Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE 2011

MARKING SCHEME

PHYSICS AND CHEMISTRY

ORDINARY LEVEL

General Guidelines

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. Marks for a description may be obtained form 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.

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*) A jogger moves at a constant speed of 2.5 m s^{-1}.
What distance does the jogger travel in 15 minutes?

2×3

$s = vt$ / $d = vt$ …3

$s = d = 2.5 \times 15 \times 60 = 2250$ (m) = 2.25 (km) …3

[s = 37.5 (m) (–1)]

(*b*) What is meant by *potential energy*? **6**

energy due to position or height or condition / energy in a compressed spring or elastic, stretched spring or elastic / stored energy or potential to do work / valid example / mgh …6

[energy of object at rest …3][work …3]

(*c*) In the equation $g = \frac{GM}{d^2}$ what does *d* represent? **6**

distance / radius / radius of earth …6

(*d*) Candle wax melts at 65 ºC. What is this temperature on the Kelvin scale? **2×3**

273 …3

+ 65 = 338 (K) …3

[208 (K) or –208 (K) (–1)]

(*e*) Figure 1 shows rays of light passing through a lens and meeting at the focus F.
What type of lens is shown? **6**

convex / converging …6

[concave / diverging …3]

(*f*) Light is split into its component colours on passing through a glass triangular prism.
What name is given to this phenomenon? **6**

dispersion / refraction …6

[spectrum, rainbow …5]

(*g*) What are emitted from the surface of a metal during the photoelectric effect? **6**

electrons / electricity / charge …6

[light …3]

(*h*) Figure 2 shows two similar waves combining together. What type of interaction occurs? **6**

(constructive) interference / addition / constructive (interaction) …6

(*i*) Name the safety device found inside a standard 3-pin plug. **6**

fuse / earth (wire) …6

[insulation …3]

(*j*) An energy efficient lamp with a power rating of 28 W is connected to a 230 V supply.
Calculate the current drawn by the lamp. **2×3**

$P = VI$ / $I = \frac{p}{V}$ …3

28 ÷ 230 = 0.122 (A) [0.1 – 0.122 (A)] …3

[6440 (A) or 8.21 (A) …3]

(*k*) Calculate the number of units (kW h) used by a 2 kW electric toaster when it is turned on for 6 minutes. **6**

$2 \times 0.1 = 0.2$ (kW h) …6

[$2 \times 6 = 12$ / $2 \times 6 \times 60 = 720$ …5]

[attempt involving dividing …3]

(*l*) State the principle on which the moving-coil galvanometer is based. **2×3**

current carrying conductor or wire or coil / in a magnetic field / experiences a force any two …2×3

(*m*) Figure 3 shows two 5 µF capacitors connected in parallel. What is the effective capacitance of the combined capacitors? **6**

$5 + 5 = 10$ (µF) …6

[$\frac{1}{5}+\frac{1}{5}=\frac{2}{5}$ …3 / 2.5 …5][$5 \times 5 = 25$ (µF) or $C = Q/V$ …3]

(*n*) Name the element commonly used to block nuclear radiation. **6**

lead …6

[concrete, water …3]

(*o*) What happens to the nucleus of an atom when it undergoes nuclear fission? **6**

it divides / it splits / it breaks down …6

Question 2

What is meant by the *kinetic energy* of a moving object? **2×3 or 6**
energy due to // work …3
motion or movement // done …3
[example …3]

or

(*KE* =) ½mv^2 …6

Define (i) *weight* **2×3**
(weight =) mass × // *m* // effect on an object // force // gravity // earth's …3
(acceleration due to) gravity // *g* // of gravity // due to gravity // acting on object // attraction for an object ….3
[how heavy …3]

(ii) *work* **2×3**
(work =) force / (*W* =) *F* / energy used …3
× distance or displacement / × *s or* × *d* / to move an object (by force) …3

