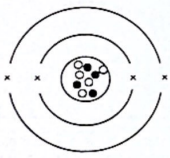
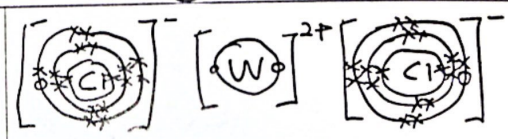
YTSS 4E CHEMISTRY PRELIM 2021

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

	ANSWER	
A1(a)	hydroxide	1
(b)	copper (II)	1
(c)	carbonate	1
(d)	ammonium	1
(e)	iodide	1
A2(a)		½ each

Particle	Name of particle	Relative mass of the particle	Relative charge on the particle
o	neutron	1	0 / no charge
●	proton	1	+1
×	electron	1/1840 or 1/1836 / neglible	-1

(b)		1
(c)	$_{4}^{9}Be$	1
A3 (a)	X, W, Z, Y	1
(b)	The particles are **closely packed in a disorderly manner** and are **slipping and sliding** over each other	1, 1
(c)	XCl has high melting point while ZCl_4 has low melting point. XCl exists as **giant ionic lattice structure** with **strong electrostatic forces of attraction between ions which require a lot of energy to break** ZCl_4 exists as a **simple covalent molecule** with **weak intermolecular forces of attraction between molecules which require little energy to break**	1 ½ ½ ½ ½

(d)		1m each for cation and anion No marks if transfer of electrons not shown
A4 (a)	Burning coal produces sulfur dioxide which is an toxic to human health and causes breathing difficulties / which is an air pollutant and dissolves in rainwater to form acid rain	1 1 (impact)
(b)(i)	Ea = 300 kJ (units must be shown) Correct Ea arrow pointing up (no mark if double-sided arrows)	½ ½
(b)(ii)	ΔH = +100 kJ (sign and units must be shown)	1
(c)(i)	Mass of ethanol burnt = 2.5 X 46 = 115g Amount of energy given out = 2972/100 X 115 = 3417.8 kJ or 3148 kJ	1 1
(c)(ii)	Ethanol is in **liquid state** so it is cheaper to transport than propane which is a **gas** and has to be **transported under pressure** which is costly	1 (answer must show comparison)
A5(a)	The percentage of nitrogen in exhaust fumes of car without catalytic converter is less than in air. **In the engine**, temperatures are high so nitrogen and oxygen in the air will react to form oxides of nitrogen The percentage of nitrogen in exhaust fumes of car with catalytic converter is greater than in car without catalytic converter. **In the catalytic converter**, the oxides of nitrogen react with carbon monoxide to form nitrogen.	½ ½ , ½ ½ ½ , ½
(b)(i)	$2CO + 2NO \rightarrow N_2 + 2CO_2$	1 (deduct ½ if eqn not balanced)
(b)(ii)	CO is the reducing agent because C in CO has been oxidised. The oxidation state of C has increased from +2 in CO to +4 in CO_2. **OR** CO is the reducing agent because the N in NO has been reduced. The oxidation state of N has decreased from +2 in NO to 0 in N_2.	1
(c)	It will not work because **CO is a neutral oxide** and cannot react / be neutralised by calcium carbonate	1
A6 (a)(i)	$Ca + Mg^{2+} \rightarrow Ca^{2+} + Mg$ $Cu + 2Ag^{+} \rightarrow Cu^{2+} + 2Ag$ $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$	1 (deduct ½ if not balanced)
(a)(ii)	Reddish brown solid formed Blue solution turns colourless	1 1
(a)(iii)	Aluminium has a layer of oxide which protects it from reaction	1
(b)	**Diagram**: labelled with Zn & Cu	1 (no mark if no labelling) 1

