Killara HIGH SCHOOL

Year 12

Chemistry

Half Yearly Examination

2016

Weighting: 15%

Time Allowed: 2 hours

Instructions:

- **Reading time – 5 minutes**
- **Working time – 2 hours**
- **Write using BLACK or BLUE pen only**
- **Draw diagrams using pencil**
- **Board approved calculators may be used**
- **A data sheet and a Periodic Table are provided at the back of the paper**
- **Write your STUDENT NUMBER ONLY on Section I and Section II**

Section I – 10 Multiple Choice questions – *Use the Answer Sheet provided*

Section II – 65 marks – *Write your answers in the spaces provided on the examination paper.*

Total: 75 marks

Student Number.....

Section I

Total marks (10)

Attempt Questions 1 – 10

Allow about 15 minutes for this section

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the grid below.

	A	B	C	D
1				
2				
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4				
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9				
10				

1. Which statement concerning galvanic cells is correct?

(A) Oxidation occurs at the anode.
(B) They are also known as electrolytic cells.
(C) The cathode is assigned a negative charge.
(D) An external power source must be present.

2. Glucose ($C_6H_{12}O_6$) is a monomer that can form naturally occurring polymers. The approximate atomic weights for the elements which make up glucose are shown in the table.

Element	*Approximate atomic weight*
Carbon	12
Hydrogen	1
Oxygen	16

Using data from the table, what would be the approximate molecular weight of a polymer made from 5 glucose monomers?

(A) 810
(B) 828
(C) 882
(D) 900

3. A student tests some solid metal oxides. All 4 oxides react with sulfuric acid. Only one of the oxides reacts with sodium hydroxide. This oxide could be:

(A) Al_2O_3
(B) MgO
(C) Fe_2O_3
(D) BaO

4. A solution made from red cabbage leaves turns pink in acid and it turns green in base. Which of the following would make the solution turn pink?

(A) Ammonia based cleaner
(B) Lemonade
(C) Table salt
(D) Washing detergent

5. A teacher found an old collection of indicators which she suspected were incorrectly labelled. She asked a student to check which indicators were correctly labelled by adding them to solutions of known pH.

The student's results are in the table below:

Label on bottle of indicator	**Colour of solutions of known pH after indicator added**			
	pH = 1	*pH = 4*	*pH = 7*	*pH = 11*
Methyl orange	red	yellow	yellow	blue
Bromothymol blue	yellow	yellow	green	blue
Litmus	blue	blue	purple	red

Which bottles of indicator were labelled correctly?
(A) The methyl orange and the litmus
(B) The litmus and the bromothymol blue
(C) Only the bromothymol blue
(D) Only the methyl orange

6. *"Rinse first with water, then with the solution to be held in it."*

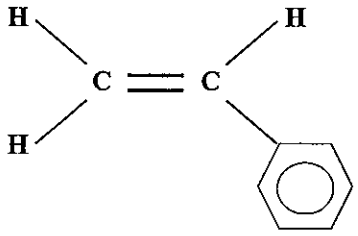
For which two items of equipment, used in titration, does this instruction apply?

(A) Volumetric flask and burette
(B) Reaction (conical) flask and pipette
(C) Pipette and burette
(D) Reaction (conical) flask and burette

7. Which characteristic of ethylene makes it so easily transformed into other products?

(A) gaseous nature at 25°C and 100kPa
(B) carbon-hydrogen single bonds
(C) low molecular weight
(D) carbon-carbon double bond present

8. Which of the following correctly identifies the following monomer?



	Systematic name	*Common name*
(A)	Benzylethene	Polystyrene
(B)	Ethenylbenzene	Styrene
(C)	Ethylbenzene	Styrene
(D)	Polybenzene	Polystyrene

9. The molar heat of combustion of ethanol is 1367 kJ mol^{-1}.

Assuming no heat losses to the surroundings, what mass of ethanol must be combusted to raise the temperature of 0.250 kg of water from 20.0°C to 60.0°C?