State one of Newton's laws of motion. **2×3**
an object remains at rest / an object remains at constant velocity / an object remains in uniform motion /
an object remains at constant speed (in a straight line) …3
unless acted upon by a force …3

or

the rate of change of momentum is proportional to …3
(and in the same direction as) the applied force …3
[allow $F \propto ma$ and $F = ma$ …6]

or

for every action / for every force …3
there is an equal reaction / there is an equal and opposite force …3

[allow equations of motion: $v = u + at$, $v^2 = u^2 + 2as$, $s = ut + \frac{1}{2}at^2$ or $s = \frac{1}{2}(u + v) \times t$ …6]
[Newton's law of gravitation unacceptable]

Figure 4 shows a curling stone from a team event in the Winter Olympics. It is thrown along a frozen horizontal ice track to reach a target. During a practice session on an empty track, a curling stone of mass 18 kg is released with an initial velocity of 2 m s^{-1} and it eventually stops after moving 25 m.

Calculate

(iii) the weight of the curling stone **2×3**

($W =$) mg …3

$= 18 \times 9.8 = 176.4$ (N) (176 – 180) (N) …3

[18 (kg) …3]

(iv) the initial kinetic energy of the curling stone **2×3**

($KE =$) $\frac{1}{2}mv^2$ …3

$= \frac{1}{2}\ 18 \times (2^2) = 36$ (J) …3

[square shown but omitted in calculation 18 (J) (–1)] [square not shown, 18 (J) …3]

(v) the acceleration of the curling stone **2×3**

$v^2 = u^2 + 2as$ / $a = (v^2 - u^2) / 2s$ …3

($a =$) $(0^2 - 2^2) / (2 \times 25) = -0.08$ (m s^{-2}) …3

[positive sign in a acceptable]

or

$s = \frac{1}{2}(u + v) \times t$ / $t = 2s/(u + v)$

$t = 50 / (2 + 0) = 25$ (s) …3

$v = u + at$ /$a = (v - u) / t$ // $s = ut + \frac{1}{2}at^2$ / $a = 2(s - ut) / t^2$

($a =$) $(0 - 2) / 25 = -0.08$ (m s^{-2}) // ($a =$) $2(25 - (2 \times 25))/ 25^2 = -0.08$ (m s^{-2}) …3

[positive sign in a acceptable]

(vi) the force on the curling stone as it slows down **2×3**

$F = ma$ …3

($F =$) $18 \times -0.08 = -1.44$ (N) …3

[allow positive or negative sign]

(vii) the total work done on the curling stone **2×3**

($W =$) Fs …3

$= 1.44 \times 25 = 36$ (J) …3

[ignore any negative sign]

Team members use special brushes on the ice directly in front of the moving curling stone to smoothen the surface of the ice.

What effect does this have on the horizontal force acting on the curling stone? **6**

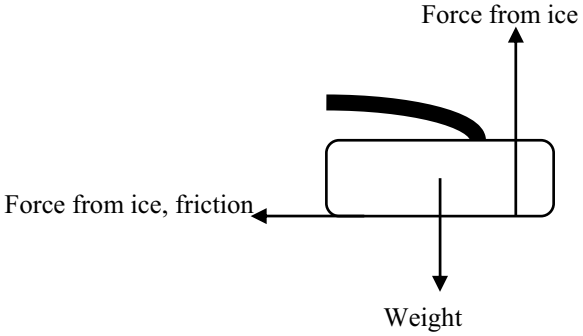
makes stone move faster or more easily / makes stone moves longer distance / reduces friction / keeps stone moving …6

[makes ice more slippy / melts ice /smoothens ice …6]

Draw a diagram showing two forces acting on the moving curling stone. **2×3**

weight down, (normal reaction) force upwards, (friction) force left any two 2×3

[arrows sufficient][friction arrow can be at an angle but must be to left]



Question 3

Figure 5 shows two plane mirrors found inside a periscope, a device which is based on the *laws of reflection*.

