

G12 ECZ CHEMISTRY 2019 INTERNAL PAPER 1 SOLUTIONS

Grade 12 ECZ Chemistry 2019 Internal Paper 1 (5070/1)

Worked solutions — 40 multiple-choice questions

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



EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Chemistry

Paper 1 Multiple Choice

5070/1

Tuesday

19 NOVEMBER 2019

Additional Materials:

- Electronic calculator (non programmable) 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.

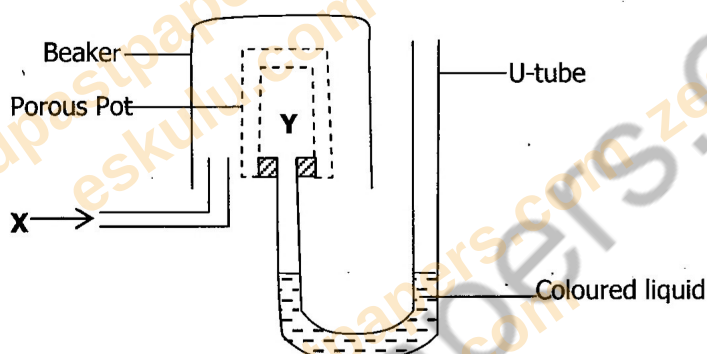
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- 1 Argon, salt and water are common chemical substances used in our day to day life. Which of the following is correct about the basic unit particles of matter each of them is made of?

	Argon	Salt	Water
A	Gas	Solid	Liquid
B	Atoms	Ions	Molecules
C	Molecules	Ions	Atoms
D	Molecules	Atoms	Ions

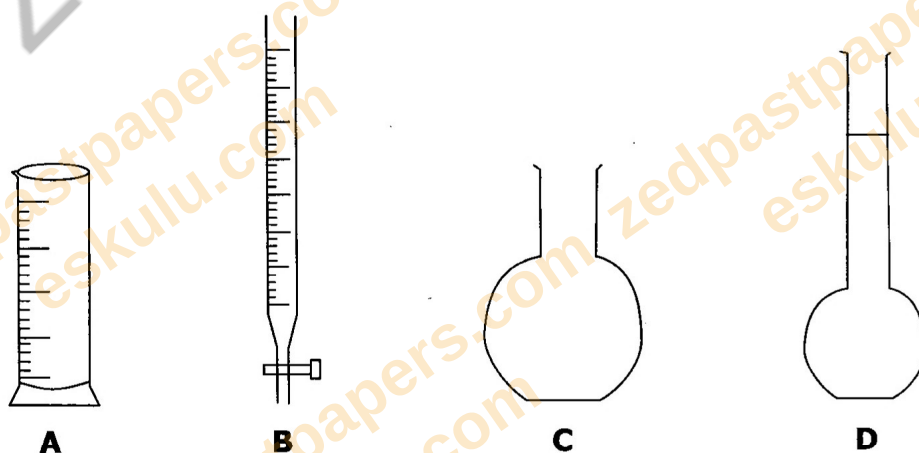
- 2 The rates of diffusion of two gases **X** and **Y** of equal volume are determined using the following apparatus.



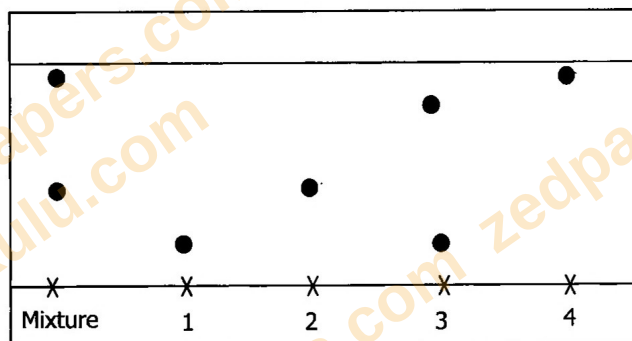
After a long period, the levels of coloured liquid in both arms of the U-tube remain the same. Which pair of gases would be responsible for this observation?

- A Carbon dioxide and Propane
- B Carbon dioxide and Nitrogen
- C Carbon and Sulphur dioxide
- D Propane and Propene

- 3 Which **one** of the following pieces of apparatus is **not** used to measure the volume of liquid?



