YIO CHU KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
SECONDARY FOUR EXPRESS

CHEMISTRY 6092

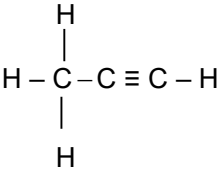
ANSWER SCHEME

PAPER 1

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

PAPER 2 SECTION A

Qn		Answers	Marks
A1	(a)	Si	[1]
	(b)	Ar	[1]
	(c)	I	[1]
	(d)	N/ P/ As	[1]
	(e)	Ni	[1]
	(f)	S and O / N and O	[1]
			Total : [6]
A2	(a)	No. of mol of sulfuric acid = 0.0005 mol ; No. of mol of sodium hydroxide = 0.001 mol ; Concentration of sodium hydroxide = 0.001/0.01; = 0.1 mol/dm^3 ;	;;[1] Max [2]
	(bi)	10 cm^3	[1]
	(bii)	ethanoic acid is monobasic while sulfuric acid is dibasic / ethanoic acid produces one mole of hydrogen ions while sulfuric acid produces 2 moles of hydrogen ions per mole of acid. To neutralise the same number of moles of NaOH, twice the volume of ethanoic acid is required compared to sulfuric acid given that the concentration of acid used is the same.	[1]
	(c)	A strong acid completely ionises in water while a weak acid partially ionises in water. [1] H_2SO_4 (aq) → $2H^+$ (aq) + SO_4^{2-} (aq) CH_3COOH (aq) ⇌ CH_3COO^- (aq) + H^+ (aq) equations [1] ignore state symbols	[2]
			Total : [6]

Qn		Answers	Marks
A3	(a)	Diamond has the highest resistivity as it does not conduct electricity. All its valence electrons are used in covalent bonding. No mobile/delocalised electrons present to conduct electricity. [1] The three precious metals have low resistivity as they are good conductors of electricity. They have a sea of delocalised/mobile electrons that act as charge carriers in their giant metallic lattice structure. [1] Accept : free electrons	[2]
	(b)	No. I do not agree with student's comment. Graphite's resistivity value will be closer to the metals because graphite has mobile/delocalised electrons in its structure that makes it a good electrical conductor.	[1]
	(c)	Pure metals are too soft to be sold commercially / alloys are harder. [1] In alloys, the different-sized atoms disrupt the regular arrangement of the atoms of pure metal. A larger force is required for the layers of atoms to slide over each other. [1]	[2]
	(d)	Resistivity of metals and graphite increases with increasing temperature [1] As temperature increases, metal ions/carbon atoms gain energy and vibrate faster / more vigorously. The increased vibrations (of ions / carbon atoms) interferes with and slows down electron movement. [1]	[2]
			Total : [7]
A4	(ai)	general formula : C_nH_{2n-2}	[1]
	(aii)	any one of the following : They have the same functional group carbon-carbon (C≡C) triple bonds/ Each member differ from the next consecutive member by a $-CH_2$ group/ There is a gradation in physical properties down the series (– melting and boiling point increases as the number of carbon atoms in the molecule increases.)	[1]
	(b)	Name : propyne Full Structural Formula : 	[1] [1]
	(ci)	Carbon dioxide and water	[1]
	(cii)	Yes. Ethyne has a higher percentage of carbon by mass (92.3%) as compared to ethene (85.7%). Hence it is less flammable and gives a sootier flame.	[1]
			Total: [6]

