Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2013

Marking Scheme

Physics and Chemistry

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

General Guidelines

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

1. In many instances only key words are given, i.e. 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. Marks for a description may be obtained from a relevant diagram, depending on the context.

6. Where indicated, 1 mark is deducted for incorrect/ no units.

7. Each time an arithmetical slip occurs in a calculation, one mark is deducted. Use of an incorrect multiple is an example of a mathematical slip.

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

Question 1
Any eleven parts **11×6**

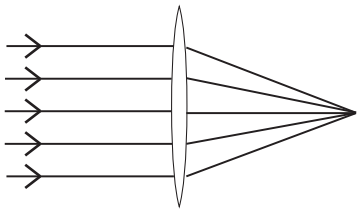
(*a*) Figure 1 shows a ride-on lawnmower. If it is driven at 2.2 m s^{-1} what length of lawn does it cut every 15 seconds? **2×3**
$s = vt$ …3
$= 15 \times 2.2 = 33$ (m) …3
[$15 \div 2.2 = 6.8$……3]
[Any correct formula …3]

(*b*) A car has a mass of 950 kg. What force is needed to give it an acceleration of 6 m s^{-2} ? **2×3**
$(F) = ma$ …3
$950 \times 6 = 5700$ (N) …3
[$950 \div 6 = 158$……3]

(*c*) In the equation $g = \frac{GM}{d^2}$ what does *G* represent? **6**
(universal) gravitational constant …6
[gravity….3]

(*d*) State *Boyle's law*. **2×3**
volume of a (fixed mass of gas) // p // pV // p_1V_1 …3
is inversely proportional to its pressure (at constant temperature) // $\propto 1/V$ // is constant // $= p_2V_2$ …3

(*e*) Figure 2 shows rays of light approaching a lens. Copy the diagram to show the path of the rays after passing through the lens. **6**
rays converging (to a focus) …6
[rays diverging ...3]



(*f*) Light is split into its component colours on passing through a triangular prism. What name is given to this phenomenon? **6**
dispersion …6
[refraction …3]
[spectrum….5]

(*g*) What name is given to the effect where electrons are emitted from the surface of a metal when light of high frequency is shone on it? **2×3**
photo …3
electric effect …3

(*h*) State one way to *increase* the capacitance of a parallel-plate capacitor. **6**
increase (common) area (of plates) / decrease separation or distance between plates / change medium
any one…6

(*i*) Give two items needed to make an electromagnet. **2×3**
coil of wire …3
d.c electrical supply …3

(*j*) A security system with a power rating of 46 W is connected to a 230 V supply. Calculate the current drawn by the system. **2×3**

$P = VI$ / 46 = 230 × I / 46 ÷ 230 = I …3

(I) = 0.2 (A) …3

[230÷ 46 / 230x46 / 10580…..3]

(*k*) Calculate the number of units of electricity (kW h) used by a 2 kW grill in 3 minutes. **2×3**

3 ÷ 60 = 0.05 …3

0.05 × 2 = 0.1 (kWh) 3

[6 (kW h) …5]

(*l*) Why does a conductor that is carrying a current move in a magnetic field? **2×3**

experiences a …3

force …3

(*m*) Figure 3 shows a 4 µF capacitor connected in parallel with an 8 µF capacitor. What is the effective capacitance of this arrangement? **2×3**

4 + 8 …3

= 12 (µF) …3

[$\frac{1}{4}+\frac{1}{8}=\frac{3}{8}$ …3, $\frac{8}{3}$ …5]

(*n*) Name a chemical element commonly used to shield nuclear radiations. **6**

lead …6

[concrete, another heavy element ….3] …3

(*o*) What happens to the nuclei during a nuclear fusion reaction? **6**

they join / they release energy / they lose mass …6

[fission / split …3]

Question 2

(a)

Define (i) velocity **2×3**

rate of change / *d or s or l* …3

of displacement / ÷ *t* …3

[how fast, speed …3]

acceleration, **2×3**

rate of change / $(v - u)$ …3

of velocity / ÷ *t* …3

[speeding up / going faster …3]

