1 Bromate ion, bromide ion and hydrogen ions react according to the equation as shown.

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

Some apparatus for measuring the change in the rate of this reaction are suggested.

- 1 gas syringe
- 2 balance
- 3 pH meter

Which apparatus are suitable to measure the rate of this reaction?

- A 1 only
- **B** 3 only
- **C** 1 and 2
- **D** 2 and 3
- 2 A mixture of propane, butane, hydrogen sulfide and carbon dioxide at -30 °C is allowed to cool down gradually to -200 °C.

compound	melting point / °C	boiling point / °C				
propane	-188	-42				
butane	-135	-1				
hydrogen sulfide	-85	-51				
carbon dioxide	-78	-78				

Which compound will solidify first?

- A butane
- B carbon dioxide
- C hydrogen sulfide
- **D** propane

3 The apparatus shown is used to obtain ethanol from a dilute solution of ethanol in water. [boiling point of ethanol: 78 °C]



Which graph shows the change in concentration of the ethanol in the boiling flask as the distillation proceeds?



4 Which option correctly shows the numbers of particles in ${}^{34}_{16}S^{2-}$?

	protons	neutrons	electrons
Α	16	16	16
В	16	18	18
С	18	16	20
D	20	14	22

5 A sample of oxygen is a mixture of the two isotopes ${}^{16}_{8}$ O and ${}^{18}_{8}$ O.

The relative atomic mass of carbon is 12.

What are possible values of the relative molecular mass of different molecules of carbon dioxide formed by the combination of carbon and oxygen.

- 1 44
- 2 46
- 3 48
- A 1 only
- B 1 and 2 only
- C 1 and 3 only
- **D** 1, 2 and 3
- 6 Three elements X, Y and Z have consecutive increasing proton (atomic) numbers. If element Z is a noble gas, how is a stable compound formed between X and Y?
 - **A** An atom of X transfers 2 electrons to 1 atom of Y to form XY.
 - **B** An atom of X transfers 2 electrons to 2 atoms of Y to form XY_2 .
 - **C** An atom of X shares 2 electrons with 1 atom of Y to form XY.
 - **D** An atom of X shares 2 electrons with 2 atoms of Y to form XY₂.

- 7 Which solid contains more than one type of bonding?
 - A magnesium nitrate
 - B silicon dioxide
 - C sodium chloride
 - D zinc
- 8 P, Q and R represent three different structures of an element.



Which structures are giant covalent?

- A P and Q
- B P and R
- $\boldsymbol{C} \quad \text{Q and } R$
- $\boldsymbol{D} \quad P, \, Q \text{ and } R$
- **9** 5.0 g samples of the carbonates of barium, copper, sodium and magnesium are decomposed to form the metal oxides and carbon dioxide.

For which compound is there the greatest loss in mass?

- A barium carbonate
- B copper(II) carbonate
- C magnesium carbonate
- D sodium carbonate

10 In an experiment, 8.0 cm³ of 1.0 mol/dm³ aqueous copper(II) nitrate was mixed with 6.0 cm³ of 1.0 mol/dm³ aqueous potassium carbonate in a beaker.

The reaction can be represented by the equation:

 $Cu(NO_3)_2 + K_2CO_3 \rightarrow CuCO_3 + 2KNO_3$

What did the reaction vessel contain when the reaction was complete?

- A a green precipitate only
- **B** a green precipitate and a blue solution
- **C** a green precipitate and colourless solution
- D a blue precipitate and a colourless solution
- **11** The equation for the combustion of methane is as shown.

 $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Which statement is incorrect for a complete combustion of methane?

- **A** 1 mole of methane will react with 48 dm³ of oxygen at r.t.p.
- **B** 5 cm³ of methane will reacts with 10 cm³ of oxygen at r.t.p.
- **C** 8 g of methane when burnt will form 24 dm^3 of carbon dioxide.
- **D** 8 dm³ of methane will produce 12 g of water.
- **12** Ferrite is a ceramic-like material with magnetic properties that are useful in many types of electronic devices. It is made of a mixture of the oxides of calcium and iron. It contains 18.5% calcium and 51.9% iron by mass.

What is the empirical formula of ferrite?

