Coimisiún na Scrúduithe Stáit
State Examinations Commission

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Fisic agus Ceimic *Ardleibhéal*

Marking Scheme *Leaving Certificate Examination, 2004*

Physics and Chemistry *Higher level*

Leaving Certificate Examination

2004

Physics & Chemistry

Higher Level

Marking Scheme

- **Six** questions to be answered
- Answer any **three** questions from **Section I** and any **three** questions from **Section II**
- All questions carry equal marks.
- However, in each section, one additional mark will be given to each of the first two questions for which the highest marks are obtained by the candidate

Introduction

In considering this marking scheme the following points should be noted.

1. In many instances only key words are given, words that must appear in the **correct context** in the candidate's answer in order to merit the assigned marks.

2. Marks shown in brackets represent marks awarded for partial answers as indicated in the scheme.

3. Words, expressions or statements separated by a solidus, / , are alternatives which are equally acceptable.

4. Answers that are separated by a double solidus, // , are answers which are mutually exclusive. A partial answer from one side of the // may not be taken in conjunction with a partial answer from the other side.

5. The descriptions, methods and definitions in the scheme are not exhaustive and alternative valid answers are acceptable.

6. The context and the manner in which the question is asked and the number of marks assigned to the answer in the examination paper determine the detail required in any question. Therefore, in any instance, it may vary from year to year.

7. Where indicated deduct 1 mark for incorrect /no units.

QUESTION 1

Any eleven parts

(a) ***What is the relationship between G, the gravitational constant, and g, the acceleration due to gravity?***

* $g = \frac{GM}{r^2}$ … 3

… 3

(b) ***State the principle of conservation of energy***

energy cannot be created // (total) energy is constant … 3

nor destroyed/ but can be converted from one form into another // in a closed system … 3

(c) ***Define the unit of work, i.e., the joule.***

force of 1 N … 3

moves 1 m … 3

[$W = F \times s$ / J = N m … 3]

(d) ***A pin is 30 cm from a concave mirror and a real image is formed 20 cm from the mirror. What is the focal length of the concave mirror?***

$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ / $\frac{1}{30} + \frac{1}{20} = \frac{1}{f}$ /

drawing to scale showing correct arrangement of pin, image and mirror … 3

$f = \frac{60}{5}$ (cm) / f = 12 (cm) / correct location of focus using scale drawing … 3

(e) ***Give <u>two</u> properties of the final image formed in a compound microscope.***

inverted / virtual / magnified / etc. **any two** … 2×3

(f) ***Give <u>one</u> difference between transverse waves and longitudinal waves***

transverse waves can be polarised / direction in which energy travels is perpendicular to direction of vibration of source / medium not required

longitudinal waves cannot be polarised / direction in which energy travels is parallel to direction of vibration of source / medium required … 6

[differences correct but in reverse / incomplete statements (both must be given); correct examples / speed … 3]

(g) ***Under what circumstances can light be diffracted?***

when light passes through a (narrow) slit (e.g. diffraction grating) / past an obstacle etc. … 6

(h) ***State Boyle's law***.

fixed mass

constant temperature

pressure // pV // p_1V_1

inversely proportional to volume ($\propto$ 1/V) // $= k$ // $= p_2V_2$ … 2×3

[any two … 3]

QUESTION 1 (continued)

(i) ***A gas occupies 330 cm^3 at 290 K. If the pressure remains constant, what is the volume of the gas at 350 K?***

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ / $\frac{330}{290} = \frac{V_2}{350}$ … 3

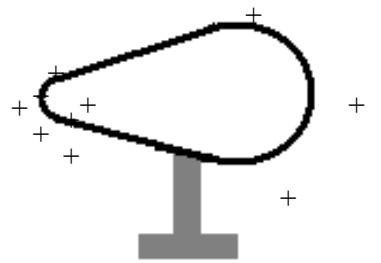
398.3 (cm^3) / (range 398 – 400) … 3

(j) ***Two capacitors with a value of 3μF and 6μF each are connected in series. Calculate their effective capacitance***

