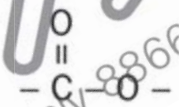
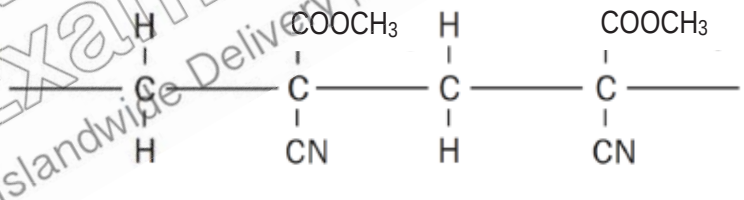
Yishun Secondary School
Preliminary Examination 2019
Secondary 4 Express Chemistry (6092)
Mark Scheme

Paper 1

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

Paper 2

Qn no.	Key marking points	Remarks
A1a	iron(III) oxide;	
b	nitric acid;	
c	iron(III) nitrate;	
d	iron(III) hydroxide;	
e	ammonia;	
A2a	 carbon-carbon double bond;  ester;	
b	Addition polymerisation;	
c		
d	Poly(methyl cyanopropenoate);	
ei	Red brown; aqueous bromine turns colourless;	
ii	Addition reaction / addition of aqueous bromine / bromination;	
A3a	H_2A (aq) + 2 NaOH (aq) → Na_2A (aq) + 2 H_2O (*l*) Correct equation; Correct state symbols;	
b	$\frac{(25/1000) \times 0.02}{V \times 0.05} = \frac{1}{2}$; $V = 20\ cm^3$;	

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<table>
<tr><td>ci</td><td><table><tr><td></td><td>carbon</td><td>hydrogen</td><td>oxygen</td></tr><tr><td>mass (in 100g)</td><td>26.7</td><td>2.2</td><td>71.1</td></tr><tr><td>no of moles</td><td>2.225</td><td>2.2/1 = 2.2</td><td>4.44</td></tr><tr><td>lowest ratio</td><td>1</td><td>1</td><td>2</td></tr></table>working;
Empirical formula of oxalic acid = CHO_2 ;</td><td></td></tr>
<tr><td>ii</td><td>n (12 + 1 + 32) = 90
n = 2
molecular formula of oxalic acid = $C_2H_2O_4$;</td><td></td></tr>
<tr><td>d</td><td>mass of oxalic acid in one star fruit = 0.00011 X 90 = 0.0099 g
maximum amount of serving = 0.05 g/0.0099 g = 5;</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>A4ai</td><td>methoxybutane ;
$CH_3OC_4H_9$;</td><td></td></tr>
<tr><td>ii</td><td>isomers

with the same number of carbon, both the alcohol and ether has the same molecular formula ;</td><td>no marks given without comparison</td></tr>
<tr><td>iii</td><td>298;</td><td></td></tr>
<tr><td>bi</td><td>same general formula of $C_nH_{2n}O$ / $C_nH_{2n+1}CHO$;
same functional group of –CHO;</td><td>must make ref to the table</td></tr>
<tr><td>ii</td><td>butanal ;
any temp between 70 – 80°C (midpoint of 49°C & 103°C);</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>A5a</td><td>the photograph is unlikely to show deposits of pure rubidium / hoax

Rubidium is a highly reactive metal /more reactive than sodium ;
so will react violently when exposed to air / water ;</td><td>no mark without explanation</td></tr>
<tr><td>b</td><td>Beryllium is less reactive than magnesium ;
no reaction with cold water / reacts very much slower than magnesium with water ;
react with steam to form beryllium oxide and hydrogen gas ;</td><td></td></tr>
<tr><td>c</td><td>reduction by carbon / carbon monoxide ;</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>A6a</td><td>Oxidation state(O.S) of N increases from -2 in N_2H_4 to 0 in N_2, and O.S of O decreases from 0 in O_2 to -2 in H_2O ;
N_2H_4 is oxidised while O_2 is reduced ;</td><td>or using any definition of [O] or [R]</td></tr>
<tr><td>b</td><td>$N_2H_4(g) + 2F_2(g) \rightarrow N_2(g) + 4HF(g)$;
ΔH = -1179 kJ/mol ;</td><td>ΔH must be negative</td></tr>
<tr><td>c</td><td>hydrazine and fluorine is a better rocket fuel