[$a = F/m$, $F = ma$ …3]

Figure 4 shows a walrus which is a large sea-based mammal found in the Arctic. A walrus starting from rest accelerates to a velocity of 9 m s^{-1} in 18 seconds.
Calculate

(i) the acceleration of the walrus **2×3**

$v = u + at$ / $a = (v - u) \div t$ / $s = \frac{1}{2}(v + u) \times t = 81$ (m) …3

$a = (9 - 0) \div 18 = 0.5$ m s^{-2} / $s = ut + \frac{1}{2}at^2$ or $v^2 = u^2 + 2as \Rightarrow a =$ 0.5 m s^{-2} …3

[no unit or incorrect unit (–1)]

(ii) the distance covered by the walrus in the 18 seconds **2×3**

$s = ut + \frac{1}{2}at^2$ or $v^2 = u^2 + 2as$ …3

$s = \frac{1}{2} \times 0.5 \times 18^2 = 81$ m or $9^2 = 2 \times 0.5 \times s \Rightarrow s = 81$ m …3

[no unit or incorrect unit (–1)]

(iii) the time taken by the walrus to move the first 25 m. **3×3**

$s = ut + \frac{1}{2}at^2$ …3

$25 = \frac{1}{2} \times 0.5 \times t^2$ …3

$\Rightarrow t = 10$ s …3

[no unit or incorrect unit (–1)]

(b)

Define work. **2×3**

product of force // $F \times$ // energy …3

and displacement or distance // *s* // used …3

Give the unit of work. **3**

joule / J …3

[kilojoule, kJ …2]

Figure 5 shows a 0.25 m high platform used by a 65 kg student while doing a personal fitness test. The student steps on and off the platform 208 times during the test.

Calculate

(i) the weight of the student **2×3**

$(W) = mg$ …3

$(W) = 65 \times 9.8 = 637$ N …3

[no unit or incorrect unit (–1)]

(ii) the work done by the student each time he steps on to the platform **2×3**

$(W) = Fs$ / $(E) = mgh$ …3

$(W) = 637 \times 0.25 = 159.25$ J / $(E) = 65 \times 9.8 \times 0.25 = 159.25$ J …3

[no unit or incorrect unit (–1)]

(iii) the total work done by the student during the test. **3**

$159.25 \times 208 = 33124$ J $= 33.124$ kJ …3

[66248 J or 66.248 kJ (–1)]

[no unit or incorrect unit (–1)]

Give one example of an energy conversion during the test. **3**

kinetic to potential, potential to kinetic, chemical to kinetic, kinetic to heat, etc.

any one …3

Sketch a diagram showing two forces that act on the student when he is standing still on the step. **2×3**

weight down …3

reaction force up …3

Question 3

State the *laws of reflection of light*. **4×3**

the incident ray or beam, the reflected ray or beam and the normal …3

all lie in the same plane. …3

[normal omitted (–1)]

[refraction instead of reflection (–1)]

and

the angle of incidence is equal to // i = …3

the angle of refection // r …3

[refraction instead of reflection (–1)]

[allow object distance is equal to image distance…6]

Figure 6 shows a ray of light striking a plane mirror at an angle of 32°.

What is the *angle of incidence* of the ray? **6**

58° …6

[32°…3]

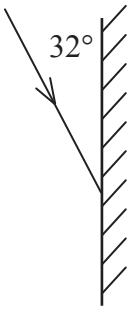


Figure 6

Give two properties of the image formed by a plane mirror. **2×6**

upright, virtual, same size as object laterally inverted,

same distance from mirror as object any two …2×6

Describe an experiment to measure the focal length of a concave mirror. **5×3**

Apparatus: object, mirror, screen or search pin …3

correctly arranged drawn or described …3

Method: focus image / move screen …3

measure u and v …3

calculate f / correct formula given …3

Figure 7 shows a pin placed 16 cm in front of a concave mirror of focal length 8 cm.