$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$ / $\frac{1}{3} + \frac{1}{6} = \frac{3}{6} = \frac{1}{C}$ … 3

2 + 2 = 4 (μF) / … 3

(k) ***A pear-shaped conductor is placed on an insulated stand. The conductor is given a positive charge. Draw a diagram to show how the charge is distributed over the conductor***



concentration of charge at pointed end … 3

diagram also showing low charge density over curved end … 3

[negative charges only / positive and negative charges shown … 3]

(l) ***What is the principle on which a moving coil galvanometer is based?***

current carrying conductor or coil, in a magnetic field, experiences a force (or torque) … 2×3

[any two … 3]

(m) ***A transformer has 5000 turns on the primary coil and 250 turns on the secondary. If the primary coil is connected to the 230 V mains supply, calculate the output voltage.***

$\frac{N_P}{N_S} = \frac{V_P}{V_S}$ / $\frac{5000}{250} = \frac{230}{V_s}$ / 1/ 20 th … 3

V_S = 11.5 (V) … 3

(n) ***Give <u>one</u> difference between nuclear fission and nuclear fusion.***

fission splits a large nucleus (atom) into two smaller nuclei (atoms) / relatively low temperature required for fission/fission is a chain reaction / fission produces isotopes with long half-lives / fuel scare

fusion joins two small nuclei (atoms) together to make a larger nucleus (atom) / very high temperature required / fusion not a chain reaction / produces isotopes with short half-lives / fuel plentiful **any one** … 6

[incomplete statement … 3]

(o) ***The energy released in a nuclear reaction is 1.7 × 10^{-12} J. Calculate the loss in mass.***

* $E = mc^2$ / $1.7 \times 10^{-12} = m\,(3 \times 10^8)^2$ … 3

$m = 1.89 \times 10^{-29}$ (kg) … 3

QUESTION 2

Define* (i) *momentum* (ii) *acceleration **4×3**

(i) mass // mv …3
× velocity // where m is mass and v is velocity …3

(ii) rate of change // $v - u \div t$ …3
of velocity / of speed in a given direction // and explain two terms …3

State Newton's second law of motion and use it to derive the expression force = mass × acceleration **5×3**

* rate of change of momentum $\propto$ to the force// $F \propto mv - mu \div t$ …3
and is in the same direction as applied force // and explain the terms …3

$$\frac{mv - mu}{t} \propto F \quad / \quad \frac{m(v-u)}{t} \propto F$$ …3

$F \propto ma$ …3

$F = kma$ …3
[where candidates use = instead of $\propto$ (–1)]

Describe an experiment to measure the acceleraton of a moving body **6×3**

App: trolley, timing arrangement …3

Method: correct arrangement of apparatus shown or described …3
release the trolley / explain how initial velocity obtained …3
calculate / record final speed of the trolley …3
measurement of interim distance // time …3
acceleration calculated from $v^2 = u^2 + 2as$ / $v = u + at$ / $s = ut + ½at^2$ …3

Calculate (i) the acceleration of the car **3×3**

$v^2 = u^2 + 2as$ / $(15)^2 = (25)^2 + 2a100$ …3
$225 - 625 = 200a$ …3
$a = (-)2$ m s^{-2} …3
incorrect units/no units (-1)

(ii) *the force acting on the car while the brakes are applied* **3**

$F = (750 \times 2) = 1500$ N …3
incorrect units/no units (-1)

(iii) the loss in kinetic energy by the car as a result of slowing down **2×3**

E_K = W = Fs / E_K = (1500)(100) // $E_k = ½mv^2$ / E_K before / E_K after …3
ΔE_K = 150 000 J …3
incorrect units/no units (-1)