(A) 1.41×10^{-3} g
(B) 2.11×10^{-3} g
(C) 1.41 g
(D) 2.11 g

10. A student needs to prepare 250mL of 0.1mol/L solution using anhydrous sodium carbonate. The mass of solid required is closest to:

(A) 2.65g
(B) 26.5 g
(C) 2.08g
(D) 20.8g

Section II **Student Number .....**

Short Answer Questions (65 Marks)

Answer the questions in the spaces provided.

Question 11 (6 Marks)

Ethanol can be produced from crops such as corn and sugar cane.

(a) Ethanol is still produced industrially from hydrocarbon stock. Write a balanced chemical equation for this process. 1

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(b) i) Write a balanced chemical equation for the formation of ethanol from sugar. 1

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ii) Assess the potential of ethanol produced in this way as an alternative fuel. 4

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Question 12 (5 Marks)

Americium-243 is a radioisotope used in smoke detectors. It undergoes alpha decay.

(a) Write a nuclear equation for this process. 1

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(b) Describe the conditions under which a nucleus will be unstable. 2

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(c) Outline two major problems associated with the use of radioisotopes. 2

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Question 13 (7 Marks)

A student was asked to perform a first-hand investigation to measure the difference in potential of various combinations of metals in an electrolyte solution. The student was provided with three metals: aluminium, zinc and silver; and three electrolyte solutions: aluminium nitrate, zinc nitrate and silver nitrate.

(a) Identify which combination of the metals supplied should give the highest potential difference. 1

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(b) Sketch and label a diagram of an experimental setup that the student could use with the combination of metals identified in part (a). 2

(c) Write a balanced chemical equation for the overall reaction for the metals identified in part (a), and calculate the expected potential difference. 2

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(d) The measured potential difference obtained varied from the theoretical value. Outline steps the student could have taken to minimise this variation. 2

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Question 14 (4 Marks)

Cellulose is a natural occurring condensation polymer.

(i) Identify the monomer that forms cellulose 1

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(ii) Draw the structure of cellulose (2 monomer units long only) and explain why it is described as a condensation polymer. 3

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Question 15 (4 Marks)

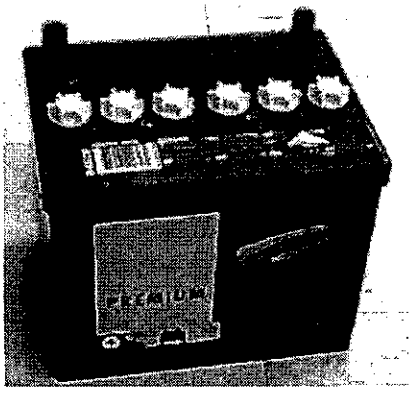
You have studied one of the cells shown below.

Cell *X* *and* Cell *Y*

Choose ONE of the cells and answer parts (a) and (b).

Cell *X*

Cell *Y*



(a) State ONE environmental impact associated with the cell you have chosen. 1

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(b) Describe the chemistry of the cell you have chosen. 3

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Student Number .....

Question 16

(8 Marks)

The demands of modern society result in the release of ever increasing amounts of sulfur and nitrogen oxides into the Earth's atmosphere.

(a) Provide details, including a suitable equation, for one process which results in each of these pollutants entering our atmosphere.

(i) Sulfur oxides 2

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(ii) Nitrogen oxides 2

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(b) Explain briefly how these gases result in acid rain and describe the effects of acid rain on the natural environment. 4

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Question 17 (3 Marks)

As part of your course work, you prepared an indicator from a natural material.

Outline the procedure that you followed for making the indicator and testing it.

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Question 18 (3 Marks)

The radioisotopes listed below are currently used in medicine. Choose ONE of the radioisotopes listed or one you have studied. Describe how it is used in medicine and how its use relates to its properties.

Cobalt-60
Iodine-131
Technitium-99m

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Student Number .....

Question 19 (3 Marks)

Polyethylene is an example of a commercially and industrially important polymer. Outline the steps in the production of one type of polyethylene.

