y→Z cooling), where are the particles most closely packed?

After freezing (along Y to Z) the substance is solid, and a solid has its particles packed most closely together.

Answer: C — Y to Z.

Question 3. Which method is used to obtain oxygen from liquid air?

Liquid air is separated into its gases by fractional distillation.

Answer: B — distillation.

Question 4. Chromatogram: dye starts at 0, finishes at 20, solvent front at 30. Find the R_f value.

$R_f = \text{distance moved by dye} \div \text{distance moved by solvent} = 20 \div 30 = 0.67.$

Answer: B — 0.67.

Question 5. An ion X⁺ has 10 electrons and the atom of X has relative atomic mass 18. How many protons and neutrons are in the ion?

X⁺ has 10 electrons, so the neutral atom has 9 electrons and 9 protons. Neutrons = 18 – 9 = 9.

Answer: C — 9 protons and 9 neutrons.

Question 6. Why does lead(II) bromide conduct electricity only when molten?

When it melts, the ions become free to move (mobile) and so can carry the current; in the solid they are fixed.

Answer: C — ions are delocalised (free to move).

Question 7. Which molecule has exactly four electrons involved in its covalent bonds?

Four bonding electrons means two single bonds. Water (H–O–H) has two O–H single bonds = 4 electrons.

Answer: C — H₂O.

Question 8. Which oxide reacts with both aqueous sodium hydroxide and hydrochloric acid?

An oxide that reacts with both an alkali and an acid is amphoteric — zinc oxide.

Answer: D — ZnO.

Question 9. A man with excess stomach acid and no tablets — what could lower his acidity?

Bicarbonate of soda ($\text{pH} \approx 8$) is alkaline and neutralises the excess acid.

Answer: B — bicarbonate of soda.

Question 10. Cold dilute hydrochloric acid reacts readily with all of the following EXCEPT ...

Silver is below hydrogen in the reactivity series, so it does not react with dilute acid. Iron, magnesium and zinc all do.

Answer: A — Ag.

Question 11. Salt R: barium nitrate gives a white precipitate; NaOH gives a white precipitate soluble in excess; ammonia gives a white precipitate soluble in excess. What is R?

Soluble-in-excess white precipitates with both NaOH and ammonia identify Zn^{2+} ; the white precipitate with barium nitrate identifies sulphate. So R is zinc sulphate.

Answer: D — zinc sulphate.

Question 12. Excess zinc carbonate reacts with dilute hydrochloric acid. What volume of CO_2 (r.t.p.) comes from 0.1 mol of acid? ($\text{ZnCO}_3 + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$)

2 mol acid give 1 mol CO_2 , so 0.1 mol acid gives 0.05 mol $\text{CO}_2 = 0.05 \times 24 = 1.2 \text{ dm}^3$.

Answer: A — 1.2 dm³.

Question 13. 32 g of element Y combines with 48 g of oxygen (Ar of Y = 32). Find the empirical formula.

Moles Y = $32 \div 32 = 1$; moles O = $48 \div 16 = 3$. Ratio 1 : 3 $\rightarrow \text{YO}_3$.

Answer: B — YO_3 .

Question 14. Find the relative formula mass of calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$.

3 Ca = 120, 2 P = 62, 8 O = 128; total = 120 + 62 + 128 = 310.

Answer: D — 310.

Question 15. Which is true of 1 mole of water and 1 mole of carbon dioxide at r.t.p.?

One mole of any substance contains the same number of molecules (Avogadro's number).

Answer: A — contain the same number of molecules.

Question 16. In the formula of a hydrated salt $\text{X} \cdot n\text{H}_2\text{O}$, what does n represent?

n is the number of moles of water of crystallisation combined with one mole of the salt.

Answer: C — moles of water.

Question 17. 0.92 g of ethanol is burned and 27.2 kJ is absorbed by the water and beaker. Find the enthalpy of combustion of ethanol.

Moles ethanol = $0.92 \div 46 = 0.02$. ΔH per mole = $27.2 \div 0.02 = 1360$ kJ, and combustion is exothermic: -1360 kJ/mol.

Answer: C — -1360 kJ/mol.

Question 18. What is the oxidation state of chromium in potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$?

2 K = +2 and 7 O = -14 , so 2 Cr = $+12 \rightarrow$ each Cr is $+6$.

Answer: B — $+6$.

Question 19. $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 + \text{heat}$. How do the forward and reverse rates change when the pressure is increased at constant temperature?

Higher pressure brings the molecules closer, increasing the collision frequency for BOTH the forward and the reverse reactions.

Answer: C — both increase.

Question 20. Zinc reacts with excess dilute sulphuric acid; the hydrogen-volume graph becomes flat at Y. Why?

The acid is in excess, so the reaction stops once all the zinc (the limiting reactant) has been used up.

Answer: A — all the zinc has reacted.

Question 21. Dissolving ammonium nitrate in water lowers the temperature from 24 °C to 18 °C. What type of reaction is this?

Because the temperature falls, heat is taken in from the surroundings — the process is endothermic.

Answer: A — endothermic.