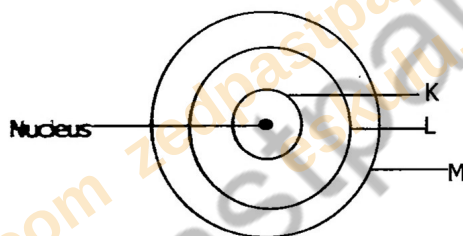
- 4 A mixture of two salts was compared with four different salts using chromatography. The results are shown on the chromatogram below.



Which **two** salts are **not** contained in the mixture?

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

- 5 The diagram below shows different energy levels around the nucleus of an atom.



What is the maximum number of electrons that can be accommodated in energy level **M**?

- A 2
- B 8
- C 18
- D 32

- 6 The elements **P** and **R** form the compound **P₂R**. What is the correct electronic configuration of the atoms **P** and **R**?

	Atom P	Atom R
A	2, 1	2, 7
B	2, 2	2, 7
C	2, 1	2, 6
D	2, 2	2, 6

7 Which substance has metallic bonding?

	Conducts electricity		State of product formed on reaction with oxygen
	when solid	when liquid	
A	✓	✓	solid
B	✓	✓	gas
C	X	✓	no reaction
D	X	X	solid

8 Which of the following has the lowest mass?

- A 0.1 moles of iodine molecules, I₂.
- B 0.5 moles of carbon dioxide, CO₂.
- C 1.0 mole of beryllium oxide, BeO.
- D 1.0 mol of sodium atoms, Na.

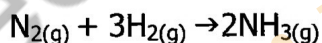
9 A 0.1mol of the hydrate X.nH₂O contains 9 grams of water. What is the value of n in X.nH₂O?

- A 4
- B 5
- C 7
- D 10

10 In order to determine the actual formula of a compound from its empirical formula, which extra information is needed? Its ...

- A atomicity.
- B density.
- C melting point.
- D molar mass.

11 Nitrogen and hydrogen gases react according to the equation shown.



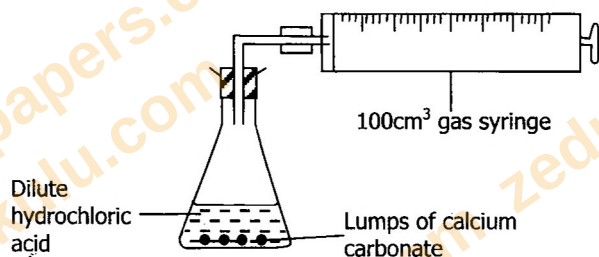
If 60dm³ of nitrogen and 60dm³ of hydrogen are made to react, what would be the volume compositions of the individual gases after the reaction?

	Volume of		
	Nitrogen/dm ³	Hydrogen/dm ³	Ammonia/dm ³
A	0	0	120
B	40	0	40
C	0	40	40
D	40	40	40

- 12** 1.0g calcium carbonate was reacted with excess dilute hydrochloric acid according to the equation:



The diagram below shows the set up for this reaction.



Why would the set up above be practically impossible to collect all the gas at r.t.p?

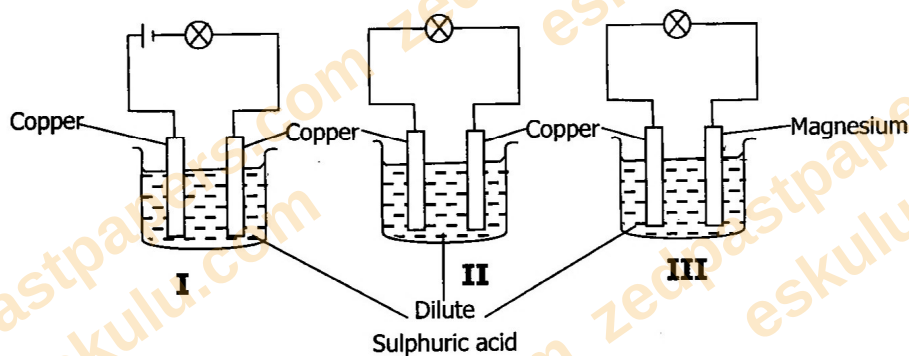
- A** A catalyst must be added.
B No gas is produced.
C Powdered calcium carbonate must be used.
D The gas syringe is small.
- 13** What mass of nickel is formed from a nickel salt solution, electrolysed by a current of 0.4A for 965 seconds? (1 mol of electrons = 96 500C)
- A** 0.029 g
B 0.059 g
C 0.118 g
D 0.236 g
- 14** Which substance will conduct electricity?
- A** Aqueous sodium chloride
B Liquid ammonia
C Molten sugar
D Solid sodium chloride
- 15** Which products are formed at the anode and cathode when an electric current is passed through molten lead (II) chloride?