What happens to the kinetic energy lost by the car in slowing down? **3**

Converted into heat/sound/vibration/other forms of energy …3

QUESTION 3

Define the terms* (i) *refractive index* (ii) *critical angle ***4×3***

(i) ratio of sin *i* // speed in less dense medium …3
to sin *r* // speed in more dense medium …3

(ii)angle of incidence in denser medium …3
corresponding to angle of refraction of 90º …3
[*n* = real depth / apparent depth …0]

Give the relationship between these two terms ***3***

$n = \frac{1}{\sin c}$ …3

Draw a suitable graph on graph paper and explain how your graph verifies Snell's law ***7×3***

values for sin *i* and sin r …3
axes labelled correctly …3
any 3 points plotted correctly …3
3 further points plotted correctly …3
good straight line …3
[graph of *i vs r* … 2×3 max; graph paper not used … deduct 6]

Sin *i*	0.26	0.42	0.57	0.7	0.82	0.91	0.97
Sin *r*	0.17	0.28	0.37	0.47	0.54	0.6	0.64

straight line through the origin …3
shows that sin *i* ∝ sin *r* …3

From your graph, find the refractive index of glass and hence calculate a value for the critical angle of the glass ***6×3***

reference to graph / line …3
n = 1.44 - 1.60 …2×3

1.5 = 1 / sin *c* …3
sin C = 1 / 1.5 …3
c = ($\sin^{-1}$0.666) = 41.76º / 41º45' (range 38.68 – 43.98) …3

What happens to the ray of light at A? Explain why. ***6,2×3***

the ray is totally internally reflected (stated / shown) …6

[calculated critical angle > 45º and ray emerges from glass at A – allow 6]

the angle of incidence (in the glass at A) is 45º (shown / stated) //
angle of incidence is greater than …3

the critical angle is exceeded // the critical angle …3
[the critical angle is not exceeded – allow 3]

QUESTION 4

What are the principles involved in establishing a temperature scale*?** ***3×3

thermometric property, two fixed points, scale …3×3

Give an expression which define temperature on the Celsius scale ***3×3***

$\frac{\theta}{100}$ …3

$Y_\theta - Y_0$ …3

$Y_{100} - Y_0$ …3

Describe an experiment to calibrate a mercury-in-glass thermometer ***5×3***

App: mercury-in-glass thermometer …3

ice-water mixture, steam (above boiling water) …3

Method: explain how lower fixed point is established …3

explain how upper fixed point is established …3

explain how scale is set / equation …3

Name one other type of thermometer and state an advantage it has over the mercury-in-glass thermometer ***2×3***

alcohol-in-glass thermometer /constant volume gas thermometer /
constant pressure gas thermometer/ resistance thermometer / thermocouple, etc. …3

(alcohol) reads lower range of temperatures / is more sensitive//
(gas) more accurate / wide range / more sensitive / used to calibrate other thermometers // (resistance) have a broad range // (thermocouple) has a low heat capacity/ has a broad range/ can measure a rapidly changing temperature …3

Why is it necessary to have a standard thermometer? ***2×3***

different/other thermometers // thermometers based on different thermometric properties …3

register different values at the same temperature …3

What is the temperature on the Celsius scale at X? ***3***

–273ºC …3

What is the significance of the point marked X? ***6***

(at this temperature) the gas has zero volume/(the temperature) is absolute zero/ no temperature below this value can be attained / zero Kelvin …6

Give one way in which a real gas differs from an ideal gas. ***6***

the molecules of a real gas have a non-negligible volume /
there are intermolecular forces of attraction between the molecules of a real gas /
one correct statement for a real or ideal gas …6

How is an increase in the temperature of a gas explained by the kinetic theory*?** ***2×3

molecules / particles …3

move faster / have greater E_K …3

[temperature ∝ average kinetic energy …3]

QUESTION 5

Define the resistance of a conductor **2×3**

ratio of potential difference (voltage) / V …3
to current (across conductor) / I …3
[opposition to the flow of current …3]