any 2 of the following reasons:
(produces larger volume of gases and more thrust, 5 moles of gases compared to hydrazine and oxygen which produces 3 moles of gases ;)
amount of energy produced per mole by the fluorine mixture is more / is a more energy efficient fuel ;
does not use oxygen as a reactant;
more energy release, causing a larger increase in the volume of gases;</td><td>no mark without reasons</td></tr>
<tr><td>d</td><td>reaction of hydrazine with fluorine produces HF which is acidic compared to water which is neutral ;
HF is likely to cause acid rain which is harmful to the environment and aquatic life ;</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td>A7a</td><td>atoms of the same element with the same number of protons but different number of neutrons / nucleon number ;</td><td></td></tr>
<tr><td>b</td><td>
<table>
<tr><th>Name</th><th>Formula</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th></tr>
<tr><td>Hydrogen atom</td><td>$^{1}_{1}H$</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>Deuterium ion</td><td>$^{2}_{1}H^{+}$</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>Tritium ion</td><td>$^{3}_{1}H^{-}$</td><td>1</td><td>2</td><td>2</td></tr>
</table>
3m – all correct; 2m – 3 to 4 correct; 1m – 1-2 correct;
</td><td></td></tr>
<tr><td>c</td><td>Ar of Ge = ((24.4/100) x 70) + ((32.4/100) x 72) +((43.2/100) x 74) ;
= 72.4 (3sf) ;</td><td></td></tr>
<tr><td>d</td><td>Agree
all isotopes of the same element have same number of valence electrons ;</td><td>no mark if no reason given</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>B8a</td><td>reaction is not reversible ;</td><td></td></tr>
<tr><td>b</td><td>endothermic reaction causes the temperature to decrease ;
at a higher temperature of 450 °C, the reaction shifts to the right to increase the concentration of products and decrease concentration of reactants; ;</td><td></td></tr>
<tr><td>c</td><td>1.01 mol/dm^3;</td><td>3 s.f.</td></tr>
<tr><td>d</td><td>higher temperatures would shift reaction in favour of forming the reactants, lowering yield;
at lower temperatures rate of reaction is slower;</td><td>accept: high cost to maintain high temperature</td></tr>
<tr><td>e</td><td>high yield of sulfur trioxide without increasing pressure /
increase in pressure would be expensive (for marginal increased yield) ;</td><td></td></tr>
<tr><td>f</td><td>Reaction 1 – graph B
Vr = Vp ;
Reaction 2 – graph A
Vr > Vp ;</td><td>both graphs must be correct

accept: moles of gas / molecules of gas as an alternative to volume</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>B9</td><td>$2NiS + 3O_2 \rightarrow 2NiO + 2SO_2$;</td><td></td></tr>
<tr><td></td><td>no. of moles of NiS= $\frac{182000}{59+32}$ =2000 mol ;
2000 x (32 +16x2) = 128 kg ;</td><td></td></tr>
<tr><td>b</td><td>simple covalent molecule/ simple molecular structure with weak intermolecular bonds/FOA ;
low boiling point;</td><td></td></tr>
<tr><td>c</td><td>with zinc nitrate - no reaction;
with copper(II) nitrate - blue solution turned green;
nickel coated with pink solid;</td><td></td></tr>
<tr><td>d</td><td>magnesium is more reactive than carbon ;
thus manufacture by electrolysis (of its ore);</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Either</td><td>$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$</td><td></td></tr>
</table>

B10a	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ Mol of zinc = 0.488/65 = 0.00751 ; Mol of acid = 2.0 x 20.0/1000 = 0.04mol ; Zinc is the limiting reagent and will produce the same volume (180 cm^3) of hydrogen ;	
b	A – sulfuric acid, dibasic → due to twice the concentration of $H^{\pm}$ and higher rate; B – hydrochloric acid, due to lower concentration of H^+ and lower rate;	
c	C – sulfuric acid, as same gradient as A ; mol of hydrogen = 90/24000 = 0.00375 mass of zinc = 0.00375 x 65 = 0.244 g ; Or half the volume of hydrogen, therefore half the mass of zinc so 0.488/2 = 0.244 g ;	no mark if no calculation presented
di	zinc displaces copper from copper(II) sulfate to produce brown copper deposit ; less zinc reacts with acid to produce less hydrogen ;	
ii	Wrong copper(II) sulfate forms copper, but a catalyst should remain chemically unchanged after the reaction ;	no mark given without reason
Or B10a	sodium ethanoate + CH_3COONa ;	
b	From graph, volume of NaOH used = 20 cm^3 mole of NaOH = 20/1000 X 0.1 = 0.002mol ; 1 mole of CH_3COOH = 1 mole of NaOH conc of CH_3COOH = mole / vol = 0.002 / (20/1000) = 0.1 mol/dm^3 ;	
c	Methyl orange ; 'Step' occurs at pH 9, but methyl orange only changes colour between 3.1 to 4.4 / does not change colour at pH 9 ;	accept OWTTE
di	hydrochloric acid ionises/ dissociate completely while ethanoic acid ionises/ dissociate partially / hydrochloric acid is a strong / stronger acid while ethanoic acid is a weak / weaker acid ; so hydrochloric acid has a higher concentration / no of moles per unit volume of $H^{\pm}$ ions so frequency of effective collision increases ; thus time taken is shorter ;	
ii	Volume of NaOH = 10cm^3 and same shape ;	