Name: _____ ( ) Class:_____

CHIJ KATONG CONVENT

PRELIMINARY EXAMINATIONS 2022

Secondary Four Express

CHEMISTRY

6092/01

Duration: 1 hour

Classes: 405 and 406

Additional Material: Optical Answer Sheet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid/ tape.
Write your name, class and index number in the spaces provided at the top of this page and on the Optical Answer Sheet.

There are **forty** questions on 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.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in the question booklet.
A copy of the Periodic Table is printed on page 11.

At the end of the examination, hand in:

1. Optical Answer Sheet; and
2. Question booklet **separately**.

1 Hydrogen chloride gas (M_r = 36.5) is released at P in the apparatus shown.

The Universal Indicator paper turns red after 38 s.

Universal Indicator paper

The experiment is repeated under the same conditions using sulfur dioxide (M_r = 64).

Which shows the result for sulfur dioxide?

	Universal Indicator turns	time for Universal Indicator to change colour/ s
A	blue	26
B	blue	51
C	red	26
D	red	51

2 Substance M melts at –7.0 °C and is a brown liquid at room temperature.

At which temperature(s) will pure M boil?

A –77.0 °C
B –7.0 °C to 7.0 °C
C 48.0 °C to 65.0 °C
D 59.0 °C

3 A student is asked to measure the time taken for 0.4 g of magnesium carbonate to react completely with 20.0 cm^3 of dilute hydrochloric acid.

Which pieces of apparatus does the student need?

A electronic balance, burette, stopwatch
B electronic balance, pipette, stopwatch
C electronic balance, stopwatch, thermometer
D stopwatch, pipette, thermometer

4 R_f values are used to identify unknown substances using paper chromatography.

Which statements about R_f values are correct?

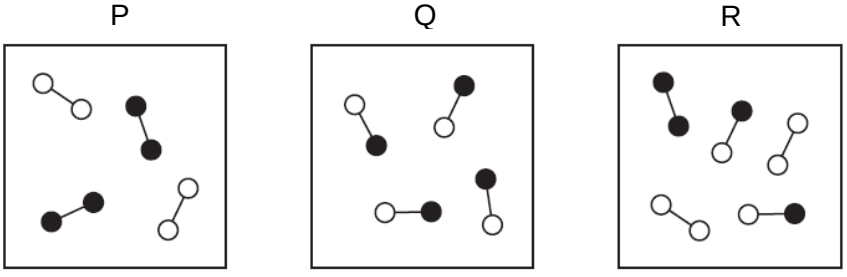
1 R_f values are always less than 1.0.
2 R_f value = distance travelled by solvent ÷ distance travelled by unknown substance.
3 The higher the R_f value, the further the unknown substance travels.
4 R_f values are not affected by the solubility of the unknown substance.

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

5 Which physical property is used to separate the nitrogen and oxygen from air?

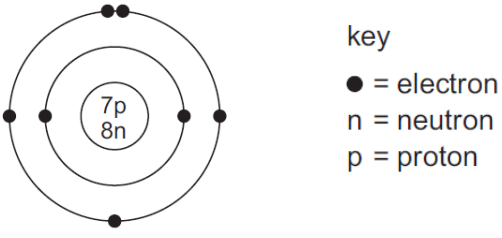
A boiling point
B density
C electrical conductivity
D molecular mass

6 Which statement about P, Q and R is correct?



A P contains two compounds and R contains a mixture.
B P contains two elements and Q contains a mixture.
C P contains two elements and Q contains one compound.
D Q contains two compounds and R contains a mixture.

7 The structure of an atom is shown.



Which element is the atom an isotope of?

A nitrogen
B oxygen
C phosphorus
D titanium

8 Which row describes the structure of the positive ion in sodium chloride?

	protons	electrons	neutrons
A	11	11	12
B	11	10	12
C	17	17	18
D	17	18	18

9 Which row describes what happens to the electrons when lithium and nitrogen atoms form ions?

	lithium atoms	nitrogen atoms
A	each lithium atom loses one electron to form a Li^+ ion	each nitrogen atom gains three electrons to form a N^{3-} ion
B	each lithium atom loses one electron to form a Li^- ion	each nitrogen atom loses three electrons to form a N^{3+} ion
C	each lithium atom gains one electron to form a Li^+ ion	each nitrogen atom gains five electrons to form a N^{5-} ion
D	each lithium atom gains one electron to form a Li^- ion	each nitrogen atom loses five electrons to form a N^{5+} ion

10 Which statement about metals is correct?

A Layers of positive ions can slide over one another making metals malleable.
B Metallic bonding consists of a lattice of negative ions in a sea of delocalised electrons.
C Metallic bonding consists of a lattice of positive ions in a sea of delocalised negative ions.
D Metals conduct electricity because positive ions are free to move.

11 Which statement is correct about the structures of both diamond and silicon(IV) oxide?

A Molecules of both diamond and silicon(IV) oxide are held together by weak intermolecular forces of attraction.
B The carbon in diamond and the silicon in silicon(IV) oxide each form four covalent bonds.
C They both contain atoms arranged in planes held together by weak intermolecular forces of attraction.
D They both contain ions that are free to move.