Describe an experiment to verify the relationship that the heat produced in a given time is proportional to the square of the current. **6×3**

App: heating coil, calorimeter, insulation, variable resistor, d.c. power supply, ammeter, thermometer (joulemeter) **any four** …2×3
[any two …3]

Method: Record temperature rise θ and current I …3
repeat at other current values …3
a graph of θ versus I^2 …3
straight line (through the origin) / precaution / experimental detail …3

Explain why the ESB uses high voltages to transmit electricity over long distances **3×3**

low current …3
heating in the wires …3
less energy lost / more efficient …3
[$P = VI$ / RI^2 …3]

Calculate (i) the total resistance of the circuit **3×3**

$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{R_{Parallel}} / \frac{1}{4} + \frac{1}{4} = \frac{1}{R_{Parallel}}$ …3

$\frac{4}{2} = R_{Parallel}$ …3

$2 + 4 = 6\ \Omega$ …3
incorrect units/no units (-1)

(ii) ***the total current flowing in the circuit*** **2×3**

$I = \frac{V}{R} / I = \frac{12}{6}$ …3

$I = 2$ A …3
incorrect units/no units (-1)

(iii) the current flowing in each bulb **4×3**

2 A flows in bulb C …6
V_{ab} / V_c // same current in A and B …3
= 1 A flows in each of bulbs A and B // value is half that of C …3
incorrect units/no units (-1)

Which of the bulbs A, B or C glows the brightest? ***Explain your answer*** **2×3**

bulb C …3
greatest current / higher voltage …3

QUESTION 6

Answer any two parts

(a) State Coulomb's law of force between electric charges ***2×3***

force proportional to (equals a constant times)/$F \propto (=k)/$ product of the charges / Q_1Q_2 …3

and inversely proportional to the distance squared / $1 \div d^2$ …3

What is an electric field? ***3***

(space around a charge) where a charge experiences (exerts) a force …3

Describe an experiment to demonstrate an electric field pattern ***4×3***

App: cooking oil, semolina, two metal plates, high tension d.c. power supply …2×3

[any two parts … 3]

Method: correct arrangement of apparatus …3

observation …3

What is the size of the force between the charges, when each charge is doubled ***2×3***

$F \propto Q_1Q_2$ …3

2 N …3

[4N … 3]

What is the size of the force between the charges, when the separation between the two original charges is increased to 4 cm? ***2×3***

$F \propto 1 \div d^2$ / distance increases by factor of 4 …3

0.5 N / $1/16^{th}$ …3

(b) ***Explain the term electromagnetic induction*** ***2×3***

* an emf (current) induced, in a conductor, when there is a change in the magnetic flux (field) …2×3

[any two … 3]

Describe an experiment to demonstrate electromagnetic induction ***3×3***

App: coil, galvanometer, magnet …3

Method: move magnet relative to coil …3

deflection in the galvanometer …3

[incomplete circuit …3]

Name the parts labelled A and B and state the function of each. ***4×3***

(A) coil …3

*(B) slip ring …3

[A and B reversed (–1)]

(A) provides conducting loop /path (for emf to be generated) …3

(B) to ensure a.c output / to conduct current out …3

Give <u>two</u> ways in which the output voltage from an a.c. generator can be increased ***2×3***

increase strength of magnetic field / rate of rotation of coil (relative to magnetic field)/increase number of turns in coil/connect to a transformer, etc **any two** …2×3

Question 6 (continued)

(c) ***Explain the underlined terms*** ***5×3***

isotopes: (are atoms of the same element/atoms with) the same atomic number/
(atoms with) the same number of protons …3
but differ in mass number / differ in the number of neutrons present …3

beta-particle: an electron …3

half-life: the time taken for half // the time taken for the activity of a sample …3
a (radioactive) sample to decay // to halve …3

Write an equation for the nuclear reaction in which iodine-131 emits a beta particle ***2×3***