	Anode (+)	Cathode (-)
A	Chloride ions	Lead ions
B	Chlorine molecules	Lead atoms
C	Lead atoms	Chlorine molecules
D	Lead ions	Chloride ions

- 16** An iron nail is to be electroplated with silver. Which entries in the table are correct?

	Anode	Cathode	Electrolyte
A	Silver metal	Iron nail	Dilute nitric acid
B	Iron nail	Silver metal	Aqueous silver nitrate
C	Iron nail	Silver metal	Dilute nitric acid
D	Silver metal	Iron nail	Aqueous silver nitrate

17 Study the diagrams below.



In which of the set ups will the bulb light?

- A I only
- B III only
- C I and II only
- D I and III only

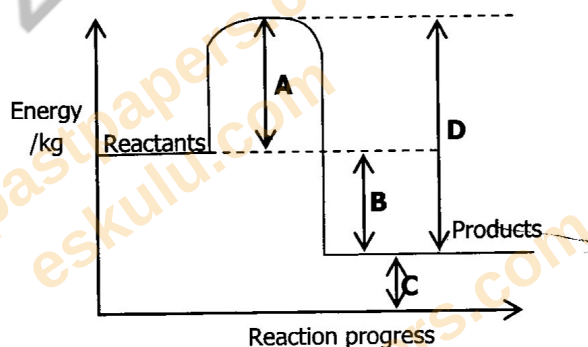
18 The table shows the energy released by the complete combustion of some compounds used as fuels.

Compound	Formula	Relative molecular mass	ΔH in KJ/mol
Benzene	C_6H_6	78	-3 270
Heptane	C_7H_{16}	100	-4 800
Octane	C_8H_{18}	114	-5 510
Propane	C_3H_8	44	-2 200

Which fuel releases the least energy when 1g of the compound is completely burned?

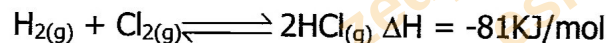
- A Benzene
- B Heptane
- C Octane
- D Propane

19 The diagram below shows an energy profile for a reaction.



Which of the labelled parts A, B, C and D on the diagram above represents the enthalpy change for the reaction?

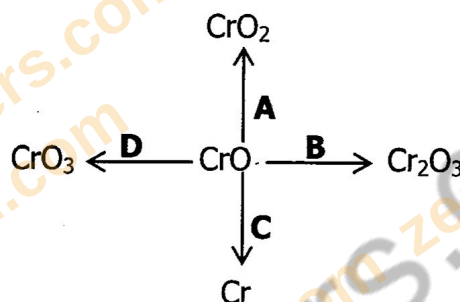
- 20 Below is a reaction at equilibrium.



Which of the following conditions should a manufacturer apply in order to increase the yield of hydrogen chloride gas?

- A Add a catalyst
- B Increase the temperature
- C Increase the pressure
- D Lower the temperature

- 21 In which change is chromium (II) oxide, CrO , reduced?

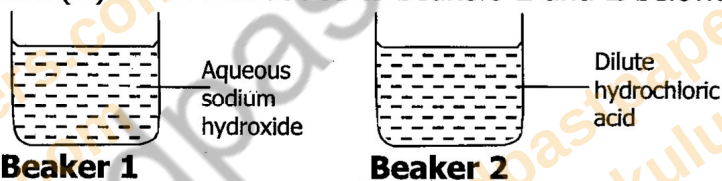


- 22 Which change will **not** increase the rate of a chemical reaction?

An increase in the ...

- A concentration of aqueous reactants.
- B pressure of gaseous reactants.
- C particle size of solid reactants.
- D temperature of the reaction system.

- 23 Lead (II) oxide was added to beakers 1 and 2 below.



Which of the following entries is correct?

	Beaker 1	Beaker 2
A	No salt formed	Salt formed
B	No salt formed	No salt formed
C	Salt formed	No salt formed
D	Salt formed	Salt formed

- 24 A colourless solution **X** gives a white precipitate when added to separate solutions of dilute sulphuric acid and aqueous silver nitrate. What is solution **X**?

