Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scéimeanna Marcála *Scrúduithe Ardteistiméireachta, 2005*

Fisic agus Ceimic *Ardleibhéal*

Marking Scheme *Leaving Certificate Examination, 2005*

Physics and Chemistry *Higher Level*

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Leaving Certificate

2005

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 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.

SECTION I – PHYSICS

QUESTION 1

Any eleven parts

(a) ***Define velocity.***

rate of change // change of displacement // speed … 3

of displacement // w.r.t. time // in a given direction … 3

[distance ÷ time … 3]

(b) **State *the principle of conservation of momentum.***

in a closed system / no external forces … 3

total momentum is constant // / $m_1u_1 + m_2u_2 = m_1v_2 + m_2v_2$ //

momentum before= momentum after … 3

(c) ***Calculate the potential energy of an object of mass 0.5 kg at a height 100 m above the surface of the earth. ($g = 9.8\ m\ s^{-2}$)***

$E = mgh$ / $E = 0.5 \times 9.8 \times 100$ … 3

490 (J) … 3

(d) ***Give an example of (i) a transverse wave, (ii) a longitudinal wave.***

electromagnetic waves / water/ skipping rope/ slinky, etc … 3

sound / slinky / ultrasonic, etc … 3

(e) ***A ray of light enters a 45º right-angled glass prism as shown in Fig. 1. Copy the diagram and complete the path of the ray through the prism. (Critical angle for the glass is 42º.)***

first total internal reflection as shown … 3

second total internal reflection as shown … 3

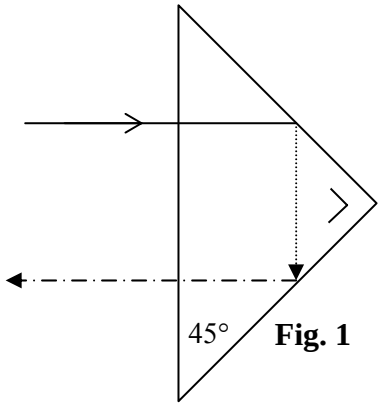


Fig. 1

(f) ***When an object is placed 20 cm in front of a concave mirror, a real image is* formed 40 cm from the mirror. What is the magnification of the image?**

$m = \frac{v}{u}$ / $m = \frac{40}{20}$ …3

2 …3

(g) ***What is meant by the dispersion of white light?***
breaking up / separation / splitting of (white) light …3
into its constituent colours / different wavelengths / list colours …3
[good diagram … 2 × 3]

(h) ***Give an expression to define temperature on the Celsius scale.***
$\frac{\theta}{100} = \frac{Y_\theta - Y_0}{Y_{100} - Y_0}$ // $\theta = T - 273$ …6

(i) ***State two assumptions of the kinetic theory of gases.***
particles occupy negligible volume / rapid (random) (straight line)
motion of molecules / time for a collision to occur is very small /
molecules exert no forces on one another except during collisions/
collisions are elastic / small volume of gas contains large number of molecules /
temperature depends on kinetic energy / speed of molecules **any two** … 2×3
[molecules / particles omitted (−1)]

(j) ***Fig. 2 shows a positively charged insulated metal sphere A near an uncharged insulated metal sphere B. Draw a diagram to show the distribution of charge on sphere B.***

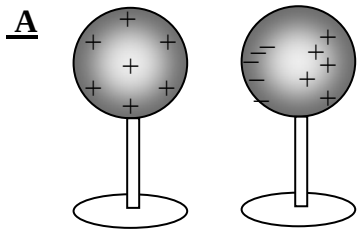


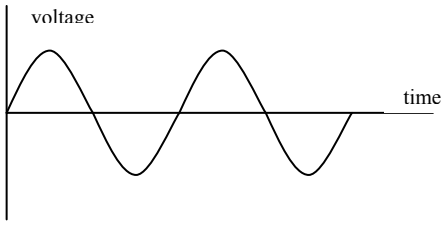
Fig. 2

concentration of negative charge on left hand side of B …3
concentration of positive charge on right hand side of B …3

(k) ***State Coulomb's law of force between electric charges.***
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

(l) *A* ***current of 6.25 A is drawn by the bulb shown in Fig. 3 when connected to a 12 V car battery. What is the power rating of the bulb?***
$P = VI$ / $P = 12 \times 6.25$ …3
75 (W) …3