State the laws of reflection of light. **2×3, 2×3**

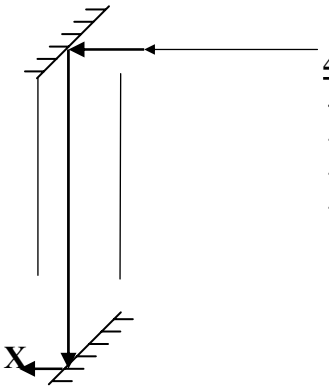
the incident ray, the reflected ray and the normal / beams or rays …3
all lie in the same plane. …3
[normal omitted (–1)]
[refraction instead of reflection (–1)]

the angle of incidence is equal to / i = …3
the angle of reflection / r …3
[a good diagram will be sufficient for second law]
[word refraction instead of reflection (–1)]
[Snell's law …3]

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

virtual, upright or erect, laterally inverted, image and object equal in size / image not magnified / image not diminished / object distance to mirror equal to image distance / image behind mirror any two… 2×6

Copy Figure 5 into your answerbook and complete it to show the path of light through the periscope to the observer at X. **4×3**



continue incident ray horizontally to strike mirror …3
show ray reflected (at right angles) by first mirror …3
show ray reflected (at right angles) by second mirror …3
ray exits periscope towards X …3
[arrows in wrong direction (–1)]
[ray between mirrors not vertical (–1)]

Figure 6 shows a pin placed 12 cm in front of a concave mirror of focal length 4 cm. F is its focus.
What is the distance of the image of the pin from the concave mirror? **4×3**

$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ / ray diagram attempt using scaled paper …3

$\frac{1}{12}+\frac{1}{v}=\frac{1}{4}$ / one ray reflected correctly …3

$\frac{1}{v}=\frac{1}{4}-\frac{1}{12}=\frac{1}{6}$ / second ray reflected correctly …3

v = 6 (cm) / image located at 6 (cm) on scale …3
[error in fractions, scale if image between F and 2F (–1)]

Give one use of a concave mirror. **6**

to produce magnified image, to produce upright image, shaving mirror, make-up mirror, dentist's mirror, to reflect a beam of light, (reflector in) spotlight or torch or car headlamps or microscope, reflecting telescope, etc …6
[use for a convex mirror, e.g. security mirror or car rear-view mirror …3, use for concave lens, e.g. glasses …3]

Give two differences between this image formed in the concave mirror and an image of an object formed when using a periscope. **4×3**

where candidate takes 'this image' to refer to the diagram or a real image

Image in concave mirror	**Image in Periscope**
diminished	same size as object
real or can be formed on a screen or caused by actual intersection of light rays	virtual, or cannot be formed on a screen or caused by apparent intersection of light rays
inverted	upright or erect
laterally inverted	no lateral inversion
image not at infinity or close to mirror	image at infinity or far away
imageand object are at different distances to the concave mirror	image and object are equidistant from the plane mirrors
image and object are in same horizontal plane	image and object in two different horizontal planes

any four...4×3

or

where candidate takes this image to refer to their use of a concave mirror or a virtual image

Image in concave mirror	**Image in Periscope**
magnified	same size as object
virtual	
erect	
image and object are at different distances to the concave mirror	image and object are equidistant from the plane mirrors
image not at infinity or close to mirror	image at infinity or far away
image and object are in same horizontal plane	image and object in two different horizontal planes

any four …4×3

Question 4

Explain the terms
(i) *heat* **6**
(internal) energy …6

(ii) *temperature* **6**
degree of hotness or coldness / how hot or how cold …6

The kelvin is the SI unit used to measure temperature.
What is the significance of the temperature zero on the Kelvin scale? **3**
minimal (internal) energy, no (internal) energy, absolute zero of temperature, lowest temperature possible, particles (almost) stopped, – 273 ºC, gas has zero volume …3
[273 º, – 273 º, 273 K or – 273 K (–1)]