12 What is the total number of electrons in one molecule of ammonia, NH_3?

A 6
B 8
C 10
D 11

13 Four fertilisers are each supplied in 100 kg bags.

Which fertiliser supplies the greatest mass of nitrogen per 100 kg bag?

A ammonium nitrate, NH_4NO_3
B ammonium phosphate, $(NH_4)_3PO_4$
C ammonium sulfate, $(NH_4)_2SO_4$
D urea, $CO(NH_2)_2$

14 1 g of calcium carbonate is added to 50.0 cm^3 of 0.050 mol / dm^3 hydrochloric acid. The reaction is as shown.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Which volume of carbon dioxide is produced in this reaction?

A 30 cm^3
B 60 cm^3
C 120 cm^3
D 240 cm^3

15 A tablet contains 0.080 g of ascorbic acid (*M*r = 176).

What is the concentration of ascorbic acid when one tablet is dissolved in 200 cm^3 of water?

A 0.0000909 mol / dm^3
B 0.000455 mol / dm^3
C 0.00227 mol / dm^3
D 0.0909 mol / dm^3

16 Which statement about amphoteric oxides is correct?

A They are made by combining an acidic oxide with a basic oxide.
B They react with water to give a solution of pH 7.
C They react with both acids and bases.
D They do not react with acids or bases.

17 Ethanoic acid is a weak acid. Hydrochloric acid is a strong acid.

1 Ethanoic acid molecules are partially dissociated into ions.
2 1.0 mol / dm^3 ethanoic acid has a higher pH than 1.0 mol / dm^3 hydrochloric acid.
3 Ethanoic acid is always more dilute than hydrochloric acid.
4 Ethanoic acid does not produce hydrogen ions.

Which statements are correct?

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

18 When blue-green crystals of nickel(II) sulfate are heated, water is produced and a yellow solid remains. When water is added to the yellow solid, the blue-green colour returns.

Which process describes these changes?

A combustion
B corrosion
C neutralisation
D reversible reaction

19 Lead(II) sulfate is prepared by mixing two substances, X and Y. When the reaction is complete, the mixture is filtered.

Which row shows the best way to prepare pure lead(II) sulfate?

	substance X	substance Y	method after filtration
A	aqueous lead(II) nitrate	aqueous sodium sulfate	crystallise the filtrate
B	aqueous lead(II) nitrate	aqueous sodium sulfate	wash and dry the residue
C	solid lead(II) carbonate	dilute sulfuric acid	crystallise the filtrate
D	solid lead(II) carbonate	dilute sulfuric acid	wash and dry the residue

20 The thermite reaction can be used to produce iron from iron(III) oxide. The equation for the reaction is shown.

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

Which statements about this reaction are correct?

1 Aluminium is the oxidising agent.
2 Aluminium oxidises iron(III) oxide.
3 Electrons are transferred from aluminium to iron(III) ions.
4 Iron in iron(III) oxide is reduced.

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

21 Which pair of compounds shows that transition elements have variable oxidation states?

A Cr_2O_3 and $CrBr_3$
B $CuSO_4$ and $CuCl_2$
C Fe_2O_3 and $FeCl_2$
D NiO and $NiCl_2$

22 Which statement about the uses of metals is not correct?

A Aluminium is used in aircraft because of its strength and good electrical conductivity.
B Copper is used in electrical wiring because of its good electrical conductivity.
C Stainless steel resists corrosion and is used to make cutlery.
D Transition elements are often used as catalysts.

23 Heating copper(II) carbonate produces copper(II) oxide and carbon dioxide. Heating the copper(II) oxide with carbon produces copper.

Which processes are involved in the conversion of copper(II) carbonate to copper?

A sublimation followed by oxidation
B sublimation followed by reduction
C thermal decomposition followed by oxidation
D thermal decomposition followed by reduction

24 Which statement about the hydrogen fuel cell is not correct?

A Chemical energy is converted into electrical energy.
B Hydrogen is oxidised.
C Reaction only involves bond formation.
D Water is the only product.

25 Which statement about the electrolysis of copper(II) sulfate solution using carbon electrodes is correct?

A A colourless gas is produced at the anode.
B A colourless gas is produced at the cathode.
C The colour of the electrolyte remains the same.
D The mass of both electrodes remains constant.

26 Elements in Group I of the Periodic Table react with water.

Which row describes the products formed in the reaction and the trend in reactivity of the elements?

	products	trend in reactivity
A	metal hydroxide and hydrogen	less reactive down the group
B	metal hydroxide and hydrogen	more reactive down the group
C	metal oxide and hydrogen	less reactive down the group
D	metal oxide and hydrogen	more reactive down the group

27 An inert gas E is used to fill weather balloons.

Which descriptions of E are correct?

	number of valence electrons in an atom of E	structure of gas E
A	2	diatomic molecules
B	2	monatomic atoms
C	8	diatomic molecules
D	8	monatomic atoms

28 Nitrogen reacts with hydrogen to produce ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The reaction is exothermic. The bond energies are shown in the table.

bond	bond energy in kJ / mol
N≡N	945
H–H	436
N–H	390

Which shows the overall energy change for this reaction?