(m) ***Sketch a graph to show the variation of an a.c. voltage with time.***
voltage and time axes labelled …3
sinusoidal wave …3



(n) ***List two products of a nuclear fission reaction.***
neutrons, two nuclei / atoms, energy, radioactivity **any two** …6

(o) ***What is meant by the half-life of a radioactive isotope?***
time taken for half // time taken for the activity / mass …3
the nuclei / atoms / particles to decay // to decrease to half …3

QUESTION 2

Define (i) acceleration ***2×3***

rate of change // $v - u$ …3

of velocity / of speed in a given direction // $\div t$ …3

(ii) work ***2×3***

force moves a body / force of 1N / $F \times$ …3

through a distance (displacement) / moves 1 metre / s …3

State Newton's second law of motion ***2×3***

rate of change of momentum is proportional to the force // $F \propto (mv - mu) \div t$ …3

and in same direction as applied force …3

Draw a labelled diagram of the apparatus used in this experiment ***3×3***

trolley, timing device, means of applying a force …2×3

[any two … 3]

correct arrangement …3

[no labels … deduct 3]

Draw a suitable graph on graph paper to show the relationship between the applied force and the acceleration of the body ***5×3***

F /N	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
a/ m s^{-2}	0.13	0.28	0.42	0.57	0.74	0.89	0.99	1.14

axes labelled correctly …3

correct scale …3

6 points plotted correctly …3

one relevant straight line …3

good distribution …3

[graph paper not used … deduct 6]

Estimate the acceleration of the body when the applied force was 0.45 N ***3×3***

horizontal perpendicular …3

vertical perpendicular …3

(0.63 - 0.67) m s^{-2} …3

incorrect units/no units (-1)

Calculate the distance travelled by the body in 2 seconds while the force applied was 0.45 N ***3×3***

$s = ut + \frac{1}{2}at^2$ …3

$s = 0 \times 2 + \frac{1}{2}(0.63 - 0.67) \times 2^2$ …3

s = (1.26 – 1.34) m …3

incorrect units/no units (-1)

How much work is done by the force of 0.45 N in this time? ***2×3***

$W = Fs$ / $W = ½\ mv^2$ / $W = mgh$ / W = 0.45 × (1.26 - 1.34) …3

W = (0.567 - 0.603) J …3

incorrect units/no units (-1)

QUESTION 3

(a) ***Explain the underlined terms*** ***4×3***

(*diffraction*) spreading out / bending of waves …3
after passing through a narrow slit/behind an obstacle …3
[good diagram …2 × 3]

(*interference*) two or more waves …3
superimpose / meet …3
[good diagram …2 × 3]

Describe the pattern observed on the screen ***2×3***

bright and dark // series / lines …3
lines / fringes // dots …3

Explain how this experiment contributes to our understanding of the nature of light. ***6***

light is a wave motion …6

What measurements must be taken in this experiment in order to determine the wavelength of the light? ***3×3***

separation between slits / d // lines per mm
distance between slits and screen / D //read angle on one side
distance between images / x // read angle on opposite side
number of fringes // fringe order **any three** …3×3

(b) ***What is the photoelectric effect?*** ***3×3***

release of electrons …3
from the surface of a metal …3
when electromagnetic radiation (light) of a suitable frequency falls on it /
UV light shines on zinc …3

Describe an experiment to demonstrate the photoelectric effect ***4×3***

Apparatus: electroscope, zinc plate, UV source …3

Method: zinc plate on cap …3
charge electroscope negatively …3

Observe: leaves collapse when UV shines …3

Calculate (i) the frequency ***2×3***

$c = f\lambda$ / $3.0 \times 10^{8} = f \times 450 \times 10^{-9}$ **…**3
$f = 6.67 \times 10^{14}$ Hz **…**3
incorrect units/no units (-1)

(ii) the energy of a photon of this light ***2×3***

$E = hf$ / $E = 6.6 \times 10^{-34} \times 6.67 \times 10^{14}$ **…**3
$E = 4.40 \times 10^{-19}$ J **…**3
incorrect units/no units (-1)

QUESTION 4

State Boyle's Law **2×3**

fixed mass of gas, at constant temperature, pressure (p), inversely proportional to volume ($\propto 1/V$) …2×3