A mercury thermometer is a common type of laboratory thermometer.
Name one other type of thermometer. **6**
alcohol, resistance, thermistor, thermocouple, constant volume gas, constant pressure gas, etc …6
[accept colour, digital, clinical, wet and dry bulb, soil, temperature probe, datalogging temperature sensor, etc]

Describe an experiment to calibrate an unmarked mercury thermometer. **6, 3, 3**
mark mercury or liquid level or height
when dipped into ice (water)
(mark mercury or liquid level or height when) held in steam or boiling water
scale / two fixed points / zero and 100
[information in a labelled diagram can be awarded marks]

first correct point…6
any two other points…2×3

Give one disadvantage of a mercury thermometer. **6**
cannot read low temperatures, insensitive, inaccurate, if broken mercury (vapour) is poisonous or toxic or harmful or dangerous …6
[reading changes quickly…3]

What is meant by a *thermometric property*? **6**
changes …3
with temperature …3

Give one example of a thermometric property. **9**
length (of liquid) (in a column) / pressure / volume / emf / current / resistance / colour, etc …9

A temperature θ on the Celsius scale is calculated using the equation:

$$\frac{\theta}{100} = \frac{X_\theta - X_0}{X_{100} - X_0}$$

What do the symbols
(i) X_θ **2×3**
value of thermometric property / height of mercury …3
at temperature θ (ºC) …3

(ii) X_{100}, represent? **2×3**
value of thermometric property / height of mercury …3
at temperature 100 (ºC) / at boiling point (of water) / in steam …3

Question 5

(*a*) Copper is a good <u>electrical conductor</u>.

Explain the underlined term. **<u>3</u>**
electrons or electricity can (easily) flow through it / it has low (electrical) resistance /
it carries current easily / allows electricity or current to flow through it …3
[metals are good conductors (–1)]

The following terms are used in stating *Ohm's law*:

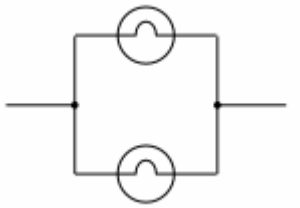
potential difference	current	temperature	proportional

Using these terms, copy and complete the following statement of Ohm's law:
"The . . . . . through a conductor is . . . . . to the . . . . . between its ends at constant . . . . . ." **<u>4×3</u>**
current …3
proportional …3
potential difference ...3
temperature …3
[correct order essential but where current and potential difference reversed …(–3)]

Figure 7 shows a circuit with two lamps each of resistance 3 Ω connected in series to a 12 V battery. Calculate
(i) the effective resistance of the circuit **<u>2×3</u>**
$R = R_1 + R_2$ …3
$= 3 + 3 = 6\ (\Omega)$ …3
[$V = IR$ / $R = \frac{V}{I}$ …3 but not if used in (ii)]
[$\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$ …3 / 1.5 …5]

(ii) the current in the circuit **<u>2×3</u>**
$V = IR$ / $I = \frac{V}{R}$
…3
$= \frac{12}{6} = 2.0\ (\text{A})$ …3

Draw a circuit diagram to show how to connect the two lamps in parallel. **<u>2×3</u>**



lamps in parallel …3
wires as shown …3

(*b*) "Many devices plugged into a mains supply use a transformer."