$^{131}_{53}I \rightarrow$ …3

$^{131}_{54}Xe + ^{0}_{-1}e$ …3

Calculate the fraction of a sample of iodine-131 remaining after 32 days. ***2×3***

4 half lives …3
one sixteenth ($1/16^{th}$) …3

Give one use for carbon-14. ***3***

carbon dating /dating archaeological finds etc. …3

How should radioactive materials be safely stored? ***3***

in lead containers / locked away …3

(d) ***Name this phenomenon*** ***3***

photoelectric effect …3

Give one application of the phenomenon demonstrated in this experiment ***6***

burglar alarm / counting device /detecting light levels for photography
or switches / television cameras, etc …6

Explain why the negatively charged electroscope loses its charge ***2×3***

electrons released / emitted …3
leaves collapse // electrons move up from the leaves // from the zinc (zinc
becomes positively charged) …3

Why is ultraviolet radiation used ***6***

photon energy must exceed a minimum to release an electron /
high energy (frequency) / threshold frequency /
ultraviolet light has photons of high energy **any one** …6

Calculate (i) the frequency of the ultraviolet radiation ***2×3***

$c = f\lambda$ / $3.0 \times 10^{8} = f3.3 \times 10^{-7}$ …3
$f = 9.09 \times 10^{14}$ Hz …3
incorrect units/no units (-1)

(ii) the energy of the photon of the ultraviolet radiation ***2×3***

$E = hf$ / $E = 6.6 \times 10^{-34} \times 9.09 \times 10^{14}$ …3
$E = 6.0 \times 10^{-19}$ J …3
incorrect units/no units (-1)

QUESTION 7

Any eleven parts

(a) ***Define first ionisation energy***

energy required to remove most loosely bound / first / outermost electron …3
from a neutral /gaseous / isolated atom …3

(b) ***Define relative atomic mass***

mass of an atom (of an element) …3
* compared to $1/12^{th}$ of mass carbon-12 isotope …3

(c) ***Explain why graphite is an electrical conductor***

electrons …3
are free / move …3
[carbon forms three bonds …3]

(d) ***Name the forces which hold a crystal of ice together***

hydrogen bonds …6
[dipole-dipole interactions/van der Waals forces … allow 3]

(e) ***Name a group in the Periodic Table whose elements are metallic and have a valency of one***

alkali metals/group I /group1// group IB / group11 …6
[Alkaline Earth metals, Group 1 / Alkali metals, Group 2 …3]

(f) ***Give <u>two</u> chemical properties usually associated with transition metals***

variable valency/good catalysts/coloured compounds **any two** …2×3
[incomplete d sub-level … 3]

(g) ***Why do electronegativity values decrease down a group in the Periodic Table?***

increase in …3
atomic radius / number of shells …3
[screening effect (of inner electrons) …6]

(h) ***Define heat of solution of a substance***

heat (change) when one mole of a substance …3
* is dissolved in excess solvent …3

(i) ***Give <u>two</u> properties of an acid-base indicator***

which change colour according to the pH of the solution /
colour of undissociated molecule and the anion (cation) differ /
a weak acid (base) / should not interfere with the reaction / sharp colour
change close to the end point / not effected by heat or pressure **any two** …2×3
[example …3]

QUESTION 7 (continued)

(j) ***Write a balanced chemical equation for the reaction of sodium hydride with water***

$NaH + H_2O$ …3

$\rightarrow NaOH + H_2$ …3

[one correct product only … allow 3]

(k) ***Calculate the percentage by mass of oxygen in calcium carbonate***

$40 + 12 + (3 \times 16) / 100$ …3

$(\frac{48}{100} \times 100) = 48\%$ …3

(l) ***Give an example of (i) an acidic oxide, (ii) an amphoteric oxide***

(i) carbon dioxide/sulphur dioxide (trioxide)/phosphorus pentoxide, etc …3

(ii) aluminium oxide/zinc oxide/iron(III) oxide/water, etc …3

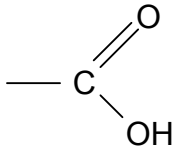
(m) ***Give the systematic name for the organic compound shown***