[two correct expressions / $pV = k$ / $p_1V_1 = p_2V_2$ … 3]

Describe an experiment to verify Boyle's law **6×3**

App: fixed volume of gas, scale to read volume, device to change and measure pressure …2 × 3

[any two …3]

Method: correct arrangement of apparatus shown or described …3

volume and corresponding pressure recorded …3

repeat for a number of values of pressure and volume …3

pV = const / graph of p versus $1/V$ is straight line through origin …3

What is meant by an ideal gas? **2×3**

obeys Boyle's law / gas laws / satisfies Kinetic Theory assumptions …3

always / exactly / at all temperatures and pressures …3

Calculate the volume occupied by 2.5 moles of helium gas at a temperature of 300 K and a pressure of 2 × 10^5 Pa. **2×3**

$pV = nRT$ / $2 \times 10^5 \times V = 2.5 \times 8.3 \times 300$ …3

$V = 0.031125\ m^3$ …3

incorrect units/no units (-1)

Calculate the pressure of the helium gas if its temperature is increased to 400 K and the volume of the gas remains constant. **3×3**

$\frac{p_1}{T_1} = \frac{p_2}{T_2}$ // $pV = nRT$ …3

$\frac{2 \times 10^5}{300} = \frac{p_2}{400}$ // $p \times 0.031125 = 2.5 \times 8.3 \times 400$ …3

$p_2 = 2.67 \times 10^5$ Pa …3

incorrect units/no units (-1)

What is the thermometric property on which this thermometer is based? **6**

pressure …6

Why is the mercury level adjusted to be at mark M? **3**

to maintain a constant volume …3

Explain why is it necessary to have a standard thermometer **2×3**

different / other thermometers …3

are based on different thermometric properties / register different values for a given temperature …3

Why is the constant volume gas thermometer used as a standard thermometer? **6**

accurate / wide range / sensitive / …6

QUESTION 5

(a) Define capacitance **2×3**

ratio of charge / Q ÷ …3

to potential / V …3

Name one factor on which the capacitance of a parallel plate capacitor depends **3**

common area /distance between the plates / permittivity …3

Describe an experiment to investigate how the capacitance of a parallel plate capacitor depends on this factor **4×3**

App: parallel plate capacitor, electroscope …3

Method: correct arrangement shown or described …3

increase (decrease) distance / common area / permittivity …3

Result divergence of leaves increasing means capacitance decreasing/ divergence of leaves decreasing means capacitance increasing …3

(b) Define electric current **2×3**

flow of / It …3

charge / Q …3

Describe an experiment to demonstrate that a current carrying conductor in a magnetic field experiences a force **4×3**

App: conductor, battery (power supply), magnet …3

Method: correct arrangement of apparatus shown or described …3

switch on current in conductor …3

observe conductor moves …3

Name one device based on this principle **3**

ammeter / voltmeter / galvanometer / motor / loudspeaker, etc …3

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

$\frac{1}{R_1}+\frac{1}{R_2}=\frac{1}{R_{Parallel}} / \frac{1}{12}+\frac{1}{12}=\frac{1}{R_{Parallel}}$ …3

$\frac{12}{2}=6=R_{Parallel}$ …3

$6 + 6 = 12\ \Omega$ …3

incorrect units/no units (-1)

(ii) the current which flows through the 6 Ω resistor **2×3**

$V = IR$ / $6 = I \times 12$ …3

$I = 0.5$ A …3

incorrect units/no units (-1)

Calculate the change in the current flowing through the 6 Ω resistor as a result of introducing the ammeter **2×3**

adding one ohm to total resistance …3

0.46 A / 0.04 A …3

incorrect units/no units (-1)

What resistance should the ammeter have if it were to have no effect on the size of the current in the circuit? ***3***

zero / very small …3

QUESTION 6

Answer any two parts

(a) ***Describe an experiment to measure the acceleration due to gravity, g*** **6×3**

App: timer, electromagnet, ball // pendulum, cork/support/ stopwatch …3

Method:

measure distance, s // measure length of pendulum, l …3

allow ball to free fall // allow pendulum to swing for >10oscillations …3

record time, t, for fall // determine time, T, for one oscillation …3

graph s versus t^2/ $s = \frac{1}{2}gt^2$ // graph l versus T^2 / $T = 2\pi\sqrt{\frac{l}{g}}$ …3