A –959 kJ / mol
B –87 kJ / mol
C 87 kJ / mol
D 959 kJ / mol

29 Which statements about endothermic reactions are correct?

1 The energy of the products is greater than the energy of the reactants.
2 The energy of the reactants is greater than the energy of the products.
3 The temperature of the surroundings increases during the reaction.
4 The temperature of the surroundings decreases during the reaction.

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

30 Which change in reaction conditions increases both the collision frequency and the proportion of molecules with sufficient energy to react?

A addition of a catalyst
B increasing the concentration of a reactants
C increasing the surface area of a reactants
D increasing the temperature of the reactants

31 The rate of reaction between magnesium ribbon and 2 mol / dm^3 hydrochloric acid at 25 °C to produce hydrogen gas is measured.

In another experiment, either the concentration or the temperature of hydrochloric acid is changed. All other conditions are kept the same.

Which conditions would increase the rate of reaction?

A 1 mol / dm^3 hydrochloric acid at 25 °C
B 2 mol / dm^3 hydrochloric acid at 10 °C
C 2 mol / dm^3 hydrochloric acid at 20 °C
D 3 mol / dm^3 hydrochloric acid at 25 °C

32 Which statements about the Haber process are correct?

1 An increase in pressure increases the speed of reaction.
2 An iron catalyst is used to increase the yield of ammonia.
3 A higher temperature of 450 °C is used to decrease the yield of ammonia.
4 A relatively low pressure of 250 atm is used because it is costly to maintain a high pressure.

A 1 and 4 only
B 1, 3 and 4 only
C 2 and 3 only
D 1, 2, 3 and 4

33 Oxides of nitrogen are formed in car engines and are a source of air pollution. To decrease this pollution, catalytic converters are fitted to car exhausts.

What happens to the oxides of nitrogen in the catalytic converter?

A combustion
B cracking
C oxidation
D reduction

34 Which statement/s about sulfur dioxide pollution is/ are correct?

1 It increases the pH of rivers.
2 It damages limestone buildings.
3 It causes respiratory problems.

A 1 only
B 2 only
C 1 and 3 only
D 2 and 3 only

35 Which chemical equation shows a correct reaction of methane?

A $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$
B $CH_4 + Cl_2 \rightarrow CH_4Cl_2$
C $CH_4 + Cl_2 \rightarrow CH_2Cl_2 + H_2$
D $2CH_4 + 2Cl_2 \rightarrow 2CH_3Cl + Cl_2 + H_2$

36 Which two compounds are molecules containing a double bond?

A ethane and ethanoic acid
B ethane and ethanol
C ethene and ethanoic acid
D ethene and ethanol

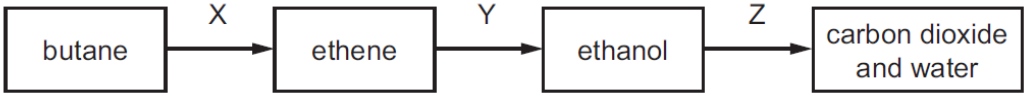
37 Ethanol can be formed using the two following methods.

1 fermentation
2 reaction between ethene and steam

Which row correctly shows the condition for the two methods?

	1	2
A	uses a catalyst	uses a catalyst
B	uses a catalyst	does not use a catalyst
C	does not use a catalyst	uses a catalyst
D	does not use a catalyst	does not use a catalyst

38 The diagram shows a reaction sequence.



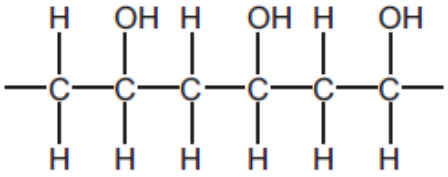
Which row shows the processes X, Y and Z?

	X	Y	Z
A	cracking	fermentation	respiration
B	cracking	hydration	combustion
C	distillation	fermentation	respiration
D	distillation	hydration	combustion

39 Which reaction can be used to make ethanoic acid?

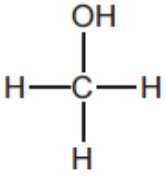
A oxidation of ethanol
B oxidation of ethene
C reduction of ethanol
D reduction of ethene

40 The structure of an addition polymer is shown.

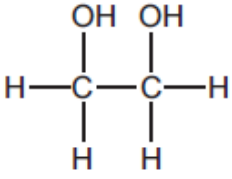


Which monomer is used to make this?

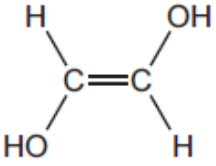
A



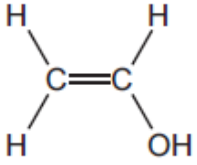
B



C



D



The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).