2,3-dichloro …3

butane …3

[dichlorobutane … allow 3]

(n) ***Draw the structure of the functional group in a carboxylic acid***



…2×3

[-COOH … allow 3]

(o) ***Identify the organic product collected in the test tube.***

ethanal / CH_3CHO …6

[ethanoic acid …3]

QUESTION 8

(a) ***Explain the terms (i) energy level, (ii) orbital.*** ***4 × 3***

(i) definite (discrete) (specific) level of energy …3
possessed by an electron in an atom …3

(ii) region in space around the nucleus …3
where there is a high probability of finding an electron …3

What information about an electron in an atom is given by the principal (first) quantum number and by the subsidiary (second) quantum number? ***2×3***

shell/main energy level / orbit (to which the electron belongs) …3
type of subshell / sublevel (to which an electron belongs) …3

In the relationship $E_2 - E_1 = hf$, which applies to atomic emission spectra, what do E_1 , E_2 and f represent? ***3×3***

E_1 energy of electron in lower / inner energy level …3
E_2 energy of excited state/energy of electron in outer/ higher energy level …3
f frequency (of photon) …3

Name one metallic element whose salts give a lilac colour to a Bunsen burner flame. ***3***

potassium …3

(b) ***Define electronegativity*** ***2×3***

attraction an atom (element) has …3
for a shared pair of electrons …3

Use electronegativity values to predict the type of bonding in ammonia. ***3***

polar covalent (bonding) …3

Is ammonia soluble in water? Explain your answer in terms of bonding. ***2 × 3***

yes …3
water is polar / there is an attraction between the water molecules and the ammonia molecules / hydrogen bonds form between the water and the ammonia molecules **any one** …3
[like dissolves like unacceptable]

Write the electronic (s, p) configuration of the nitrogen atom ***6***

N = $1s^2\ 2s^2$ …3
$2p^3$ …3

Draw a diagram to show the valence electrons and the bonding in ammonia (NH_3). ***3×3***

three single bonds …3
one lone pair …3
correct arrangement of atoms …3

Use electron pair repulsion theory to predict the shape of and the bond angle in the ammonia molecule. ***2×3***

pyramidal (shown / stated) …3
107° (107.5°) …3
[3 bond pairs and 1 lone pair of electrons / lp:lp > lp:bp > bp:bp …3]

QUESTION 9

Explain the underlined primary standard. **2×3**

pure substance … 3

used to make a solution of known concentration … 3

Describe how the 500 cm^3 of 0.05 M sodium carbonate solution was accurately made up. **5×3**

transfer the sodium carbonate / solid to the beaker completely.
add deionised water
stir until dissolved
transfer the contents of the beaker into a volumetric flask
rinse the beaker with water and add to the flask
add water to the flask to bring volume to / near (calibration) mark
add water dropwise / carefully / view meniscus at eye level
stopper and invert flask **any five** …5×3

(i) ***Describe how to ensure that exactly 25 cm^3 of sodium carbonate solution was transferred by the pipette into a conical flask.*** **6**

allow 10 - 20 seconds after pipette is emptied /
tip end of pipette gently against wall of conical flask /
do not blow out (shake) last drop …6

(ii) ***Explain why the accuracy of the titration is improved by using deionised water rather than tap water*** **6**

tap water may contain impurities/dissolved substances / ions …6

(iii) ***Name a suitable indicator for this titration and state the colour change observed at the end point*** **3×3**

methyl orange/methyl red …3

from yellow/orange …3

to red / pink …3

[correct colours in reverse order …allow 3]

(iv) ***Write a balanced chemical equation for the titration reaction.*** **2×3**