$g = 2 \times$ slope // $g = 4\pi^2 \times$ slope // repeat and average g …3

What is the relationship between G, the gravitational constant, and g, the acceleration due to gravity? **2×3**

$g = GM$ …3

$\div r^2$ …3

Calculate the value of the acceleration due to gravity on the surface of the moon **2×3**

$$g = \frac{GM}{r^2} = \frac{6.67\times10^{-11}\times7.35\times10^{22}}{\left(1.74\times10^{6}\right)^2}$$ …3

$g = 1.62$ m s^{-2} …3

incorrect units/no units (-1)

What is the weight of a 100 kg astronaut on the surface of the moon? **3**

162 N …3

incorrect units/no units (-1)

(b) ***State the laws of refraction of light*** **3×3**

the incident ray, the refracted ray and the normal all lie in the same plane …3

sin ***i*** $\propto$ / sin ***i*** = …3

sin ***r*** / constant sin ***r*** …3

Distinguish between a real image and a virtual image **2×3**

formed by the intersection of light rays, formed by the apparent intersection of light rays //

can be projected on a screen, cannot be projected on a screen //

inverted image, erect image …2×3

Use a ray diagram to show how the final image is formed by an astronomical telescope **5×3**

two converging lenses …3

show focal lengths of lenses …3

parallel rays from distant object …3

first image formed at focus of objective lens …3

formation of final image …3

Describe the final image formed **3**

inverted / magnified / virtual / infinity …3

(c) ***What is radioactivity?*** ***2×3***

the decay / disintegration of nuclei (atoms) …3

with the emission of radiation / energy /particles …3

Give three properties of beta particles. ***3×3***

negatively charged // charge of -1 / 1.6×10^{-19} C) / detected by GM tube /
very small mass // mass 9.1×10^{-31} kg) / travel at high speeds /
deflected in an electrical field / deflected in a magnetic field /
medium penetration through matter / medium ionising ability /
long thin tracks in cloud chamber / effect photographic plates etc. **any three** …3 × 3

Write an equation for the nuclear reaction in which cobalt–60 emits a beta particle ***2×3***

$^{60}_{27}Co \rightarrow ^{60}_{28}Ni \; + ^{0}_{-1}e$ …2×3

[one correct term …3]

Calculate the energy released in this process ***4×3***

$(2 \times 1.673 \times 10^{-27}) + (2 \times 1.675 \times 10^{-27}) \;\; / \;\; 6.696 \times 10^{-27}$ …3

$6.696 \times 10^{-27} - 6.647 \times 10^{-27} \;\; / \;\; 0.049 \times 10^{-27}$ …3

$E = mc^2 \;\; / \;\; E = 0.049 \times 10^{-27} \times (2.998 \times 10^{8})^2$ …3

$E = 4.4 \times 10^{-12}$ J …3

incorrect units/no units (-1)

(d) ***State Faraday's law of electromagnetic induction.*** ***2×3***

induced emf / current, proportional to, rate of change of magnetic flux / field …2×3

[any two terms …3]

Explain how a transformer works ***3×3***

alternating supply in primary (coil) …3

causes changing magnetic field in core …3

induces emf in secondary (coil) …3

Calculate the output voltage of the transformer when the primary coil is connected to the 230 V mains supply ***2×3***

$\frac{N_s}{Np} = \frac{V_{out}}{V_{in}} / \frac{2000}{50} = \frac{V_{out}}{230}$ …3

$V_{out} = 9200$ V …3

incorrect units/no units (-1)

Name two devices which use transformers. ***2×3***

television / phone charger / CRO / doorbell / ESB transmission station, etc

any two …2 × 3

Give a reason why a transformer loses energy ***6***

heat loss in wires or coils / heat loss in the core / eddy currents /
energy lost magnetising and demagnetising core / energy lost as sound /
energy lost as vibration …6

[partial answer …3]

SECTION II – CHEMISTRY

QUESTION 7

Any eleven parts

(a) ***What are isotopes?***

atoms of the same element / atoms with same atomic number …3
with different numbers of neutrons / with different mass numbers …3