Name one device which uses a transformer. **6**
television, computer, computer printer, (phone or laptop) charger, doorbell, etc …6

Give one difference between a mains supply and a battery. **6**
alternating current from mains, direct current from battery / high voltage from mains, low voltage from battery / continuous supply or power from mains, limited from battery …6

Figure 8 shows a transformer.
Identify the parts labelled A, B and C. **3×3**
A: coil or winding or wire or inductor …3
B: coil or winding or wire or inductor …3
C: core / lamination /iron …3

Part A has 345 turns and is connected to a 230 V a.c. supply.
If the output voltage is 30 V, calculate the number of turns needed on part B. **2×3**
$\frac{V_p}{V_s} = \frac{N_p}{N_s} / \frac{345}{V_s} = \frac{230}{30}$ …3
(V_s =) 45 (V) …3
[$\frac{V_p}{V_s} = \frac{N_s}{N_p}$, ($V_s$ =) 2 645 (V) (–1)]

Why does a transformer become warm during use? **6**
electrical energy passing through it / electrical energy converted to heat energy / inefficiency / eddy currents …6
[heat produced in coils …3]

Question 6
Answer 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 // $m_1v_1 + m_2v_2$ …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]

In Figure 9 a girl of mass 30 kg, standing still on a smooth horizontal surface, catches her dog of mass 12 kg moving horizontally through the air towards her at a velocity of 2 m s^{-1}.
Why has the girl no momentum before she catches the dog? **6**
not moving / has zero velocity / is stationary / *mv* is zero …6

Calculate
(i) the momentum of the dog before the girl catches the dog **2×3**
mv / 12 × 2 …3
= 24 (kg m s^{-1}) …3

(ii) the velocity of the girl after she catches the dog. **3×3**
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ / $m_1u_1 + m_2u_2 = (m_1 + m_2)v$ or equivalent …3
($m_1u_1 + m_2u_2$ =) (30 × 0) + (12 × 2) = 24 …3
($m_1v_1 + m_2v_2$ =) 30 *v* + 12 *v* (= 42 *v*) / ($m_1 + m_2$)*v* = (30 + 12) *v* (= 42 *v*) …3
v = 24/42 = 0.57 (0.57 – 0.6) (kg m s^{-1})

(*b*) Figure 10 shows part of the electromagnetic spectrum which classifies regions of waves.
Give one property common to all regions of the electromagnetic spectrum. **6**
all travel at same speed / speed common / speed 3 × 10^8 (m s^{-1}) / have (oscillating) electric and magnetic field associated with them …6

Microwaves	**A**	Light	**B**	X-rays

Figure 10

Name each of the regions labelled
(i) A **6**
infrared …6
[ultraviolet …3]

(ii) B **6**
ultraviolet …6
[infrared …3]

Give one use of the electromagnetic waves found at B. **6**
cause fluorescence, security marking of property and banknotes, detecting forged banknotes, optical brighteners (in detergents, paper, etc), sunlamps or sunbeds, disinfecting hairbrushes, killing bacteria, causes photoelectric effect, killing flies, etc. any one …6

Describe how you could detect the electromagnetic waves found at A. **6, 3**
use a heat detector, e.g. a thermometer …6
relevant detail. e.g. temperature rises …3

(*c*) What is an *electric field*? **6**

area or space or region around a charge …3

where another charge experiences or feel a force or an attraction or repulsion …3

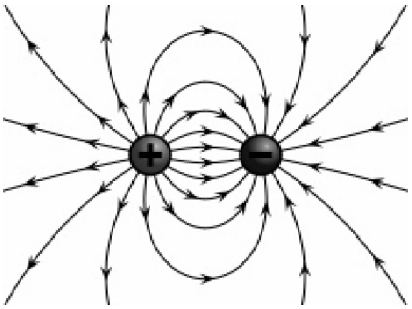
Figure 11 shows a pair of isolated and equal opposite charges.