- A Silver nitrate
- B Magnesium chloride
- C Lead (II) nitrate
- D Barium chloride

25 A learner, accidentally spilt nitric acid on the floor of a chemistry laboratory. Which of the following substances, when added in excess would neutralise the acid without leaving an alkaline solution?

- A** Aqueous sodium hydroxide
- B** Ammonia solution
- C** Calcium carbonate
- D** Distilled water

26 ... is the common name for saturated calcium hydroxide solution.

- A** Lime water
- B** Limestone
- C** Quick lime
- D** Slaked lime

27 Which one of the following is a use of a noble gas? A noble gas is used ...

- A** as an antiseptic.
- B** for advertising.
- C** in photography.
- D** in toothpaste.

28 When copper (II) oxide is reacted with dilute sulphuric acid, a blue solution of copper (II) sulphate is formed. Which property of transition metals is shown in this reaction?

- A** Formation of coloured compounds.
- B** Being used as a catalyst.
- C** High melting point.
- D** Variable valency.

29 Which one of the following is used in the sacrificial protection of underground steel oil pipe lines?

- A** Iron
- B** Potassium
- C** Sodium
- D** Zinc

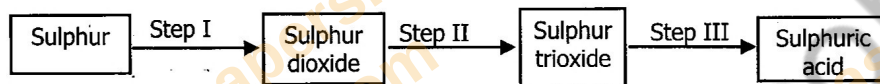
30 The table below shows some properties of metals. Which element could be sodium?

	Melting point (°C)	Density (g/cm ³)	Electrical conductivity
A	1 535	7.86	Good
B	1 083	8.92	Good
C	113	2.07	Poor
D	98	0.97	Good

- 31 The table below contains some alloys and their uses. Which use of the alloys is correct?

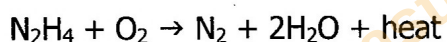
	Alloy	Use
A	Stainless steel	In cutlery
B	Mild steel	To make coins
C	Bronze	In food packaging
D	Brass	To make aircrafts

- 32 The diagram shows three steps in the manufacture of sulphuric acid.



In which step, is a catalyst used?

- A Step I only
 B Step II only
 C Step III only
 D Steps II and III
- 33 Hydrazine, N_2H_4 , burns completely in oxygen according to the equation below.



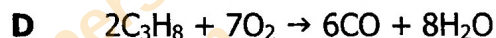
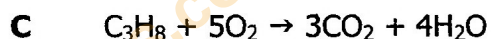
Which one of the following describes hydrazine?

- A Unclean fuel
 B Organic fuel
 C Fire resistant
 D Clean fuel
- 34 Gas P + vegetable oil $\xrightarrow[180^\circ\text{C}]{\text{Ni}}$ margarine

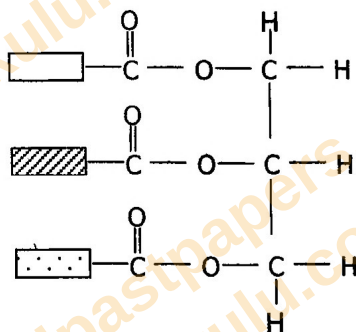
What is gas P?

- A Ethene
 B Hydrogen
 C Methane
 D Oxygen
- 35 Diesel, petrol, refinery gases and kerosene are fractions obtained from the distillation of crude oil. The order of volatility of these fractions, starting with the most volatile is refinery gas, ...
- A kerosene, petrol, diesel.
 B kerosene, diesel, petrol.
 C petrol, kerosene, diesel.
 D petrol, diesel, kerosene

36 Which of the equations below represents the complete combustion of propane?



37 Below is the structure of a fat.



The fat was hydrolysed using sodium hydroxide solution. What are the products of this hydrolysis?

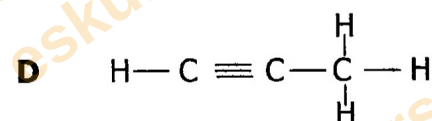
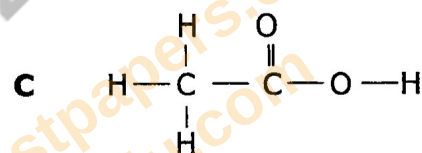
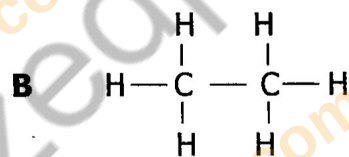
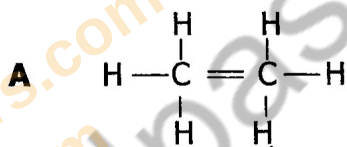
A One alcohol and three soaps.