(b) ***What colour do sodium salts give to a Bunsen burner flame?***

yellow / orange …6

(c) ***Why is diamond a poor electrical conductor?***

all electrons involved in bonding // no electron free to move …6

(d) ***What is the maximum number of electrons which can occupy (i) a 2p sub-shell and (ii) a 2p orbital?***

6 …3
2 …3

(e) ***State the number of (i) neutrons and (ii) electrons in the*** $^{33}_{16}S^{2-}$ ***ion***

17 neutrons … 3
18 electrons … 3

(f) ***Define electronegativity***

attraction that an atom / element has …3
for a shared pair of electrons …3

(g) ***Name the group in the periodic table whose elements are non-metallic and have a valency of one***

halogens, Group 17, Group VII, Group VIIA, Group 7A …6

(h) ***Define a mole of a substance***

molecular mass / quantity (amount) of a substance …3
expressed in grams / with same number of particles as 12 g of carbon /
which contains 6×10^{23} (Avogadro number of) particles …3

(i) ***Distinguish between a strong acid and a weak acid***

good proton donor, poor proton donor//
fully dissociated, slightly dissociated //
weak conjugate base, strong conjugate base **any one** …6

(j) ***Give the two possible shapes of a molecule with general formula QH_2 where Q represents any element***

linear and v-shaped in words or clear drawing … 2×3

(k) Calculate the percentage by mass of nitrogen in ammonium nitrate (NH_4NO_3)

$M_r = 80$ …3

$\frac{28}{80} \times 100 = 35\%$ …3

(l) Distinguish between an exothermic and an endothermic reaction

releases energy/ heat …3

absorbs energy/ heat …3

(m) Identify the reagent required and the necessary condition for the following conversion: $CH_4 \rightarrow CH_3Cl$

chlorine / Cl_2 …3

ultraviolet light / sunlight … 3

(n) Name and draw the structure of the alkene, C_3H_6.

propene …3

3 carbons with one double bond …3

(o) Identify the aromatic compounds A and B that are shown in Fig. 9.

A = bromobenzene …3

B = methylbenzene/ toluene …3

QUESTION 8

(a)Write the electronic (s, p) configuration of (i) the beryllium atom ***3***

Be = $1s^2\ 2s^2$ …3

(ii) the sodium atom ***3***

Na = $1s^2\ 2s^2\ 2p^6\ 3s^1$ … 3

(iii) the sodium ion, Na^+ ***3***

$Na^+ = [1s^2\ 2s^2\ 2p^6]^+$ … 3

What is the principal quantum number of the outermost electron in a sodium atom? ***3***

3 ...3

Define first ionisation energy of an element ***2×3***

energy required to remove most loosely bound / first / outermost electron … 3

from a neutral / gaseous / isolated atom …3

State and account for the general trend in first ionisation energy values from Li to Ne on the periodic table ***6, 2×3***

(ionisation energies) increase …6

decreasing // increasing …3

atomic radius // nuclear charge …3

Explain why the first ionisation energy of beryllium is larger than that of boron ***6***

Be has a full sub-shell // B has one electron in sub-shell // Be has a stable electron configuration …6

[difficult / easier to remove the electron …3]

(b) ***Define an ionic bond*** ***6***

attraction between oppositely charged ions // transfer of electrons between two atoms…6

[E.N. difference > 1.7 …3]

Use diagrams to show the formation of a bond between a sodium atom *and a* ***chlorine atom.*** ***3×3***

one electron in valence shell sodium …3

seven electrons in valence shell chlorine …3

electron transfer from sodium to chlorine …3

Describe the crystal structure of sodium chloride ***3×3***

ions occupy the lattice points, ions occupy alternate positions, unit repeats itself,

each sodium ion (Na^+) is surrounded by 6 chloride (Cl^-)ions,

each chloride (Cl^-) ion is surrounded by 6 sodium (Na^+) ions,

consists of a three dimensional cubic lattice **any three** …3×3

Give two general properties of ionic compounds. ***2×3***

high melting points, high boiling points, soluble in water, conduct electricity when molten or in solution, hard, solid, crystalline etc **any two** …2 × 3

QUESTION 9

(i) ***Explain the underlined terms*** **3×3**

(*conc*) expression of quantity (mass/volume) of a substance …3
in a known amount (mass/volume) of solvent or solution …3
(*s. soln*) solution whose concentration is known …3