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Question 20 (2 Marks)

Calculate the volume of CO_2 gas produced (measured at 25°C and 100kPa), when 5g of $CaCO_3$ is dissolved in excess hydrochloric acid.

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Question 21 (3 Marks)

Explain the effect of decreasing the temperature on the solubility of carbon dioxide in soft drink in terms of Le-Chatelier's principle. Include relevant equations in your answer.

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Question 22 (5 Marks)

A student wants to determine the concentration of ethanoic acid in household vinegar. To do this, she makes a primary standard using anhydrous sodium carbonate (Na_2CO_3).

(a) Identify TWO properties needed for a compound to be a suitable primary standard. 1

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(b) The student weighs a 7.52 g sample of anhydrous sodium carbonate and dissolves this completely in a 250 mL volumetric flask.

Calculate the concentration of the resulting sodium carbonate solution. 1

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(c) The student titrated 25.0 mL aliquots of the primary standard against the household vinegar. She found that it took an average of 24.3 mL of vinegar to neutralise the sodium carbonate.

Determine the concentration of ethanoic acid in the original vinegar sample. 3

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Student Number .....

Question 23

During your course you performed a first-hand investigation to compare the reactivity of an alkane and the corresponding alkene. (8 Marks)

(a) Describe how you carried out the investigation. 3

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(b) Identify one risk and justify the related precaution required when carrying out this investigation. 2

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(c) Outline the results of the investigation. 2

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(d) Construct a balanced chemical equation for a reaction that took place (using structural formulae) 1

Question 24 (4 marks)

So far in this course you have made an ester by reacting an alkanol with an alkanoic acid by heating under reflux.

(a) Draw a labelled diagram of the equipment used. (2 marks)

(b) (i) Using structural formulae write a balanced equation for the reaction between propanol and ethanoic acid. (1 mark)

(ii) Name the ester produced in this reaction. (1 mark)

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THE END

Chemistry

DATA SHEET

Avogadro constant, N_A ..... 6.022×10^{23} mol^{-1}

Volume of 1 mole ideal gas: at 100 kPa and

at 0°C (273.15 K) ..... 22.71 L

at 25°C (298.15 K) ..... 24.79 L

Ionisation constant for water at 25°C (298.15 K), K_w ..... 1.0×10^{-14}

Specific heat capacity of water ..... 4.18×10^3 J kg^{-1} K^{-1}

Some useful formulae

$$pH = -\log_{10}[H^+] \qquad \Delta H = -mC\Delta T$$

Some standard potentials

$K^+ + e^-$	$\rightleftharpoons$	$K(s)$	–2.94 V
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	$Ba(s)$	–2.91 V
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	$Ca(s)$	–2.87 V
$Na^+ + e^-$	$\rightleftharpoons$	$Na(s)$	–2.71 V
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	$Mg(s)$	–2.36 V
$Al^{3+} + 3e^-$	$\rightleftharpoons$	$Al(s)$	–1.68 V
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	$Mn(s)$	–1.18 V
$H_2O + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g) + OH^-$	–0.83 V
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	$Zn(s)$	–0.76 V
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	$Fe(s)$	–0.44 V
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	$Ni(s)$	–0.24 V
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	$Sn(s)$	–0.14 V
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	$Pb(s)$	–0.13 V
$H^+ + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g)$	0.00 V
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(aq) + 2H_2O$	0.16 V
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	$Cu(s)$	0.34 V
$\frac{1}{2}O_2(g) + H_2O + 2e^-$	$\rightleftharpoons$	$2OH^-$	0.40 V
$Cu^+ + e^-$	$\rightleftharpoons$	$Cu(s)$	0.52 V
$\frac{1}{2}I_2(s) + e^-$	$\rightleftharpoons$	I^-	0.54 V
$\frac{1}{2}I_2(aq) + e^-$	$\rightleftharpoons$	I^-	0.62 V
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	0.77 V
$Ag^+ + e^-$	$\rightleftharpoons$	$Ag(s)$	0.80 V
$\frac{1}{2}Br_2(l) + e^-$	$\rightleftharpoons$	Br^-	1.08 V
$\frac{1}{2}Br_2(aq) + e^-$	$\rightleftharpoons$	Br^-	1.10 V
$\frac{1}{2}O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O	1.23 V
$\frac{1}{2}Cl_2(g) + e^-$	$\rightleftharpoons$	Cl^-	1.36 V
$\frac{1}{2}Cr_2O_7^{2-} + 7H^+ + 3e^-$	$\rightleftharpoons$	$Cr^{3+} + \frac{7}{2}H_2O$	1.36 V
$\frac{1}{2}Cl_2(aq) + e^-$	$\rightleftharpoons$	Cl^-	1.40 V
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	1.51 V
$\frac{1}{2}F_2(g) + e^-$	$\rightleftharpoons$	F^-	2.89 V