Qn		Answers	Marks
A5	(a)	P = activation energy/Ea [1] Q = enthalpy change (of reaction)/ΔH [1]	[2]
	(bi)	energy change is positive/enthalpy change is positive/ energy of products (2NO) is higher than that of reactants (N_2 and O_2) implying that energy is absorbed.	[1]
	(bii)	bond breaking is endothermic/absorbs energy/takes in energy; bond making is exothermic/releases energy/gives out energy. [1] more energy is absorbed than released [1]	[2]
	(ci)	Provide alternative pathway with lower activation energy	[1]
	(cii)	2.4/2 = 1.2 dm^3	[1]
	(ciii)	By volume ratio, NO: N_2 2 : 1 2.0/2.4 x 100% [1] = 83.3% [1] OR No. of moles of N_2 = 1.0/24 = 0.04166 No. of moles of NO reacted= 2 x 0.04166 = 0.08333 [1] No. of moles of NO produced by engine = 2.4/24 = 0.1 % = 0.08333/0.1 = 83.3% [1]	[2]
			Total: [9]
A6	(ai)	acts as a protective barrier / layer stops air/oxygen and water from getting to the surface (of the iron)	[1]
	(a)(ii)	with tin: - iron more reactive than tin, oxygen / water react more readily with iron than tin/iron reacts first (where it is scratched) ; [1] with zinc : - zinc more reactive than iron - zinc is sacrificial metal / idea of sacrificial protection i.e. zinc corrodes more readily than iron / zinc reacts first [1]	[2]
	(bi)	has layer of (aluminium) oxide that will not flake off / [1] layer of insoluble / unreactive (aluminium) oxide / layer of impermeable (aluminium) oxide / protective oxide layer / reject: oxide coating without further qualification reject: forms a protective layer with oxygen	[1]

<table>
<tr><th>Qn</th><th></th><th>Answers</th><th>Marks</th></tr>
<tr><td>A6</td><td>(bii)</td><td>correct use ; [1]
e.g. drink cans / car bodies / aircraft bodies / high voltage electricity cables / cooking foil / window frames / ladders /
ALLOW: cooking utensils / mirrors (as does not corrode)
reject: for cutlery

correct explanation related to specific use stated ; [1]
e.g. drinks cans → will not react with water / acids
car bodies → will not corrode
aircraft bodies → lightweight / low density
electricity cables → lightweight / good conductor of electricity</td><td>[2]</td></tr>
<tr><td></td><td colspan="2"></td><td>Total: [6]</td></tr>
<tr><td>A7</td><td>(ai)</td><td>It reduces hydrogen peroxide to water
by removal of oxygen/decreasing the oxidation state of oxygen from -1 to -2/
while itself loses electrons/increase in oxidation state from -1 to 0
and is oxidised to form iodine.</td><td>[1]</td></tr>
<tr><td></td><td>(ii)</td><td>colourless KI turns brown</td><td>[1]</td></tr>
<tr><td></td><td>(b)</td><td>potassium iodide : increase concentration increase rate [1]
When concentration of sulfuric acid is kept constant in experiments 1 and 2, and concentration of KI doubles, the speed of reaction doubles. [1]

Accept : comparison of data for experiment 1 and 4 / 2 and 4

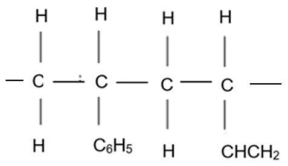
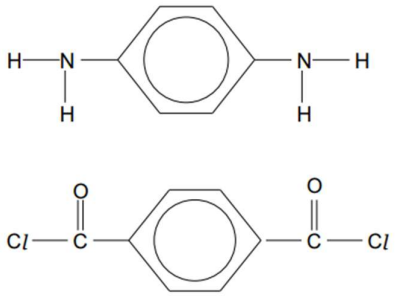
sulfuric acid : no effect [1]
In experiments 1, 3 and 5, when the concentration of KI is kept constant and the concentration of sulfuric acid doubled or tripled, the speed of reaction remains the same. [1]</td><td>[4]</td></tr>
<tr><td></td><td>(c)</td><td>Reactant particles have less energy and move slower at lower temperature
Number of collisions lesser and fewer particles have energy greater than activation energy. Frequency of effective collisions decrease, rate decreases.</td><td>[1]

[1]</td></tr>
<tr><td></td><td>(d)</td><td><table><tr><td>number of protons</td><td>53</td></tr><tr><td>number of electrons</td><td>54</td></tr><tr><td>number of neutrons</td><td>78</td></tr></table>All 3 correct [2]
1 or 2 correct [1]</td><td>[2]</td></tr>
<tr><td></td><td colspan="2"></td><td>Total: [10]</td></tr>
<tr><td></td><td colspan="3"></td></tr>
</table>