Question 22. Which statement about catalysts is correct?

Catalysts lower the activation energy, allowing lower temperatures and so reducing energy costs in industry. They are not used up.

Answer: A — used in industry to reduce energy costs.

Question 23. An element of proton number 17 has similar chemical properties to the element of proton number ...

Proton number 17 is chlorine (Group VII). The element above it in the same group is fluorine, proton number 9.

Answer: B — 9.

Question 24. Which pair of properties is NOT correct for a typical transition element?

Transition metals have high density and high melting points. 'Low density' together with 'low melting point' is wrong for them.

Answer: D — low density and low melting point.

Question 25. Cells in series with molten MgCl_x and molten TiCl_x : the same current deposits 4.8 g of Mg and 4.8 g of Ti. Find x.

Same charge $\rightarrow$ same electrons. Mg: $4.8 \div 24 = 0.2$ mol needs 0.4 mol electrons. Ti: $4.8 \div 48 = 0.1$ mol, so electrons per ion = $0.4 \div 0.1 = 4 \rightarrow \text{TiCl}_4$, $x = 4$.

Answer: A — 4.

Question 26. Which simple cell (in dilute sulphuric acid) gives the highest reading on the ammeter?

The bigger the difference in reactivity between the two metals, the larger the voltage and current. Copper with magnesium (the most reactive metal here) gives the biggest difference.

Answer: A — copper and magnesium.

Question 27. What are the products of the electrolysis of molten lead(II) bromide?

With no water present, the cathode gives lead and the anode gives bromine.

Answer: A — anode: bromine; cathode: lead.

Question 28. Electrolysis of concentrated aqueous nickel chloride with carbon electrodes. Electrode G is joined to the + terminal. What happens at G?

Electrode G is the anode (positive). In concentrated chloride solution the chloride ions are oxidised there to chlorine gas.

Answer: A — chloride ions were oxidised.

Question 29. Which of the following is NOT a commercial use of hydrogen gas?

Hydrogen is used to make ammonia, to make margarine and as a rocket fuel. 'Formation of water' is just a reaction, not a commercial use.

Answer: C — formation of water.

Question 30. Element Z, needed for plant growth, is added to soil as an oxo-ion ZO_4^{3-} . What is Z?

Plants take up phosphorus as the phosphate ion (PO_4^{3-}), so Z is phosphorus.

Answer: B — phosphorus.

Question 31. Which statements about how carbon dioxide is formed are correct? (1 combustion of glucose; 2 calcium carbonate + acid; 3 methane in limited oxygen)

Burning glucose and reacting a carbonate with acid both give CO_2 . Methane in a LIMITED supply of oxygen gives carbon monoxide, not CO_2 , so 3 is wrong.

Answer: D — 1 and 2 only.

Question 32. What harmful effect do the lead oxides from car exhausts have?

Lead is a poison that accumulates in the body and causes brain damage.

Answer: B — brain damage.

Question 33. Magnesium is attached to an iron pipe to prevent rusting. Which statement is FALSE?

The magnesium is oxidised (it loses electrons and corrodes, acting as a reducing agent). It does NOT gain electrons, so that statement is false.

Answer: D — magnesium gains electrons.

Question 34. Which metal is extracted by heating its oxide with carbon?

Metals below carbon in the reactivity series, such as lead, are reduced from their oxides by carbon. (Aluminium, calcium and magnesium need electrolysis.)

Answer: C — lead.

Question 35. Which metal occurs both as a native metal and as a compound in nature?

Copper is found both uncombined (native) and in ores (compounds). Gold is found only native; aluminium and iron only as compounds.

Answer: B — copper.

Question 36. Poly(vinyl bromide) is an addition polymer. What is the structure of the monomer, vinyl bromide?

An addition polymer is made from a molecule with a C=C double bond. Vinyl bromide is $\text{CH}_2=\text{CHBr}$ (structure C).

Answer: C.

Question 37. Methanoic acid is the first member of a homologous series. All members of a homologous series have the same ...

Members of a homologous series share the same general formula (and similar chemical properties), differing by CH_2 each step.

Answer: A — general formula.

Question 38. The fat shown (two $\text{C}_{17}\text{H}_{35}$ chains and one $\text{C}_{15}\text{H}_{31}$ chain) — which statement is NOT true?

On hydrolysis the fat gives glycerol (A true) and two different fatty acids — $\text{C}_{17}\text{H}_{35}\text{COOH}$ and $\text{C}_{15}\text{H}_{31}\text{COOH}$ (B true). Fats are broken down by living things, so saying it is 'non-biodegradable' is NOT true. (A fat is also not really a polymer, so D is loosely worded; C is the intended answer.)

Answer: C — is non-biodegradable.

Question 39. Which catalyst is used to prepare ethyl ethanoate from ethanol and ethanoic acid?

The esterification of ethanol with ethanoic acid is catalysed by concentrated sulphuric acid.

Answer: A — concentrated sulphuric acid.

Question 40. Which process is used to obtain amino acids from proteins?

Proteins are broken down into their amino acids by hydrolysis.

Answer: D — hydrolysis.

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