What distance is the image of the pin from the concave mirror? **6, 3 or 9**

$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ / $\frac{1}{16}+\frac{1}{v}=\frac{1}{8}$ …6

(v) = 16 cm …3

[no unit or incorrect unit (–1)][mathematical error with fractions (–1)][incorrect substitution (–1)]

or

(v) = 16 cm (deduced from diagram) …9

[no unit or incorrect unit (–1)]

Give one use of

(i) a plane mirror **6**

to see your reflection, to shave, to apply make-up, in a periscope, send a signal, to change the direction of a beam of light, mirror in a house ,etc …6

(ii) a concave mirror **6**

to see a magnified refection, in dentistry to examine teeth, to reflect a beam of light, shaving, applying make-up, etc …6

[use of convex mirror ….3]

Question 4

What is meant by a *thermometric property*? **2×3**

property that varies …3

with temperature …3

[example …3]

Some laboratory thermometers contain mercury.

State the thermometric property on which the mercury thermometer is based. **6**

volume or height (of liquid or mercury in a column)/expansion of a liquid …6

Name one other type of thermometer used in a laboratory and state the thermometric property on which it is based. **9, 3**

Type	*Thermometric property*
alcohol thermometer	height or volume (of liquid)
constant volume gas thermometer	pressure
thermistor	resistance
thermocouple	emf
etc	etc
any thermometer other than mercury …9	corresponding thermometric property …3

[where thermometer named and thermometric property do not correspond (–3)]

A student carried out an activity to calibrate an unmarked mercury thermometer to measure temperatures on the Celsius scale.

(i) What are the two *fixed points* on the Celsius scale? **2×6**

freezing water / melting water / 0 °C …6

boiling water / condensing steam / 100 °C …6

[upper ….3]

[lower….3]

(ii) After marking the fixed points, what must the student then do to be able to use the thermometer to measure temperatures on the Celsius scale? **6**

mark or create a scale ….6

Give two reasons why mercury is suitable for use in a thermometer. **6, 3**

easy to see, has a high boiling point, has a wide range or practical range of temperatures, responds quickly, has low specific heat capacity, cannot measure (very) low temperatures, etc

first correct reason ….6, second correct reason…3

Give two disadvantages of a mercury thermometer. **6, 3**

mercury is (relatively) expensive / mercury is poisonous or toxic / mercury freezes easily (compared to other liquids), has a small expansion for a small rise in temperature (compared to other liquids), less sensitive than other thermometers, not a standard thermometer, etc

first correct disadvantage….6, second correct disadvantage…3

Pure silver melts at 962 °C. What is this temperature on the Kelvin scale? **2×3**

273 …3

+ 962 = 1235 (K) …3

[689 (K) or –689 (K) (–1)]

Question 5

(*a*) Figure 8 shows a three-pin plug containing a fuse. On which effect of an electric current is a fuse based? **6**

heating …6

[safety …3]

Give one other effect of an electric current. **6**

magnetic / chemical …6

Figure 9 shows a circuit with two lamps each of resistance 3 Ω connected in *series* with a 9 V battery.

Calculate

(i) the effective resistance of the circuit **6**

3 + 3 = 6 (Ω) …6

[attempt using formula for parallel resistors …3]

(ii) the current in the circuit. **2×3**

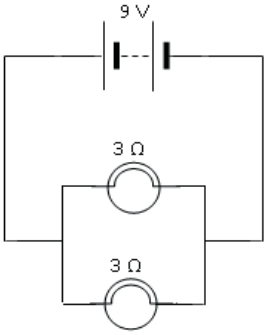
$V = IR \;/\; I = \frac{V}{R}$ …3

$\frac{9}{6} = 1.5$ A …3

[no unit or incorrect unit (–1)]

[6/9 /0.67A…3]

Draw a circuit diagram in which the two lamps are connected in *parallel*. **6**



[battery in correct position…5]

…6

Give one advantage of this parallel arrangement. **3**

lamps can be switched on off independently / if one lamp blows the other can still light / lamps light brighter or carry bigger current …3