Aylward and Findlay, *SI Chemical Data* (5th Edition) is the principal source of data for this examination paper. Some data may have been modified for examination purposes.

PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number	79
Symbol	Au
Standard Atomic Weight	197.0
Name	Gold

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.38 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.61 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.96 Molybdenum	43 Tc Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanoids	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.9 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	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						

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.1 Ytterbium	71 Lu 175.0 Lutetium

Actinoids

89 Ac Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	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

Elements with atomic numbers 113 and above have been reported but not fully authenticated.
Standard atomic weights are abridged to four significant figures.
Elements with no reported values in the table have no stable nuclides.
The International Union of Pure and Applied Chemistry Periodic Table of the Elements (February 2010 version) is the principal source of data. Some data may have been modified.

Student Number.....

Section I

Y1-12 Answers

2016

Total marks (10)

Attempt Questions 1 – 10

Allow about 15 minutes for this section

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the grid below.

	A	B	C	D
1	X			
2		X		
3	X			
4		X		
5			X	
6			X	
7				X
8		X		
9			X	
10	X			

2016 YEAR 12 HALF YEARLY EXAM MARKING GUIDELINES

Section II

Question 11

(a) & (b) equations must be balanced – 1 mark each

(c) 2 important advantages and 2 important disadvantages plus a clear assessment statement – 4 mks

Question 12

(a) Nuclear equation must be perfectly correct – 1 mark

(b) Nucleus too large – too many protons (accept >82 or >83) – 1 mark
Proton/neutron ratio outside zone of stability **OR** too many or too few neutrons compared to no of protons - 1 mark

Question 13

(a) Aluminium and Silver. (some students said silver nitrate). Must have identified both metals for 1 mark

(b) -The diagram must have two separate beakers.
-Aluminium electrode and aluminium nitrate electrolyte solution. Must mention (aq) or ions otherwise penalised (½ mark)
-KNO_3 salt bridge must be mentioned. 0 marks for KOH
-Voltmeter must be present in diagram
- Full marks were given to students who carried the error from part (a) and fulfilled the marking guidelines.
- ½ mark was penalised for each incorrect/missed component.
- If only one beaker was drawn, 0 marks were awarded.

(c) -1 mark for balanced overall reaction. If the students only provided two half equations they lost ½ mark.
- Potential difference is 2.48V -1 mark
- If they carried the error from part (a) they could still get full marks if they did it correctly.

(d) Two correct steps need to be identified for 2 marks.
- Eg. Clean the surface of the metals to remove any impurities
- Use 1 mol/L solutions for both electrolyte solutions
- Experiment to be conducted at STP (25°C and 100kpa)
- 0 marks for repeating the experiment, same size beakers, same volume of solutions etc.

Question 14

(i) Beta glucose (1 mark) If they said glucose (1/2 mark)

(ii) 1 mark for showing one correct monomer of Beta glucose
-2 marks for showing flipped glucose molecules and how the water is eliminated.
-1 mark for explaining what condensation polymers are.
Condensation polymers are polymers that are formed by the elimination of a small molecule (often water) when pairs of monomer molecules join together. The polymerisation occurs by the elimination of water molecules from between pairs of glucose molecules.