(ii) ***Describe how a pipette is prepared for use in a titration*** **2×3**

wash with deionised water …3
wash with solution it is to measure (contain) …3

(iii) ***Explain why the sides of a conical flask are washed down during a titration*** **6**

wash down any solution on the sides // all acid (base) is included in the reaction …6
[partial answer …3]

Why is deionised water used for this purpose? **6**

it contains no chemicals / ions / impurities which could effect the titration //
does not change the molarity / concentration // …6

(iv) ***Standing the conical flask on a white tile improves the accuracy of the titration result. Explain why*** **2×3**

end point / colour change …3
more easily detected …3

(v) ***Name a suitable indicator for this titration*** **3**

litmus / methyl orange / phenolphthalein etc … 3

State the colour change observed at the end point. **2×3**

first colour correct …3
second colour correct …3

(vi) ***Write a balanced chemical equation for this titration reaction.*** **2×3**

$H_2SO_4 + 2KOH$ / $H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$ … 3
$K_2SO_4 + 2H_2O$ / $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ …3

(vii) ***Use the table to determine the volume of acid required to neutralise 25.0 cm^3 of the potassium hydroxide solution.*** **3**

24.05 cm^3 …3

Calculate the concentration of the potassium hydroxide solution in (a) moles per litre (dm^3) **3×3**

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

$\frac{24.05 \times 0.05}{1} = \frac{25 \times M_2}{2}$ …3

$M_2 = 0.0962$ / 0.1 (M / moles per litre (dm^3)) …3

(b) grams per litre (dm^3) **2×3**

39 + 16 + 1 = 56 …3
0.0962 × 56 = 5.39 / 0.1 × 56 = 5.6 … 3

QUESTION 10

(a) ***Define oxidation in terms of electron transfer*** ***3***
loss of electrons …3

State which substance is oxidised in **CuO + H_2 → Cu + H_2O** ***3***
hydrogen / H_2 …3

State which substance is oxidised in **Cl_2 + 2NaBr → 2NaCl + Br_2** ***3***
bromide ion / Br^- …3

Place in order of decreasing ease of oxidation, according to the electrochemical series, the metals copper, iron, magnesium and zinc. ***9***
magnesium, zinc, iron, copper …9
[reverse order …3]

Which one of these metals may be found free in nature? ***3***
copper …3

Justify your answer ***3***
copper is the least reactive / copper is lowest on electrochemical series/
copper is least easily oxidised **any one** …3

Write a balanced chemical equation for the reaction between magnesium and water ***3×3***
$Mg + H_2O \rightarrow$ / $Mg + 2\,H_2O \rightarrow$ …3
$MgO +$ / $Mg(OH)_2 +$ …3
H_2 / H_2 …3

Identify the substance oxidised in this reaction ***3***
magnesium / Mg …3

(b) ***Define heat of combustion*** ***2×3***
heat change when one mole …3
is completely burned / burned in excess oxygen …3

State Hess's law ***2×3***
heat change for a reaction …3
is independent of path followed …3

Use Hess's law to calculate the heat of combustion of ethanol ***6×3***
$C_2H_5OH_{(l)} \rightarrow 2C_{(s)} + 3H_{2\,(g)} + \frac{1}{2}O_{2\,(g)}$ / $\Delta H = 278$ kJ …3

$2C_{(s)} + 2O_{2\,(g)} \rightarrow 2CO_{2\,(g)}$ / $\Delta H = -786$ kJ …2×3

$3H_{2\,(g)} + \frac{3}{2}O_{2\,(g)} \rightarrow 3H_2O_{(l)}$ / $\Delta H = -858$ kJ …2×3

$[C_2H_5OH_{(l)} + 3O_{2\,(g)} \rightarrow 2CO_{2\,(g)} + 3H_2O_{(l)}]$ $\Delta H = -1366$ kJ …3

QUESTION 11

Define (i) functional group ***2×3***

atom (group of atoms) which determine // reactive part …3
the characteristic properties // of a molecule …3
[correct example …3]

(ii) homologous series ***2×3***

successive members differ // group of compounds with …3
by CH_2 // same functional group / same general formula …3