Qn		Answers	Marks
A8	(a)	No. of moles of AgC*l* = 0.287/143.5 = 0.002 Mole ratio from equation AgC*l* : Ag 1 : 1 No. of moles of Ag = 0.002 [1] Mass of Ag = 0.002 x 108 = 0.216 g [1] OR 143.5 g AgC*l* contains 108 g Ag [1] 0.287 g AgC*l* contains 0.216 g Ag [1]	[2]
	(b)	copper(I) ions is oxidised because it loses an electron to form copper(II) ions or the oxidation state of Cu increases from +1 in CuC*l* to +2 in $CuCl_2$. [1] chlorine is reduced because it gains an electron or the oxidation state of C*l* decreases from 0 in C*l* to -1 in $CuCl_2$ [1]	[2]
	(c)	$Ag + CuCl_2 \rightarrow AgCl + CuCl$	[1]
	(di)	$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(aq)$ Correct ionic equation [1] Correct state symbols [1]	[2]
	(dii)	light blue/blue	[1]
			Total: [8]

Qn		Answers	Marks
A9	(ai)	$K_C = \frac{[HI]^2}{[H_2][I_2]}$ Accept if students give $[H_2]^1[I_2]^1$	[1]
	(aii)	$2000 = [HI]^2 / (0.60 \times 0.30)$ $[HI]^2 = 360$ $[HI] =$ 19.0 mol/dm^3	[1]
	(aiii)	Number of moles of HI = 19.0 x 5 = 95.0 mol	[1]
	(aiv)	The reaction is at equilibrium when the concentration of H_2, I_2 and HI remain constant / the same / do not change.	[1]
	(av)	Chemical equilibrium occurs when the rate of the forward reaction is equal / same as to the rate of the reverse / backward reaction. [1] Reactants are still continually converted to products, and vice versa. / Reaction will still occur / Reaction will not be completed. [1]	[2]
	(b)	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ (no mark if no reversible arrow)	[1]
	(c)	Condensing the gaseous ammonia removes the ammonia from the equilibrium / decreases concentration of products / less ammonia formed from the reversible reaction. [1] This causes an **equilibrium shift** (to the right) resulting in more products being formed. [1]	[2]
	(d)(i)	The higher the temperature, the lower the percentage of ammonia at equilibrium.	[1]
	(d)(ii)	Exothermic. Increased temperature for an exothermic reaction results in less ammonia / product formed.	[1] [1]
			Total: [12]

PAPER 2 SECTION B

Qn		Answers	Marks
EITHER			
B10	(a)	Addition polymerisation [1] Both monomers contain carbon-carbon double bonds. The double bond in monomers break to form single covalent bonds with two other adjacent molecules, resulting in the formation of a polymer. [1]	[2]
	(b)		[1]
	(c)	The styrene monomer can add to another styrene monomer and a butadiene monomer can also add to another butadiene monomer during the addition polymerisation process. The multiple combination of the monomers adding together makes it unlikely for the polymer to have a regular repeating pattern.	[1]
	(di)	SBR are non-biodegradable/ it takes a long time to break down. [1] Disposal of SBR causes pollution. Recycling SBR can help to minimise pollution caused by the disposal of SBR.[1]	[2]
	(dii)	In the pre-treatment phase, SBR first undergo sorting, followed by washing to remove contaminants and then grinding into small pieces for reuse.	[1]
	ei)	Amide linkage	[1]
	(eii)		[1] each Max [2]
			Total: [10]

OR			
B10	(ai)	at the cathode : $2H^+ (aq) + 2e^- \rightarrow H_2(g)$ [1] at the anode : $4OH^- (aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$ [1] ignore state symbols	[2]
	(aii)	For every 4 moles of electrons transferred, [1] 2 moles of H_2 gas and 1 mole of O_2 gas are formed. [1] The overall equation is $2H_2O (l) \rightarrow 2H_2 (g) + O_2 (g)$	[2]
	(bi)	Direction of electron flow : from negative to positive pole/anode to cathode. electrons are released at the negative pole or anode/the reaction at the negative pole is an oxidation reaction.	[1]
	(bii)	$H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$	[1]
	(ci)	Fermentation	[1]
	(cii)	The amount of CO_2 absorbed by the sugar cane plants during photosynthesis [1] is equal to [1] the amount released when ethanol burned as a fuel. [1] This results in a net zero change in atmospheric CO_2.	[3]
			Total: [10]