(b) Draw a labelled diagram of a gold-leaf electroscope. **4×3**

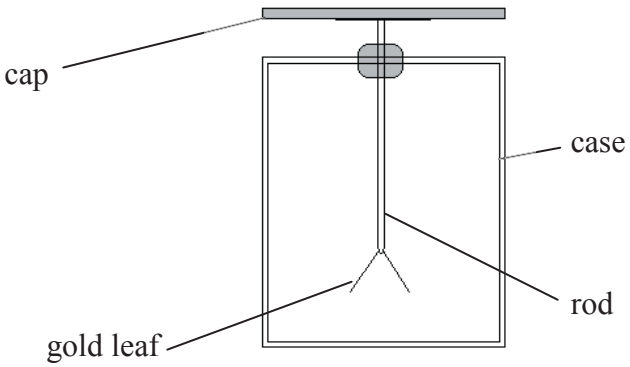
cap …3

case …3

rod …3

gold leaf or leaves …3

[no labels …9 maximum]



How would you use a positively-charged electroscope to confirm that a charged plastic rod is positively charged? **9**

leaf (or leaves) diverge (more) …9

[description of charging by induction …3]

Figure 10 shows a positively-charged rod held near two conducting spheres, A and B, which are in contact. Both spheres are on insulated stands.

When the spheres are moved apart by holding them by their stands, what charge remains on sphere A? **6**

negative / …6
[positive …5]

Give a reason for your answer. **6**
electrons or negative charge on B move(s) to A or is attracted to A …6
[If say positive above and justify it by saying rod touching A …6]

Question 6
Answer any two parts **2×33**

(*a*) State the *principle of conservation of momentum*. **6, 2×3**
momentum before // momentum // $m_1u_1 + m_2u_2$ …6
equals // remains or is // = …3
momentum after // constant // $m_1v_1 + m_2v_2$ or $(m_1 + m_2)v$ …3
[the rate of change of momentum is proportional to ..3, (and in the same direction as) the applied force…3]
[principle of conservation of energy …6]

Figure 11 shows two wheelie bins on a smooth surface.

Wheelie bin A of total mass 64 kg sliding with a velocity of 3 m s^{-1} collides with an empty wheelie bin B of mass 16 kg which is at rest. After the collision both bins continue in the same direction with wheelie bin A now moving at 2 m s^{-1}.

Explain why wheelie bin B has zero momentum before the collision. **3**
it is at rest / it has no velocity …3

Calculate
(i) the momentum of wheelie bin A before the collision **2×3**

mv / 64 × 3 …3
= 192 (kg m s^{-1}) …3

(ii) the velocity of wheelie bin B after the collision. **4×3**
$m_1u_1 + m_2u_2$ =/ (64 × 3) + (16 × 0) …3
$m_1v_1 + m_2v_2$ =/ (64 × 2) + 16 v …3
192 / 128 …3
v = 64 / 16 = 4 m s^{-1} …3
[no unit or incorrect unit (–1)]

(*b*) State two assumptions of the kinetic theory of gases. **2×6**
large number of particles or molecules, particles or molecules have negligible volume, in constant motion, in rapid motion, in random motion, in straight line motion, collide with one another, collide with walls of the container, collisions elastic or involve neither loss nor gain of energy, collision times of short duration, no interaction between particles or molecules except during collisions, etc
any two…. 2×6

How would you show *Brownian motion*? **6, 3×3**
Apparatus: smoke cell // pollen grains …6
microscope, lens, lamp // microscope, lens, water …3

Method: fill cell with smoke / shine light from side /focus microscope or lens // drop of water on slide /add pollen / focus microscope or lens …3

Observation: description of motion observed …3

What information does Brownian motion give about the nature of gases? **6**
shows gases are particulate / shows molecules of gas collide with one another / shows particles of gas are moving / shows random movement of gas particles / is evidence for kinetic theory, etc any one…. 6

(c) Figure 12 shows an interference pattern of bright and dark areas formed by light waves during an experiment to find the wavelength of a monochromatic light source.