- A CaFe₂O
- B CaFe₂O₄
- C Ca₂FeO₂
- D Ca₄Fe₂O

- **13** Both hydrochloric acid and ethanoic acid have the same concentration of 0.5 mol/dm³. Which methods are suitable to test for their strengths?
 - 1 using a pH meter
 - 2 measuring their electrical conductivity
 - 3 titration using sodium hydroxide solution
 - A 1 only
 - **B** 1 and 2
 - **C** 2 and 3
 - D all of the above
- 14 An alloy reacts with dilute hydrochloric acid to evolve a gas which extinguishes a lighted splint with a 'pop' sound. A red-brown solid residue remains, which turns into a black solid when heated in air.

Which two metals are present in the alloy?

- A silver and zinc
- B silver and copper
- C iron and copper
- D iron and aluminium
- **15** The equations represent reactions of dilute sulfuric acid.

Which reaction is **not** 'typical' of a dilute acid?

- A $CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$
- **B** $2\text{KOH}(aq) + H_2\text{SO}_4(aq) \rightarrow K_2\text{SO}_4(aq) + 2H_2O(I)$
- **C** $Pb(NO_3)_2(aq) + H_2SO_4(aq) \rightarrow PbSO_4(s) + 2HNO_3(aq)$
- **D** $ZnCO_3(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2O(I) + CO_2(g)$
- 16 Which oxide is insoluble in aqueous sodium hydroxide?
 - **A** Al₂O₃
 - B MgO
 - **C** P₄O₁₀
 - **D** SO₂

17 Which row of information correctly displays the reactants used to safely prepare a salt with the highest possible yield?

	reactants	salt to be prepared
Α	calcium oxide and sulfuric acid	calcium sulfate
В	copper and hydrochloric acid	copper(II) chloride
С	lithium and hydrochloric acid	lithium chloride
D	zinc oxide and sulfuric acid	zinc sulfate

18 Tests were carried out on an aqueous solution of an unknown compound, P.

The observations were recorded in the table.

test	observation
aqueous sodium hydroxide added	white precipitate, soluble in excess giving a colourless solution
aqueous ammonia	white precipitate, soluble in excess giving a colourless solution
aqueous barium nitrate added, followed by dilute nitric acid	white precipitate formed, white precipitate soluble in dilute nitric acid to form a colourless solution

Which ions are present?

- **A** Al^{3+} and SO_4^{2-}
- B Zn²⁺ and SO₄²⁻
- **C** Al^{3+} and CO_3^{2-}
- D Zn²⁺ and CO₃²⁻
- **19** In the Haber process, a high yield of ammonia is favoured by high pressure and low temperature. In practice, a high temperature is used.

Which statement best explains the discrepancy in the preferred temperature?

- **A** At low temperature, ammonia decomposes back to its original reactants.
- **B** At low temperature, the activation energy is too low.
- **C** At low temperature, the catalyst is inactive.
- **D** At low temperature, the reaction is too slow.

- 20 Which reaction is **not** a redox reaction?
 - A Mg + 2HNO₃ \rightarrow Mg(NO₃)₂ + H₂
 - **B** $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$
 - **C** SO₂ + NO₂ \rightarrow SO₃ + NO
 - **D** SO₃ + H₂O \rightarrow H₂SO₄
- 21 Hydrogen peroxide (H₂O₂) acts as an oxidising agent in some reactions, but in others, as a reducing agent.

reaction 1: $H_2O_2 + 2KI + H_2SO_4 \rightarrow I_2 + K_2SO_4 + 2H_2O$

reaction 2: $5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \rightarrow 2MnSO_4 + K_2SO_4 + 5O_2 + 8H_2O_4$

reaction 3: $H_2O_2 + Ag_2O \rightarrow 2Ag + O_2 + H_2O$

Which row identifies correctly the role of hydrogen peroxide in each reaction?

	reaction 1	reaction 2	reaction 3
Α	oxidising agent	reducing agent	oxidising agent
В	oxidising agent	reducing agent	reducing agent
С	reducing agent	oxidising agent	reducing agent
D	reducing agent	oxidising agent	oxidising agent

- Swiss Cottage Secondary School / Chemistry Paper 1 / 4 Express / Prelim Exam 2024
- 22 The diagram shows an electrolysis set-up using inert electrodes **before** and **after** the electrolysis.



before



Which could solution W be?