B One alcohol and three fatty acids.

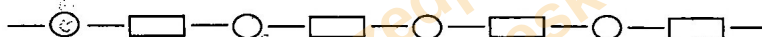
C Three alcohols and one soap.

D Three alcohols and one fatty acid.

38 Which of the following structures is **not** a correct structural formula?



- 39 Below is the structure of a carbohydrate.



The monomer for this carbohydrate is ...

- A $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\square-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}.$
- B $\text{H}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\square-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{H}.$
- C $\text{H}-\text{O}-\square-\text{O}-\text{H}.$
- D $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\square-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}.$

- 40 Which of the following compounds represents an ester?

- A $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{H} \\ & | & & | & & | & & | \\ \text{H} & -\text{C} & - & \text{C} & - & \text{O} & - & \text{C} & - & \text{C} & - & \text{H} \\ & | & & | & & & & | & & | \\ & \text{H} & & \text{H} & & & & \text{H} & & \text{H} \end{array}$
- B $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{O} \\ & | & & | & & | & & || \\ \text{H} & -\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{O} & - & \text{H} \\ & | & & | & & | & & \\ & \text{H} & & \text{H} & & \text{H} & & \end{array}$
- C $\begin{array}{ccccccc} & \text{H} & & \text{O} & & \text{H} & & \text{H} \\ & | & & || & & | & & | \\ \text{H} & -\text{C} & - & \text{C} & - & \text{O} & - & \text{C} & - & \text{C} & - & \text{H} \\ & | & & & & & & | & & | \\ & \text{H} & & & & & & \text{H} & & \text{H} \end{array}$
- D $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{H} \\ & | & & | & & | & & | \\ \text{H} & -\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{O} & - & \text{H} \\ & | & & | & & | & & | \\ & \text{H} & & \text{H} & & \text{H} & & \text{H} \end{array}$

Key

a	X
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a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

$$NA = 6.0 \times 10^{23}/\text{mol}; 1\text{F} = 96500\text{C}.$$

Chemistry/5070/1/2019



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Question 1. Argon, salt and water: which row correctly names the basic particle in each?

Argon is a monatomic noble gas (atoms), salt is ionic (ions) and water is molecular (molecules).

Answer: B — argon: atoms; salt: ions; water: molecules.

Question 2. Two gases X and Y of equal volume diffuse and the liquid levels in the U-tube stay level. Which pair is this?

Equal liquid levels mean the gases diffuse at the same rate, so they have equal molecular masses — carbon dioxide (44) and propane (44).

Answer: A — carbon dioxide and propane.

Question 3. Which apparatus is NOT used to measure the volume of a liquid?

A round-bottom flask has no volume graduations, so it cannot be used to measure volume (unlike the measuring cylinder, burette and volumetric flask).

Answer: C — the round-bottom flask.

Question 4. From the chromatogram, which two salts are NOT in the mixture?

The mixture's two spots align with salts 2 and 4; salts 1 and 3 therefore have different R_f values and are not present in the mixture.

Answer: A — 1 and 3.

Question 5. What is the maximum number of electrons in the M (third) energy level?

The third shell (M) can hold up to $2 \times 3^2 = 18$ electrons.

Answer: C — 18.

Question 6. Elements P and R form the compound P_2R_3 . What are the electron configurations of P and R?

P_2R_3 means two P^{3+} ions to one R^{2-} : P is Group I (config 2,1) and R is Group VI (config 2,6) — like Li_2O .

Answer: C — P: 2,1; R: 2,6.

Question 7. Which substance has metallic bonding (from the conductivity table)?

A metal conducts both as a solid and as a liquid and forms a solid oxide with oxygen — that is row A.

Answer: A.

Question 8. Which of these amounts has the lowest mass?

Masses: 0.1 mol I₂ = 25.4 g; 0.5 mol CO₂ = 22 g; 1 mol BeO = 25 g; 1 mol Na = 23 g. The least is the carbon dioxide.

Answer: B — 0.5 mol of carbon dioxide (22 g).

Question 9. 0.1 mol of the hydrate X·nH₂O contains 9 g of water. Find n.

Moles of water = $9 \div 18 = 0.5$; $n = 0.5 \div 0.1 = 5$.

Answer: B — 5.