Figure 11

Copy the diagram and sketch the electric field pattern around the charges. **6, 3**

two field lines correct …6

arrows starting at positive charge …3



The force between the two charges is 0.80 N.
Is this an attractive or a repulsive force? **6**

attractive …6

[repulsive…3]

Give a reason for your answer. **6**

unlike charges attract / like charges repel …6

What is the value of this force if one of the charges is doubled? **3**

1.6(0) (N) / doubled …3

What is the effect on the force if the distance between the charges is increased? **3**

reduced or decreased or gets smaller or weakens / inversely proportional to square of distance …3

(*d*) All <u>radioactive</u> isotopes decay with a certain <u>half-life</u> and emit nuclear radiation.
Explain the underlined terms. **4×3**

(atoms or isotopes with) unstable …3

nuclei …3

[atoms (–1)]

time (taken) …3

for half a radioactive sample to decay ….3

[for half the atoms to decay (–1)]

List the three types of nuclear radiation. **3×3**

alpha / α …3

beta / β …3

gamma / γ …3

What fraction of a radioactive isotope will remain after a period of time equal to four half-lives? **6 or 2×3**

one-sixteenth or 0.0625 …6

or

after one half-life, half gone or half left …3

after two half-lives, three quarters gone or quarter left / after three half-lives, three eighths gone or one eighth left / after four half-lives, three sixteenths gone or one-sixteenth left …3

Give one use of a radioactive isotope. **6**

detecting leaks, medical (diagnosis), radiation therapy or cancer (treatment), smoke alarm, carbon dating, preserve food, produce energy or electricity, nuclear plant, nuclear weapon, etc any one…6

Question 7
Any eleven parts **11×6**

(*a*) Sketch a *p-orbital*. **6**
dumbbell …6
[no penalty for set of dumbbells] [sphere …3]

(*b*) How many (i) protons, (ii) neutrons, are in an atom of $^{11}_{5}B$? **2×3**
(i) 5 …3
(ii) 6 …3
[reversed …3]

(*c*) What is meant by the *ground state* of an electron in an atom? **2×3**
(electron(s) in) lowest / …3
energy level(s) available …3
[allow not excited …6]

(*d*) Copy and complete the statement:
"Isotopes of an element have the same. . . . . number but a different . . . . . number." **2×3**
atomic / proton …3
[allow electron]
mass / neutron …3
[reversed …3]

(*e*) Give one example of an ionic compound. **6**
any ionic compound …6

(*f*) The relative atomic mass of helium gas (He) is 4.
Calculate the number of atoms in 16 g of helium gas. **5, 1**
16 ÷ 4 = 4 (moles) …5
$4 \times 6 \times 10^{23} = 24 \times 10^{23}$ (atoms) = 2.4×10^{24} (atoms) …1
[allow 16 × 4 = 64 (moles)…3]

(*g*) Calculate the percentage of nitrogen by mass in ammonium chloride (NH_4Cl). **2×3**
$M_r = 53.5$ …3

$\frac{14}{53.5} \times 100 =$ 26.2% (25.9 - 26.4%) …3

[27% (–1)]

(*h*) Define an acid in terms of the Brønsted-Lowry theory. **2×3**
proton / H^+ …3
donor …3
[accept produces H^+]

(*i*) What is the pH of a 0.03 M solution of hydrochloric acid (HCl)? **2×3**
$pH = -\log[H^+]$ / $pH = -\log[0.03]$ …3
(pH =) 1.5 …3

(*j*) What is meant by an *exothermic reaction*? **2×3**

(reaction where) heat or energy …3

released / lost / given out / evolved …3

(*k*) Give one characteristic property common to transition elements. **6**

variable valency / coloured compounds / catalysts …6

[hard, heat conducting, electrical conducting, etc any one …3]

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

Na_2SO_3 + 2HCl → NaCl + _____ + H_2O **2×3**

Na_2SO_3 + **2**HCl → **2**NaCl + **SO_2** + **H_2O**

2 HCl …3

2 NaCl …3

SO_2 …3

any two…2×3

(*m*) List the following elements in order of decreasing chemical activity:

copper calcium iron **6**

calcium, iron, copper …6

[reversed …5]