- 1 aqueous sodium nitrate
- 2 aqueous copper(II) sulfate
- 3 concentrated aqueous sodium chloride
- 4 dilute sulfuric acid
- A 4 only
- **B** 1 and 4 only
- **C** 2 and 3 only
- **D** 1, 3 and 4 only

23 Study the set-ups as shown to determine the order of reactivity of four metals, P, Q, R and S.



If a simple cell was set up between two of the metals, which pair of electrodes will give the largest voltmeter reading?

- A metal R and metal Q
- B metal R and metal S
- C metal R and metal P
- D metal P and metal Q

24 Three elements E, F and G belong to the same period in the Periodic Table. The properties of their oxides are as given.

oxide of E:	soluble in both nitric acid and aqueous potassium hydroxide
oxide of F:	insoluble in water and aqueous sodium hydroxide but dissolves readily in nitric acid
oxide of G:	changes acidified potassium manganate(VII) from purple to colourless

What is the arrangement of E, F and G in order of decreasing atomic number in the Periodic Table?

- **A** E, F, G
- **B** F, E, G
- **C** G, F, E
- $\boldsymbol{D} \quad G,\, E,\, F$
- 25 Which statement about catalysts is correct?
 - A Catalysts are used in industry to reduce energy costs.
 - **B** Catalysts are used up during a reaction.
 - **C** Manganese dioxide is used as a catalyst in the Haber Process.
 - **D** Transition metals do not make good catalysts.
- **26** The element astatine is below iodine in Group 17 of the Periodic Table.

Which statement describes astatine correctly?

- A It forms a covalent compound with potassium.
- **B** It has a high melting point due to strong covalent bonds.
- **C** It is a dark coloured gas at room temperature and pressure.
- **D** It is a weaker oxidising agent than iodine.

13

Swiss Cottage Secondary School / Chemistry Paper 1 / 4 Express / Prelim Exam 2024

27 Compound X is heated with carbon using the apparatus as shown.



A red-brown solid is formed in the reaction tube and white precipitate is seen in limewater.

What is compound X?

- A calcium oxide
- B copper(II) oxide
- C magnesium oxide
- D sodium oxide

28 Two pieces of iron, one with zinc attached and the other with copper attached, are placed separately in water as shown.



Which statements are correct?

- 1 The iron in beaker X will not rust.
- 2 The zinc in beaker X will be oxidised.
- 3 The water in beaker Y will turn blue.
- A 1 and 2 only
- **B** 1 and 3 only
- C 2 and 3 only
- **D** 1, 2 and 3

29 The formation of liquid water from hydrogen and oxygen may occur in three stages.

Stage 1 : $2H_2(g) + O_2(g) \rightarrow 4H(g) + 2O(g)$ Stage 2 : $4H(g) + 2O(g) \rightarrow 2H_2O(g)$ Stage 3 : $2H_2O(g) \rightarrow 2H_2O(I)$

Which stages are endothermic?

- A 1 only
- B 2 only
- C 1 and 3 only
- **D** 1, 2 and 3

- 30 Which is the overall equation for the reactions that take place in a hydrogen fuel cell?
 - A $H_2 \rightarrow 2H^+ + 2e^-$
 - **B** $2H_2 + O_2 \rightarrow 2H_2O$
 - **C** $2H_2O \rightarrow 2H_2 + O_2$
 - **D** $2H^+ + 2e^- \rightarrow H_2$
- **31** A student performs two reactions.

Reaction 1: 10 g of magnesium ribbon with 0.5 dm³ of 2.0 mol/dm³ dilute hydrochloric acid Reaction 2: 5 g of magnesium powder with 0.5 dm³ of 3.0 mol/dm³ dilute hydrochloric acid

In both experiments, the volume of hydrogen produced is measured against time and the results are plotted graphically.

Which graph is correct?



- Swiss Cottage Secondary School / Chemistry Paper 1 / 4 Express / Prelim Exam 2024
- 32 Powdered manganese(IV) oxide acts as a catalyst in the decomposition of aqueous hydrogen peroxide.