What is meant by the underlined term? **2×3**

distance from …3
crest to crest / trough to trough …3
[accept a clearly marked diagram ….6]

Name a source of monochromatic light. **6**

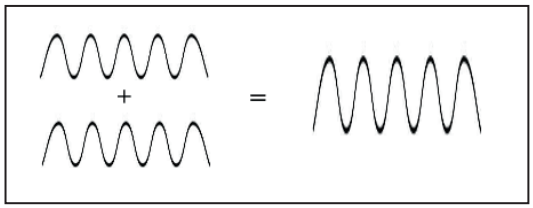
sodium lamp or laser …6

Give two measurements that should be recorded during this experiment. **2×6**

distance (from screen to diffraction grating or Young's slits)
separation of images / angle between images
separation of slits or lines of grating or grating constant

any two… 6

Sketch diagram(s) to show how the light waves combine to form the interference pattern. **6, 3**



two original waves …6
resultant …3
[accept destructive interference]

(*d*) Marie Curie first isolated the element polonium, which exhibits radioactivity. Polonium–210 has a half-life of 138 days and is an alpha-particle emitter.

Explain the underlined terms. **4×3**

(radioactivity) is the (spontaneous) disintegration …3
of unstable nuclei …3
[atom…(–1)]

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

Give one property of an alpha particle. **6**

positively charged or charge of +2, mass 4 (amu), helium nuclei, high speed particles, poorly penetrating, very ionising, deflected in an electric field, deflected in a or magnetic field, blacken photographic film, etc.

any one… 6

What fraction of a sample of polonium–210 will remain after a period of time equal to two half-lives (276 days)? **6**

one quarter …6
[idea of a mathematical sequence….3]

Give two safety precautions used when handling radioactive sources. **6, 3**

use shielding or lead, do not handle, use tongs, do not eat or drink, minimise exposure or time, maximise distance, wear protective clothing, etc

first correct …6, second correct…3

Question 7
Any eleven parts **11×6**

(*a*) What is the maximum number of electrons that can occupy an atomic orbital? **6**
2 …6

(*b*) What are *isotopes* of an element? **2×3**
(atoms that have) same number of protons or same atomic number …3
different number of neutrons / different mass number …3

(*c*) Give the chemical symbol of an element that is more electronegative than oxygen. **6**
F …6
[accept fluorine …5]

(*d*) Name a metal found free in nature. **6**
gold, silver, copper, mercury, platinum, arsenic, antimony, bismuth …6
[any named metal except alkali metal….5][alkali metal named …0]

(*e*) Which one of the following molecules has a dipole moment?
H_2 HCl CH_4 **6**
HCl …6

(*f*) The relative atomic mass of neon gas (Ne) is 20.
Calculate the number of atoms in 100 g of neon.
[Avogadro constant = 6.0×10^{23} mol $^{-1}$] **2×3**
$100 \div 20 = 5$ …3
$5 \times 6.0 \times 10^{23} = 3.0 \times 10^{24}$ …3

(*g*) Calculate the percentage of oxygen by mass in manganese dioxide (MnO_2).
[O = 16; Mn = 55] **2×3**
$M_r = 87$ …3
$\frac{32}{87} \times 100 = 36.8\%$ …3
[32 ...3]

(*h*) Give one property of transition elements. **6**
coloured compounds, variable valency, good catalysts, metallic, hard, solid, conducting, electrons in d-subshell, etc
any one…6

(*i*) What is the pH of a 0.015 M solution of hydrochloric acid (HCl)? **2×3**
$pH = -\log[H^+]$ / $pH = -\log[0.015]$ …3
(pH =) 1.82 …3

(*j*) What is meant by an *endothermic* reaction? **2×3**
heat …3
taken in ...3

(*k*) State *Hess's law*. **2×3**
heat change for a reaction …3
independent of path / depends on initial and final states only …3

(*l*) Copy, complete and balance the following equation:

$MgCO_3$ + HCl → $MgCl_2$ + _____ + ____ **5, 1**

$MgCO_3$ + 2HCl → $MgCl_2$ + H_2O + CO_2

one correct product …5

balanced …1

(*m*) List the following elements in order of increasing atomic size:

sodium potassium lithium **6**

lithium, sodium, potassium …6

[reversed …3]