Question 10. What extra information turns an empirical formula into the actual (molecular) formula?

You need the molar mass (relative molecular mass) to find how many empirical units make up one molecule.

Answer: D — molar mass.

Question 11. 600 cm³ of nitrogen and 600 cm³ of hydrogen react (N₂ + 3H₂ → 2NH₃). What are the final gas volumes?

Hydrogen is limiting: 600 cm³ H₂ uses 200 cm³ N₂ to make 400 cm³ NH₃. Left over: N₂ = 400, H₂ = 0, NH₃ = 400 — in the ratio 40:0:40.

Answer: B — N₂ 40, H₂ 0, NH₃ 40.

Question 12. 1.0 g of calcium carbonate reacts with excess acid into a 100 cm³ gas syringe. Why is it impossible to collect all the gas at r.t.p.?

Moles CaCO₃ = 0.01 → 0.01 mol CO₂ = $0.01 \times 24 \text{ dm}^3 = 240 \text{ cm}^3$, which exceeds the 100 cm³ capacity of the syringe.

Answer: D — the gas syringe is too small.

Question 13. Mass of nickel deposited by 0.4 A for 965 s from a nickel salt. (1 mol e⁻ = 96 500 C)

$Q = 0.4 \times 965 = 386 \text{ C} \rightarrow 386 \div 96\,500 = 0.004 \text{ mol electrons}$. $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$, so $0.002 \text{ mol Ni} \times 58.7 = 0.118 \text{ g}$.

Answer: C — 0.118 g.

Question 14. Which substance conducts electricity?

Aqueous sodium chloride contains free-moving Na^+ and Cl^- ions, so it conducts; the other substances lack mobile charge carriers.

Answer: A — aqueous sodium chloride.

Question 15. What forms at the anode and cathode when molten lead(II) chloride is electrolysed?

With no water present, Cl^- ions are oxidised at the anode to give chlorine molecules, and Pb^{2+} ions are reduced at the cathode to give lead atoms.

Answer: B — anode: chlorine molecules; cathode: lead atoms.

Question 16. Which row is correct for electroplating an iron nail with silver?

The item to be coated (iron nail) is the cathode; the plating metal (silver) is the anode; and the electrolyte is aqueous silver nitrate.

Answer: D — anode: silver; cathode: iron nail; electrolyte: aqueous silver nitrate.

Question 17. In which simple cell (I Cu/Cu, II Cu/Cu, III Cu/Mg) does the bulb light?

A simple cell needs two DIFFERENT metals to create a potential difference. Only cell III (copper and magnesium) has different metals, so only its bulb lights.

Answer: B — III only.

Question 18. From the table of fuels, which releases the LEAST energy per gram?

Energy per gram = $\Delta H \div \text{Mr}$. Benzene gives $3270 \div 78 \approx 42 \text{ kJ/g}$, which is less than heptane (48), octane (48) or propane (50).

Answer: A — benzene.

Question 19. On the energy profile, which label is the enthalpy change of the reaction?

The enthalpy change is the energy difference between the reactant level and the product level — label B on the diagram.

Answer: B.

Question 20. $\text{H}_2 + \text{Cl}_2 \rightleftharpoons 2\text{HCl}$ ($\Delta H = -81 \text{ kJ/mol}$). What condition raises the yield of HCl?

The forward reaction is exothermic, so lowering the temperature shifts the equilibrium to the right, giving more HCl. (Pressure has no effect — equal moles of gas on each side.)

Answer: D — lower the temperature.

Question 21. In which change is chromium(II) oxide, CrO, reduced?

In CrO the chromium is +2. Arrow C shows $\text{CrO} \rightarrow \text{Cr}$ (metal, oxidation state 0), a decrease in oxidation state — that is reduction.

Answer: C.

Question 22. Which change would NOT increase the rate of a reaction?

Increasing the particle size of a solid reduces its surface area, which slows the reaction rate — it does not speed it up.

Answer: C — increase in the particle size of solid reactants.

Question 23. Lead(II) oxide is added to NaOH (beaker 1) and to dilute HCl (beaker 2). Which row is correct?

Lead(II) oxide is amphoteric: it reacts with both the alkali ($\text{NaOH} \rightarrow$ sodium plumbate) and the acid ($\text{HCl} \rightarrow$ lead(II) chloride), forming a salt in each case.

Answer: D — salt formed in both beakers.

Question 24. A colourless solution X gives a white precipitate with dilute sulphuric acid AND with silver nitrate. What is X?