Which statement explains why the rate of production of oxygen decreases during the reaction?

- A The concentration of aqueous hydrogen peroxide decreases.
- **B** The mass of manganese(IV) oxide decreases.
- **C** The surface of manganese(IV) oxide decreases.
- **D** The temperature of aqueous hydrogen peroxide decreases.
- 33 The structures of four alcohols are as shown.



Which statement is correct?

- A Alcohol 1 can be made by the addition of steam to an alkene.
- **B** Alcohol 2 is a product of fermentation.
- **C** Alcohol 3 can undergo oxidation to form $C_3H_7CO_2H$.
- **D** Alcohol 4 has only one other isomer.
- 34 The structures of three compounds are as shown.



Why do these compounds all belong to the same homologous series?

- **A** They are all saturated.
- **B** They are all hydrocarbons.
- **C** They all contain the same functional group.
- **D** They all contain an even number of carbon atoms.

Swiss Cottage Secondary School / Chemistry Paper 1 / 4 Express / Prelim Exam 202435 The diagram shows the structure of a compound Z.

Which prediction about its properties is not likely to be correct?

- A It can react with zinc to liberate hydrogen gas.
- **B** It can turn acidified potassium iodide solution from colourless to brown.
- **C** It can undergo addition polymerisation.
- **D** It can undergo condensation polymerisation by itself.
- **36** The ester, $CH_3CO_2CH_2CH(CH_3)CH_2CH_3$, has an odour of bananas.

Which set of reagents could be used to prepare this ester in the laboratory?

	reagent 1	reagent 2
Α	CH ₃ CH ₂ CH ₂ CH(CH ₃)CH ₂ CO ₂ H	CH₃OH
В	CH ₃ CH ₂ CH(CH ₃)CH ₂ OH	CH ₃ CO ₂ H
С	CH ₃ CH ₂ CH(CH ₃)CH ₂ CO ₂ H	CH₃OH
D	CH ₃ CH ₂ CH(CH ₃)CH ₂ OH	CH ₃ CH ₂ CO ₂ H

Swiss Cottage Secondary School / Chemistry Paper 1 / 4 Express / Prelim Exam 2024 **37** The molecular formula of an organic acid is as shown.



Which structure is not an isomer of this acid?



38 Polyethenol is a new plastic which is water soluble. This plastic is useful in hospitals for keeping soiled laundry and thereby preventing infection. The dirty laundry is then placed in the wash and the bag dissolves letting the washing out.

The structure of polyethenol is as shown.



What is the monomer unit for this polymer?



39 In an artificial hip joint, bone cement is used to attach the poly(ethene) cup for the joint to the pelvic girdle. Bone cement is formed by the polymerisation of methyl 2-methylpropenoate. The process is highly exothermic.

The structure of methyl 2-methlypropenoate is as shown.



Which statements are correct about this polymerisation?

1 The repeat unit of the polymer is

- 2 The formation of the cement occurs by addition polymerisation.
- 3 Less energy is released in making the C C bonds than absorbed in breaking a C = C bond.
- A 1 and 2 only
- B 2 and 3 only
- C 1 and 3 only
- **D** 1, 2 and 3
- **40** To reduce atmospheric pollution, the waste gases from a coal-burning power station are passed through powdered calcium carbonate.

Which waste gas will not be removed by the powdered calcium carbonate?

- A carbon dioxide
- **B** nitrogen monoxide
- **C** phosphorus oxide
- D sulfur dioxide