(*n*) Give one use for ethanoic (acetic) acid. **6**

vinegar / flavouring / preservative / solvent …6

(*o*) What is the chemical formula of benzene? **6**

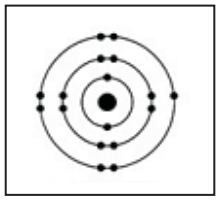
C_6H_6 …6

[hexagon with ring …5, hexagon …3]

Question 8

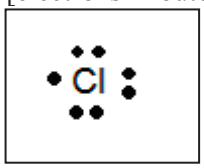
(*a*) Sketch a diagram to show the arrangement of electrons in the main energy levels (shells) in *an atom* of chlorine. **6**

correct depiction of electrons in shells using dots and/or crosses



...6

[electrons in outer shell only



...3]

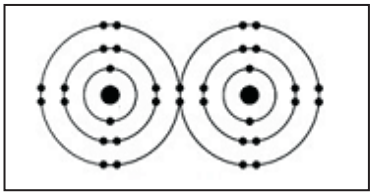
[2, 8, 7 ...3]

What is the chemical formula for a *molecule* of chlorine? **6**

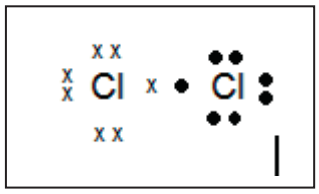
Cl_2 ...6

[Cl...3]

Sketch a diagram to show the arrangement of electrons in a *molecule* of chlorine. **3×3**



two atoms of chlorine depicted ...3
34 electrons represented by dots and /or crosses / 14 outer shell electrons ...3
two electrons shared ...3

[

....6]

[

...3]

State the shape of a molecule of chlorine. **3**

linear ...3

Chlorine is a gas at room temperature.
What does this tell you about the bonding *between* the molecules of chlorine at room temperature? **6**

weak / van der Waals / none ...6
[covalent …3][ionic ….0]

(*b*) Figure 13 shows the structure of a sodium chloride crystal. It consists of positively-charged particles and negatively-charged particles.
How does a neutral atom become a charged particle? **2×3**

gains or loses ...3
an electron ...3
[allow gets energy...3]

Name the positively-charged particles in sodium chloride. **2×3**
sodium ...3
ions ...3
[accept correct symbols]

The negatively-charged particles in a sodium chloride crystal are *larger* than the positively-charged particles.
Give a reason for this. **2×3**
chlorine has more 3
electrons or more shells (than sodium) 3

Name the type of bonding in sodium chloride crystals. **9**
ionic …9
[covalent and polar covalent ...6][named intermolecular bonds …3]

Give two properties of substances that have this type of bonding. **6, 3**
Solid, crystalline, high melting point, high boiling point, water soluble, conduct electricity in solution, conduct electricity when molten
first correct…6, second correct..3
[properties of covalent compounds …3 each]

Question 9

(*a*) Oxidation and reduction occur during the electrolysis of acidified water.

Explain the underlined words in terms of electron transfer. **4×3**

oxidation: loss …3
of electrons …3
[addition of oxygen or loss of hydrogen …3]

reduction: gain …3
of electrons …3
[addition of hydrogen or loss of oxygen …3]

[oxidation and reduction reversed …6] [one reversed …3]

Figure 14 shows an apparatus used to demonstrate the electrolysis of acidified water.

Name an element that can be used for the electrodes. **6**

carbon / platinum / (stainless) steel ...6
[iron, copper ...3]

Name the two gases produced during the process. **2×3**

hydrogen ...3
oxygen ...3

How would you confirm the identity of each of these gases? **6, 3**

(hydrogen) burns with a pop
(oxygen) relights glowing splint

first correct…6, second correct..3

[tests reversed ...6][allow correct test for incorrect gas]

(*b*) Define (i) an acid, (ii) a base, in terms of the Brønsted-Lowry theory. **4×3**

proton / H^+ …3
donor …3
[allow acid produces H^+ (ions in solution) ...6]

proton / H^+ ...3
acceptor ...3
[allow base produces OH^- (in solution) ...6]

Identify (iii) two acids, (iv) one acid-base conjugate pair in the following reaction:

$HCN + H_2O \leftrightharpoons H_3O^+ + CN^-$ **6, 3**

(iii) two acids

HCN
H_3O^+
[ignore charges]

first correct…6, second correct..3

(iv) one acid-base conjugate pair **6**

conjugate pairs: HCN and CN^-/ H_2O and H_3O^+ …6
[ignore charges]

What is meant by an *amphoteric* substance? **6**

(substance) that reacts both as an acid and a base / (substance) that can react as an acid or a base / (substance) with acidic and basic properties …6
[correct example (water, ZnO or Al_2O_3) ...3]

Question 10

A standard solution of hydrochloric acid was used in a titration experiment to determine the concentration of a potassium hydroxide solution.

Figure 15 shows the laboratory glassware A, B, and C used.

(i) Name A, B and C. **3×6**

A: pipette …6
B: burette …6
C: conical flask …6
[**A** and **B** reversed …9][**C**: flask …3]

(ii) Describe the procedure for preparing and filling B. **3×3**

rinse with deionised or distilled water /
rinse with solution it is to contain or HCl /
fill using funnel /
fill with acid /
avoid air bubbles /
fill part below the tap /
remove funnel before adjusting to zero or to the mark /
open tap to adjust level to mark or until (bottom of) meniscus lies on mark /
read at eye level /

any three…3×3

[allow fill with HCl, or wash or rinse instead of first two points…3]
[no penalty if reference is to use of NaOH instead of HCl]

(iii) State one precaution taken when reading the volume of the liquid in B. **6**

avoid air bubbles /
fill part below the tap /
read bottom of the meniscus /
read at eye level /
use white paper behind scale (to see reading) /
ensure burette is (clamped) vertical(ly)

any one…6

(iv) Name one item of safety equipment that should be used. **6**

gloves, goggles or eye protection, hair-tie, lab coat, pipette filler, etc

any one…6

The equation for the reaction is

$$\mathbf{HCl + KOH \rightarrow KCl + H_2O}$$

The end point was reached when 24.7 cm^3 of 0.12 M hydrochloric acid solution reacted with 20.0 cm^3 of the potassium hydroxide solution.

(v) Name a suitable indicator for use in this experiment. **6**

methyl orange, phenolphthalein, litmus, etc

any one…6

(vi) State the colour of the named indicator in flask C at the end point of the titration. **6**

methyl orange: pink ,peach or orange …6 [yellow or red …3]
phenolphthalein: colourless …6 [pink /purple …3]
litmus: purple …6 [blue or red …3]

(vii) Calculate the concentration of the potassium hydroxide solution. **3×3**

$\frac{V_1M_1}{n_1} = \frac{V_2M_2}{n_2}$ / 26.335 …3

$\frac{24.7 \times 0.12}{1} = \frac{20 \times M_2}{1}$ …3

(M_2 =) 0.1482 (M) (0.1482 – 0.15 (M)) …3

[correct formula, incorrect substitution …6 max]

[0.14 or incorrect rounding (–1)]

(viii) How could the accuracy of the experiment be improved? **6**

read pipette at eye level, read burette at eye level, use deionised water, wash down conical flask during the titration, swirl conical flask, carry out a rough titration, repeat, use white tile, etc

any one…6

Question 11
In Figure 16 a <u>butane</u> lighter is used to ignite the <u>methane</u> gas in a Bunsen burner.

(*a*) What is the purpose of the collar on a Bunsen burner? **<u>2×3</u>**
control …3
air intake or airflow or temperature of flame or smokiness of flame or colour of flame …3
[to make gas burn better …6]

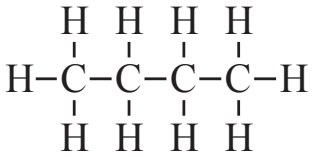
(*b*) To which homologous series do both methane and butane belong? **<u>6</u>**
alkanes …6

Name one other member of this homologous series. **<u>6</u>**
ethane, propane, etc
any one…6

Give two sources of methane (CH_4). **<u>6, 3</u>**
bogs, (refuse) dumps, animal slurry, paddy fields, (associated with) oil and gas fields, mines, etc
first correct…6, second correct..3