	In brass, the **different sizes of the copper and zinc atoms destroy the orderly arrangement** of the atoms making it **difficult for the layers of atoms to slide** thus making brass stronger.	1
A7(a)	Flask **A** has the lower concentration of H^+ ions. Sulfuric acid is dibasic. One mole of acid ionizes to give 2 moles of H^+ ions. Hydrochloric acid is monobasic. One mole of acid ionizes to give 1 mole of H^+ ions	1 1 1
(b)	Flask B: faster rate + double volume of A Flask C: slower rate + same volume as A	1 1
(c)	The speed of reaction will be faster. Powder magnesium has **smaller particle size and larger total surface area** so there will be **more collisions per unit time and the number of effective collisions per unit time increases.**	1 1
A8(a)(i) (ii)	Anode in cell A: $Cu\ (s) \rightarrow Cu^{2+}\ (aq) + 2e$ Positive electrode in cell B: $Cu^{2+}\ (aq) + 2e \rightarrow Cu\ (s)$	1 1
(b)	Reddish brown solid formed at one of the electrodes / Cathode gets larger / Anode gets smaller	1
(c)	The **blue colour** of the electrolyte in Cell B **fades** while the blue colour of the electrolyte in cell A remain **unchanged.** In cell A, at the cathode, Cu^{2+} ions are discharged. At the anode, (each) Cu is oxidised / loses (2) electrons to form Cu^{2+}. These is no net change in the concentration of Cu^{2+} In cell B, at the negative electrode, (each) Zn is oxidised / loses (2) electrons to form Zn^{2+}. At the positive electrode, Cu^{2+} is discharged. The concentration of Cu^{2+} decreases.	1 1 1
B9(a)	Mass of $MgCO_3$ in dolomite = 75/100 X 112 (Step 1) = 84 tonnes No of moles of $MgCO_3$ = 84 000 000/84 (Step 2) = 1 000 000 mol No of moles of MgO = 1 000 000 mol No of moles of Mg = 1 000 000 mol (Step 3) Mass of Mg = 1 000 000 X 24 = 24 000 000 g = 24 tonnes Actual mass of Mg obtained = 95/100 X 24 (Step 4) = 22.8 tonnes	1 1 (award marks for step 2-3 even if step 1 is not done) 1 (deduct 1/2 m if tonnes used in step 2&3 instead of grams) 1
(b)	Ca is more reactive than Si which is more reactive than Mg MgO is reduced by Si so Si is more reactive than Mg. CaO is not reduced by Si so Si is less reactive than Ca	1 1 1
(c)	The aluminim oxide acts **as an impurity** which lowers the melting point of the Mg	1
(d)	An alloy with a higher proportion of Si will **increase the yield of magnesium**. With greater Si, the **equilibrium position will shift to the right** increasing the yield.	1 1
(e)	Iron (II) oxide or iron (III) oxide or aluminium oxide.	1
(f)	Calcium oxide reacts with the silicon dioxide to form calcium silicate.	1

B10(a)	The electronegativity decreases down group I elements	1
(b)	**As the size of the atom gets larger down the group,** the **attractive force between the nucleus and the valence shell decreases** thus making it **harder for the atom to attract electrons**	1 1
(c)	Similarity: Both Group I and transition metals can conduct electricity Difference: Group I metals have low density while transition metals have high density / Group I metals have low melting points while transition metals have high melting points.	1 1 (any one)
(d)(i)	**Orange red solution**: Aqueous bromine / Br_2 **Yellow solution:** iron (III) chloride / $FeCl_3$	½ ½
(d)(ii)	Chlorine is more reactive than bromine so chlorine displaces bromine from iron (II) bromide / so chlorine displaces the bromide ions from iron (II) bromide to form bromine. Chlorine has also oxidised iron (II) to iron (III) as chlorine is an oxidising agent	1 1
B11	EITHER	
(a)	The negative elctrode is B. The metals at electrode B are more reactive than copper and lose electrons more readily	1 1
(b)	Magnesium, zinc, iron, tin, copper (in order of decreasing reactivity) The larger the voltage, the greater the difference in the reactivity of the metal with copper.	1 1
(c)(i)	P is less reactive than copper. The voltage is negative indicating that electron flow is from copper to P / electron flow is in the opposite direction	1(explanation must be correct)
(c)(ii)	Silver, gold (any metal less reactive than copper)	1
(d)	At the negative electrode/anode, calcium loses electrons to **form Ca^{2+}** which reacts with the SO_4^{2-} ions in the electrolyte and **precipitates out as $CaSO_4$ is insoluble.**	1 1
(e)	The metal electrodes conduct electricity by delocalised/mobile electrons. Sulfuric acid conducts electricty by mobile ions	1 1
B11	OR	
(a)	Cathode: $O_2 + 4H^+ + 4e \rightarrow 2H_2O$ Anode: $H_2 \rightarrow 2H^+ + 2e$	1 1
(b)	If the energy used to produce hydrogen is from the burning of fossil fuel, then there will be release of carbon dioxide which is a green house gas so the hydrogen produced is not clean	1 1
(c)	No of moles of H_2 = 60000/24 = 2500 mol Mass of H_2 = 2500 X 2 = 5000 g Distance travelled = 199 X 5 = 995 km	½ ½ 1
(d)(i)	Hydrogen: cracking of crude oil Nitrogen: fractional distillation of air	½ ½
(d)(ii)	Increasing the pressure increases the percentage of ammonia	1
(d)(iii)	Advantage: At 450°C, the speed of reaction will be faster Disadvantage: At 450°C, the percentage of ammonia is lesser / higher cost	1 1