												-			Т											-	٦								
	18	7	Чe	helium 4	10	Ne	neon	2	18	Å	argon 40	36	노	krypton o 4	4	54	Xe	xenon	131	86	Ł	radon	۱	118	ő	oganesson									
	17				თ	щ	fluorine	2	17	C7	chlorine 35.5	35	Б	bromine	001	53	п	iodine	171	85	At	astatine	I	117	۳	tennessine		71	2	lutetium	175	103	۲	lawrencium -	
	16				8	0	oxygen	<u>0</u>	16	S	sulfur 32	34	Se	selenium	201	52	Те	tellurium	128	84	S	polonium	ı	116	2	livermorium I		70	ď≻	ytterbium	173	102	٩	nobelium I	
	15				7	z	nitrogen	4	15	۹.	phosphorus 31	33	As	arsenic 7.5	0	51	Sb	antimony	122	8	Ē	bismuth	209	115	ğ	moscovium		69	ш	thulium	169	101	ΡW	mendelevium -	
	14				9	U	carbon	71	14	ŝ	silicon 28	32	9 0	germanium 7.0	2	20	Sn	Ē	119	82	Ч	lead	207	114	F1	flerovium -		68	ш	erbium	167	100	Ē	fermium I	
-	13				5	ш	poron	E	13	Ρſ	aluminium 27	31	Са В	gallium 70	5	49	IJ	mipui	C11	8	11	thallium	204	113	Ч	nihonium		67	ደ	holmium	165	66	щ	einsteinium	
	a alasind had (12	30	Z	zinc	с <u>о</u>	48	В	cadmium	211	8	ВН	mercury	201	112	ວົ	copernicium -		99	2	dysprosium	163	86	പ്	californium -	
								1	29	S	copper	40	47	Ag	silver	201	62	Au	plog	197	111	ß	roentgenium -		65	Тb	terbium	159	97	鮝	berkelium				
dn											10	28	ī	nickel	80	46	Ъd	palladium	106	78	£	platinum	195	110	ő	darmstadtium		64	B	gadolinium	157	96	ő	L curium	
ы Б											6	27	ပိ	cobalt	29	45	ዲ	rhodium	103	22	Ч	iridium	192	109	Mt	meitnerium		63	п	europium	152	95	Am	americium	
		-	т	hydrogen 1							8	26	Ъе	iron	00	44	R	ruthenium	101	76	ő	osmium 0	190	108	Я	hassium		62	Sm	samarium	150	94	Ъ	plutonium	
					,						7	25	R	manganese	cc .	43	ц	technetium	ı	75	Re	rhenium	186	107	뚼	bohrium I		61	E	promethium	1	93	ď	neptunium I	
					umber	bol		nass			9	24	ັບ	chromium	70	42	мо	molybdenum	90	74	≥	tungsten	184	106	Sg	seaborgium -		60	PN	neodymium	144	92	⊃	uranium 238	
				Key	(atomic) n	mic sym	пате	/e atomic i			5	23	>	vanadium 5.1	0	4	qN	miobium	93	73	ц	tantalum	181	105	റ്റ	dubnium		59	ሻ	praseodymium	141	9	Ра	protactinium 231	
						proton	ato	. Helen	relativ			4	22	F	titanium	6	40	Z	zirconium	91	72	Ŧ	hafnium	178	104	ř	rutherfordium		58	ဗီ	cerium	140	6	년	thorium 232
											ю	21	လိ	scandium A E	640	39	≻	yttrium	gg	57-71	lanthanoids			89-103	actinoids			57	La	lanthanum	139	80	Ac	actinium I	
	2				4	Be	beryllium	מ	12	Mg	magnesium 24	20	ပ္မ	calcium	40	38	ო	strontium	22	56	Ba	barium	137	88	Ra	radium I			noids)			oids		
	-				Itatium accounting 33 33 33 33 33 33 33 33 33 33 33 33 33									87	止	francium		lanthan					actin												

The Periodic Table of Elements

The volume of one mole of any gas is $24 \, dm^3$ at room temperature and pressure (r.t.p.). The Avogadro constant, $L = 6.02 \times 10^{23} \, mol^{-1}$.

BLANK PAGE

SWISS COTTAGE SECONDARY SCHOOL

SECONDARY FOUR O LEVEL PRELIMINARY EXAMINATION PURE CHEMISTRY Paper 1 MCQ

1	В	21	В
2	В	22	В
3	C	23	В
4	В	24	D
5	D	25	Α
6	D	26	D
7	Α	27	В
8	Α	28	Α
9	C	29	Α
10	В	30	В
11	C	31	С
12	В	32	Α
13	В	33	В
14	C	34	С
15	C	35	В
16	В	36	В
17	D	37	D
18	D	38	С
19	D	39	Α
20	D	40	В