Butane is a *saturated* hydrocarbon. What does this tell you about its structure? **<u>6</u>**
no double (or triple) bonds / all single (C-C) bonds / doesn't undergo addition reactions …6

Sketch the molecular structure of butane (C_4H_{10}). **<u>2×3</u>**



4 carbon atoms …3
10 hydrogen atoms …3
[neither carbon nor hydrogen atoms need be explicitly shown]

(*c*) In a Bunsen burner methane burns according to the following equation:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \qquad \Delta H = -895 \text{ kJ mol}^{-1}$$

What is meant by the *heat of combustion* of a substance? **<u>3×3</u>**
heat produced or heat evolved or heat given out or heat change …3
when a mole of a substance …3
is completely burned / burned in excess oxygen …3
[completely or excess oxygen omitted (–1)]

How much energy is released when 0.05 moles of methane are burned? **<u>9</u>**
0.05 × 895 = 44.75 (kJ) …9
[ignore negative sign]
[17900 (kJ) …..3]

(*d*) Carbon dioxide gas is produced during the combustion of hydrocarbons. Describe a test for carbon dioxide. **<u>9</u>**
limewater turns milky / extinguishes a flame / increase in mass of NaOH / universal indicator or litmus changes colour, etc
any one …9

Question 12

Answer any two parts **2×33**

(*a*) Ethanol reacts with sodium according to the following equation:

$$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$$

Describe the appearance of (i) ethanol, **2×3**
colourless …3
liquid …3

(ii) sodium, at room temperature. **2×3**
grey or off-white or soft or metallic /tarnished …3
solid / metal …3

If 69 g of ethanol are used in the reaction, calculate
(i) the number of moles of ethanol used **6, 3**
(M_r =) = 24 + 6 + 16 = 46 …6
69 ÷ 46 = 1.5 (moles) …3
[3 (moles) …3]

(ii) the mass of sodium needed to react with the ethanol **2×3**
(A_r =) 23 …3
1.5 × 23 = 34.5 (g) …3
[69 (g) or 138 (g) …3]

(iii) the number of moles of hydrogen produced. **2×3**
one mole hydrogen for every two moles of ethanol …3
0.75 (moles) …3

(*b*) There are three subatomic particles: protons, neutrons and electrons.
Copy and complete the following table, filling in the missing information, in your answerbook.

	Location in atom	Mass	Charge
Proton	nucleus		+1
Neutron			
Electron		1/1836	

6×3

	Location in atom	Mass	Charge
Proton		1	
Neutron	nucleus	1	0
Electron	electron cloud or outside nucleus		–1

each correct entry …6×3

The atomic number of a fluorine (F) atom is 9 and its mass number is 19.
How many (i) protons, (ii) neutrons, are there in the fluorine atom? **6, 3**
9 (protons)
10 (neutrons)
first correct …6 , second correct… 3
[reversed…6]

Write the electronic (*s*, *p*) configuration for a fluorine atom. **2×3**
$1s^2\ 2s^2$ …3
$2p^5$ …3
[correct sequence of sublevels…3]

(*c*) What is the *electrochemical series*? **6, 3**
list of elements or metals …6
in order of decreasing ease of oxidation / reactivity // increasing ease of reduction of ions …3
[use of mnemonic …3]

The following list shows three elements in order of their positions in the electrochemical series:
potassium magnesium copper

Explain why the elements are in this order by considering their reaction (if any) with water.
6, 3, 3
potassium reacts readily with water / potassium reacts with cold water
magnesium reacts with hot water or steam
copper does not react with water
first correct statement 6, either of remaining statements …3 each
[potassium is the most reactive, copper is the least reactive …9]

[use of mnemonic (if not given above)….3]

Name one element that is *below* copper in the electrochemical series. **6**
silver, gold, mercury any one …6

Copy and complete the following equation: **5, 1**

$$\mathbf{CuSO_4 + Mg \longrightarrow \_\_\_\_\_ + \_\_\_\_\_}$$

$CuSO_4 + Mg \rightarrow MgSO_4 + Cu$
one correct product …5
balanced …1

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