White precipitate with H_2SO_4 indicates Ba^{2+} (insoluble BaSO_4); white precipitate with AgNO_3 indicates Cl^- (insoluble AgCl). Therefore X is barium chloride.

Answer: D — barium chloride.

Question 25. Which substance, added in excess, neutralises spilt nitric acid without leaving an alkaline solution?

Calcium carbonate neutralises the acid and any excess remains as an insoluble solid that can be filtered off, leaving a neutral solution.

Answer: C — calcium carbonate.

Question 26. What is the common name for a saturated solution of calcium hydroxide?

A saturated aqueous solution of calcium hydroxide, $\text{Ca}(\text{OH})_2$, is called limewater.

Answer: A — lime water.

Question 27. Which is a use of a noble gas?

Noble gases such as neon are chemically inert and glow when electrical current passes through them, making them ideal for advertising signs.

Answer: B — for advertising.

Question 28. Copper(II) oxide and dilute sulphuric acid give a blue solution of copper(II) sulphate. Which transition-metal property is shown?

The characteristic blue colour of CuSO_4 solution demonstrates that transition metals form coloured compounds.

Answer: A — formation of coloured compounds.

Question 29. Which metal is used for the sacrificial protection of underground steel pipes?

Zinc is more reactive than iron and will corrode preferentially, protecting the steel pipe. (Potassium and sodium are far too reactive to be used safely.)

Answer: D — zinc.

Question 30. From the table, which element could be sodium?

Sodium melts at 98°C , has density 0.97 g/cm^3 (less than water) and is a good electrical conductor — matching row D.

Answer: D.

Question 31. Which alloy and its use is correct?

Stainless steel (an alloy of iron, chromium and nickel) resists corrosion and is used to make cutlery.

Answer: A — stainless steel / cutlery.

Question 32. Manufacture of sulphuric acid ($\text{S} \rightarrow \text{SO}_2 \rightarrow \text{SO}_3 \rightarrow \text{H}_2\text{SO}_4$). In which step is a catalyst used?

Vanadium(V) oxide (V_2O_5) is the catalyst used in Step II to convert SO_2 to SO_3 .

Answer: B — Step II only.

Question 33. Hydrazine burns: $\text{N}_2\text{H}_4 + \text{O}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O} + \text{heat}$. How is hydrazine best described?

Its combustion products are only nitrogen (non-toxic, non-polluting) and water, so it qualifies as a clean fuel.

Answer: D — clean fuel.

Question 34. Gas P + vegetable oil $\xrightarrow{\text{Ni}, 180^\circ\text{C}}$ margarine. What is gas P?

Vegetable oil is hardened to margarine by adding hydrogen across its $\text{C}=\text{C}$ double bonds (hydrogenation). Gas P is hydrogen.

Answer: B — hydrogen.

Question 35. Arrange petrol, kerosene and diesel in order of decreasing volatility (most volatile first).

Volatility decreases as boiling point rises: petrol (lowest bp) > kerosene > diesel (highest bp).

Answer: C — petrol, kerosene, diesel.

Question 36. Which equation is the complete combustion of propane?

$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$ balances all atoms (3 C, 8 H, 10 O each side) and gives only CO_2 and H_2O (complete combustion).

Answer: C — $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$.

Question 37. A fat is hydrolysed with sodium hydroxide. What are the products?

Alkaline hydrolysis (saponification) of a triglyceride fat gives glycerol (one alcohol with three $-\text{OH}$ groups) and three soap molecules (sodium salts of the fatty acids).

Answer: A — one alcohol and three soaps.

Question 38. Which structure is NOT a correct structural formula?

In structure A a carbon atom is shown with five bonds (a double bond plus three single bonds), which is impossible since carbon can only form four bonds.

Answer: A.

Question 39. From the carbohydrate chain, what is the monomer?

A carbohydrate polymer is formed by condensation; its monomer has $-\text{OH}$ groups at both ends ($\text{H}-\text{O}-\text{C}-\text{O}-\text{H}$) which join by losing water.

Answer: C — $\text{H}-\text{O}-\text{C}-\text{O}-\text{H}$.

Question 40. Which compound is an ester?

An ester contains the —C(=O)—O—C— linkage. Structure C is ethyl ethanoate ($\text{CH}_3\text{—C(=O)—O—CH}_2\text{CH}_3$).

Answer: C.

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