$Na_2CO_3 + 2HCl$ / $Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$ …3

$2NaCl + H_2O + CO_2$ / $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$ …3

What value should be taken as the final titration figure? **3**

22.45 cm^3 …3

Calculate the concentration of the hydrochloric acid in (a) moles per litre (dm^3) and (b) grams per litre (dm^3). **5×3**

$$\frac{V_1M_1}{n_1} = \frac{V_2M_2}{n_2}$$ …3

$$\frac{25 \times 0.05}{1} = \frac{22.45 \times M_2}{2}$$ …3

$M_2 = 0.11$ (M / moles per litre (dm^3)) …3

35.5 + 1 = 36.5 …3

0.11 × 36.5 = 4.02 (grams per litre (dm^3)) …3

QUESTION 10

(a) ***Define (i) oxidation, (ii) oxidising agent in terms of electron transfer*** ***2×3***

(i) loss of electrons …3

(ii) substance which gains electrons (in a redox reaction) …3

Identify the oxidising agent and reducing agent in each of the following reactions ***4×3***

hydrogen peroxide/ H_2O_2 and iodine/I_2 …2×3

iodide / I^- / HI and Zn /zinc …2×3

[pairs correct but in reverse …2×3]

Why can iron be oxidised by a copper sulfate solution but not by a magnesium sulfate solution? ***2×3***

a metal will displace another metal // metals higher up the electrochemical series will be oxidised // iron is below magnesium …3

lower than it on the electrochemical series (from a solution of its salt) // more readily than those lower down // iron is above copper …3

Can iron be oxidised by an aluminium sulfate solution? Explain your answer. ***2×3***

no …3

iron is below aluminium (in electrochemical series) …3

Name a metal which cannot liberate hydrogen from dilute hydrochloric acid. ***3***

copper / mercury / silver / gold …3

(b) ***State Faraday's first law of electrolysis.*** ***2×3***

the mass of an element liberated / deposited during electrolysis …3

is proportional to the charge passed …3

Identify (i) a suitable material for the electrodes ***3***

carbon / graphite / platinum …3

(ii) which electrode is the cathode ***3***

X / electrode where hydrogen is liberated / negative electrode …3

(iii) the electrode where oxidation occurs. ***3***

Y / electrode where oxygen is liberated / positive electrode / anode …3

Write a balanced equation for the reaction which takes place at the Y electrode. ***2×3***

$H_2O \rightarrow$ / $3\ H_2O \rightarrow$ / $4OH^- - 4e^- \rightarrow$ …3

$2H^+ + \frac{1}{2}\ O_2 + 2e^-$ / $2H_3O^+ + \frac{1}{2}\ O_2 + 2e^-$ / $2H_2O + O_2$ …3

Calculate the volume at STP of oxygen gas produced when a current of 0.32A is passed through the acidified water for 10 minutes. ***4×3***

$Q = It$ /$Q = 0.32 \times (10 \times 60)$ …3

$= 192$ C …3

number of Faradays = 192 ÷ 96500 / 0.002 /

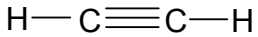
number of moles of oxygen gas = 0.002 ÷ 4 / 0.0005 …3

$(0.0005 \times 22.4) = 0.0112$ litres (dm^3) …3

QUESTION 11

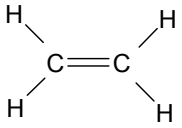
(i) ***Give the name <u>and</u> structural formula for each of the compounds X, Y and Z.*** ***6×3***

X = ethyne …3



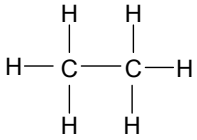
…3

Y = ethene …3



…3

Z = ethane …3



…3

(ii) ***Name the compounds S and R. Name the type of reaction which converts compound S to compound R.*** ***2×3, 6***