Question 15

(a) Most students studied cell Y. Any reasonable environmental impact was given 1 mark. Common responses were corrosive H_2SO_4, lead is a heavy metal and is toxic if not recycled correctly. No marks were given for saying the acid or lead are dangerous? How?

(b) For the chosen cell- Must show the anode and cathode reactions correctly. 1 mark was given per correct half equation (2 marks) If any part of the equation was incorrect they got 0.
- The final mark was given for identifying the electrolyte solution correctly and briefly explaining how it works.
- 3 marks were awarded for satisfying all of the above.

Question 16

(a) (i) volcanoes OR burning a fossil fuel such as coal which contains sulfur together with correct eqn for combustion of sulfur
OR smelting metal sulfide ores together with a correct eqn (many incorrect eqns here) – 2 marks

(ii) lightning OR high temperature combustion in car engines, power stations etc .
(In both cases the nitrogen and oxygen which make up the air combine) together with a correct eqn for this reaction – 2 marks

(b) Statement that these gases react with water in the atmosphere to produce acids
Correct equation for the formation of one such acid
Statement that acid rain is rain with pH<5.6
2 effects of this on plants clearly described + 2 effects on animals clearly described – 4 marks

Question 17

Adequate outline of the process of preparing the indicator – 1 mark
Procedure to test must include - reasonable quantities of test solution and indicator
- test solutions must be named and include a strong acid such as HCl, water and a strong base such as NaOH
- statement of conc. of test solutions - 2 marks

Question 18

One correct use for chosen radioisotope - 1 mark
Description of properties **must include** type of radiation emitted, half-life of isotope and how this relates to the use. – 2 marks

Q19. Steps (Initiation, Propagation and Termination) and description of each step - 2 marks

Equations for each step – 1 Mark

Q20. $CaCO_3(s) + 2HCl(aq.) \longrightarrow CaCl_2(aq.) + CO_2(g) + H_2O(l)$

$nCaCO_3 = m/M = 5.00/100.09 = 0.0500$ mol - 1 Mark

$nCaCO_3 = nCO_2$ (1:1 molar ratio)

$VCO_2 = 0.0500 \times 24.79 = 1.2395 = 1.24$ L of CO_2 - 1 Mark

Not penalised for significant figures

Q21. Balanced equation – 1 Mark

Reference of Le- Chatelier's principle and stating that equilibrium would favour exothermic reaction and reason behind it. -- 2 Marks

Q 22 a) Any two properties of the primary standard like stability, known composition high molar mass etc. - 1 Mark

*did not accept known concentration or should be an acid or a base.

b) $nNa_2CO_3 = m/M = 7.52/105.99 = 0.07095$ moles - ½ mark

$c=n/V = 0.07095/0.25 = 0.2838 = 0.28$mol/L - ½ Mark

c) $2CH_3COOH + Na_2CO_3 \longrightarrow 2\ CH_3COONa + H_2O + CO_2$

$n\ Na_2CO_3 = cV = 0.284 \times 0.025 = 0.0071$ moles - 1 Mark

$n\ CH_3COOH = 2\ n\ Na_2CO_3 = 0.0142$ moles (1:2 molar ratio) - 1 Mark

$c\ CH_3COOH = n/V = 0.0142/\ 0.0243 = 0.584$ mol/L - 1 Mark

Question 23

(a) Three appropriate reagents – 1 mark
Four appropriate volumes – 1 mark
Stopper and shake - ½ mark
Equipment must include test tubes – ½ mark

(b) one risk eg toxic fumes – 1 mark (harmful ½ mark)
Precaution – Fume cupboard - 1 mark

(c) bromine water gets decolourised/correct colour change, for cyclohexene (1 mark)
No reaction/no colour change with cyclohexane – 1 mark

(d) correct structural formulae used for equation – 1 mark

Question 24

(a) For 1and1/2 marks, 4 labels including condenser, water (in + out correctly), round bottomed flask, heating mantle,
1 mark for 3 of these labels etc
½ mark for scientific diagram

(b) (i) correct equation using structural formulae including water – 1 mark
(ii) propyl ethanoate – 1 mark