Draw the functional group in ethanol and in ethanal ***2× 3***

- OH …3
-CHO …3

Name the homologous series to which each of these compounds belong ***2×3***

alcohols …3
aldehydes …3

(i) Which nozzle of the condenser, X or Y, should be attached to the cold water supply? ***3***

Y …3

State the function of the boiling chips ***3***

to ensure the contents of the boiling flask boil gently / to prevent
shaking (cracking) of the apparatus etc. …3

Why is the ethanal collected over ice-water? ***3***

because ethanal is very volatile /ethanal evaporates easily / low b.p. …3

Identify a suitable oxidising agent for the reaction ***3***

sodium dichromate / $Na_2Cr_2O_7$ / potassium dichromate / $K_2Cr_2O_7$ …3
[allow potassium permanganate]

(ii) Ethanal can be further oxidised to another organic compound. Name and draw the structural formula of this new compound. ***3×3***

Ethanoic acid …3
-COOH …3
remainder correct …3

(iii) Ethanal can also be prepared using ethyne (C_2H_2) as the starting material. What are the two reagents and the condition necessary for this conversion? ***3×3***

mercuric sulfate …3
sulfuric acid …3
60 ºC …3
[hydration …3]

(iv) Write an equation for the reaction between ethanal and phenylhydrazine ***4×3***

$CH_3CHO + C_6H_5NHNH_2 \rightarrow C_6H_5NHN{=}CHCH_3 + H_2O$ …4×3
[allow 3 for each correct reactant or product shown]

QUESTION 12
Answer any two parts

(a) ***When 250 kg of limestone are completely decomposed, calculate (i) the number of moles of limestone used*** ***4, 3***

$n = \frac{m}{m_r}$ / $n = \frac{250000}{100}$ …4

= 2500 …3

(ii) the mass of lime formed ***2×3***

2500 moles CaO formed / 56g …3

$m = n \times m_r = 2500 \times 56 = 140000$ (g) …3

(iii) the number of molecules of carbon dioxide produced ***2×3***

2500 moles of carbon produced …3

number molecules = $2500 \times 6 \times 10^{23} = 1.5 \times 10^{27}$ …3

(iv) the volume of carbon dioxide produced at STP ***3***

2500 moles of carbon produced

$2500 \times 22.4 = 56000$ L …3

(b) ***Which one of these oxides is black?*** ***3***

CuO / copper oxide / copper(II) oxide …3

Is this oxide acidic, basic or amphoteric? ***3***

basic …3

Which one of these oxides is neutral? ***3***

CO / carbon monoxide …3

Name the oxides which are solids at room temperature ***2×3***

aluminium oxide / alumina …3

copper oxide / copper(II) oxide …3

Select the acidic oxide from the list and write a balanced chemical equation for its reaction with water ***3, 2×2***

CO_2 / carbon dioxide …3

$CO_2 + H_2O \rightarrow$ …2

H_2CO_3 …2

(c) ***Define (i) an acid*** ***4***

proton …2

donor …2

(ii) a conjugate acid-base pair according to the Brønsted-Lowry theory ***3***

two substances which differ by one proton …3

Calculate the pH of 0.05 M sulphuric acid solution ***3×3***

$[\mathbf{H}^+] = 0.05 \times 2 = 0.1$ / $[\mathbf{H_3O}^+] = 0.05 \times 2 = 0.1$ …3

$pH = - \log_{10}[\mathbf{H}^+]$ / $pH = - \log_{10}[0.1]$ …3

$pH = 1$ …3

Identify the two acids in the following equilibrium ***2×3***

HSO_4^- …3

H_3O^+ …3

(d) ***What is electrolysis?*** ***4***

electricity (electric current) …2

breaking down (splitting) of a chemical / producing a chemical reaction …2

What substance is produced at electrode A? ***3***

Chlorine / Cl_2 …3

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

$Na^+ + e^-$ …3

$\rightarrow$ Na …3

Calculate the mass of sodium formed when a current of 3.86 A flows for 30 minutes ***3×3***

$Q = It$ / $Q = 3.86 \times (30 \times 60) = 6948$ C …3

No. of Faradays /moles of electrons = $\frac{6948}{96500} = 0.072$ …3

$0.0072 \times 23 = 1.656$ g …3