S = chloroethane …3

R = ethanol …3

Hydrolysis / substitution …6

(iii) ***State the reagent required <u>and</u> a necessary condition to convert compound Z to compound*** **S**. ***2×3***

chlorine gas …3

u.v. light …3

(iv) ***What term is used to describe the conversion of compound Y to compound R?*** ***6***

addition/hydration …6

Write a balanced chemical equation for the reaction of compound R with sodium. ***3×3***

$C_2H_5OH + Na \rightarrow$ …3

C_2H_5ONa …3

$+ \frac{1}{2}H_2$ …3

(v) ***Describe, with the aid of a labelled diagram, a laboratory experiment to prepare compound X.*** ***5×3***

App: dropping /separation funnel, (reaction) flask, water trough …3

Method: correct labelled arrangement of apparatus shown …3

description of addition of water …3

to calcium (di)carbide …3

ethyne collected by downwards displacement of water shown/described …3

QUESTION 12

Answer any three parts

(a) ***Calculate (i) the number of moles of magnesium used*** *2×3*

$n = \frac{m}{m_r}$ / $n = \frac{4.8}{24}$ …3

= 0.2 …3

(ii) the mass of magnesium oxide formed *2×3*

0.2 moles MgO / M_r of MgO = 40 …3

m = (0.2 × 40) = 8 (g) …3

(iii) ***the number of atoms of carbon produced.*** *2×3*

0.1 moles of carbon produced …3

number atoms = $0.1 \times 6 \times 10^{23}$ / 6×10^{22} …3

Describe the appearance of both products of this reaction. *2×2*

carbon = black / solid …2

magnesium oxide = white powder / solid …2

(b) ***Define the pH of a solution.*** *3*

* pH = $-\log_{10}[\mathbf{H}^+]$ /pH = $-\log_{10}[\mathbf{H_3O}^+]$ …3

Name <u>two</u> ways you could measure the pH of an aqueous solution. *2×2*

pH meter …2

pH /universal indicator paper …2

Calculate the pH of a 0.02 M solution of H_2SO_4 *3×3*

$[\mathbf{H}^+] = 0.04$ / $[\mathbf{H_3O}^+] = 0.04$ …3

pH = $-\log_{10}[0.04]$ …3

pH = 1.398/1.40 …3

Identify (i) the conjugate acid, (ii) the conjugate base in the reaction *2×3*

(i) * H_3O^+ …3

(ii) * HSO_4^- …3

[reverse order …3]

QUESTION 12 (continued)

(c) ***Define heat of reaction of a substance*** ***2×2***

heat change …2

when a reaction takes place according to a given (balanced) equation /

when the number of moles indicated in the (balanced) equation react completely …2

Calculate the heat change for this reaction ***5×3***

$(ZnCO_{3(s)} \rightarrow Zn_{(s)} + C_{(s)} + 3/2O_{2(g)})$ $\Delta H = 812$ kJ …2×3

$(Zn_{(s)} + O_{2(g)} \rightarrow ZnO_{(s)})$ $\Delta H = -348$ kJ …3

$(C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)})$ $\Delta H = -393$ kJ …3

$(ZnCO_{3(s)} \rightarrow ZnO_{(s)} + CO_{2(g)})$ $\Delta H = 71$ kJ …3

[$\Delta H = 142$ kJ]

Is the decomposition of zinc carbonate an exothermic or an endothermic reaction? ***3***

endothermic …3

(d) ***Distinguish between aliphatic and aromatic organic compounds***. ***6***

aliphatic compounds do not contain the benzene ring structure /

aromatic compounds contain the benzene ring structure …6

Name the compounds A and B ***2×3***

A = nitrobenzene …3

B = phenylhydrazine …3

Name the reagents used to prepare A from benzene ***2×3***

nitric acid …3

sulphuric acid …3

Give a laboratory use for compound B . ***4***

condensation reaction of an aldehyde (ketone) /

identify an aldehyde (ketone) /

to confirm the presence a carbonyl group …4