(*n*) Name a hydrocarbon extracted from crude oil. **6**

any hydrocarbon …6

(*o*) Why is the compound shown in Figure 12 classified as an aromatic alcohol? **5, 1**

functional group of alcohol / OH functional group

benzene ring

first correct…5

second correct…1

Question 8

The element fluorine is located in a group on the right hand side of the periodic table.
Name an element found in
(i) the same group **6**
chlorine / bromine / iodine / astatine …6
[lithium / beryllium / boron / carbon / nitrogen / oxygen / neon …3]
[allow atomic symbols]

(ii) the same period, as fluorine **6**
lithium / beryllium / boron / carbon / nitrogen/ oxygen / neon …6
[chlorine / bromine / iodine / astatine …3]
[allow atomic symbols]

Give a common property of the elements found in this group. **6**
accept an electron / form negative ions / have valency one / non-metallic / reactive …6

Give the electronic configuration (*s*, *p*) of an atom of fluorine. **6**
$1s^2$, $2s^2$ …3
$2p^5$ …3

State the type of bond formed when two atoms of fluorine combine. **6**
covalent …6
[ionic…3]

Describe, with the aid of a diagram, how this bond is formed. **2×3**
correct depiction of seven electrons in valence shell of a fluorine atom using dots and crosses or shells …3

covalent bond consisting of pair of electrons between the two fluorine atoms …3

Name another type of bond formed by fluorine in its compounds. **6**
ionic, polar covalent …6
[covalent …3]

Fluorine is the element with the highest <u>first ionisation energy</u> in its group.

Explain the underlined term. **<u>2×3</u>**
energy required to remove …3
most loosely bound electron …3

Using the electronic configuration of neon, explain why neon has a higher first ionisation energy value than fluorine. **<u>3, 6, 3</u>**
$1s^2, 2s^2, 2p^6$ …3

and

neon has full shell or set of full subshells / noble gas configuration
stable
more difficult to remove the electron in neon

first correct point …6
second correct point…3

or

ionisation energy values increase across a period …6
because atomic radius decreases or nuclear charge increases …3

Explain why first ionisation energy values decrease down a group in the periodic table. **<u>6</u>**
atomic radius increasing / number of shells increasing / screening effect increasing / (outer) electron farther from nucleus …6

Question 9

(*a*) Define *oxidation* in terms of electron transfer. **2×3**

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

As well as oxidation, name the other process which occurs during an oxidation reaction. **6**

reduction …6

Identify the substance oxidised in the following reaction:

$$CuSO_{4(aq)} + Mg_{(s)} \longrightarrow Cu_{(s)} + MgSO_{4(aq)}$$ **6**

magnesium / Mg …6

What would you see happening during this reaction? **6**

magnesium dissolving or reacting or wearing away / blue colour (of solution) fades or disappears / red solid or copper appears or plates out …6

Copy and complete the following reaction:

$$CuO + H_2 \longrightarrow \_\_\_ + \_\_\_$$ **6 or 2×3**

$CuO + H_2 \rightarrow Cu + H_2O$ …6
copper / Cu …3
water / H_2O …3

Identify the oxidising agent in this reaction. **3**

copper oxide / CuO

…3

(*b*) Each of the following elements combines with oxygen to form a stable oxide:

calcium (Ca) sulfur (S) sodium (Na)

Give the name and chemical formula of an oxide formed by each element. **6, 6, 3**

calcium oxide
CaO
sulfur dioxide // sulfur trioxide
SO_2 // SO_3
sodium oxide or sodium peroxide or sodium superoxide
Na_2O // Na_2O_2 // NaO_2

first correct…6
second correct…6
third correct…3

From these oxides, identify **6, 3**

(i) an acidic oxide

sulfur dioxide / sulfur trioxide / SO_2 / SO_3

(ii) a basic oxide

calcium oxide / CaO / sodium oxide or sodium peroxide or sodium superoxide / Na_2O / Na_2O_2 / NaO_2

first correct…6
second correct…3

How would you show that an oxide is acidic? **6, 3**

any indicator / universal indicator / pH meter …6
take colour or reading on pH meter (to confirm acidity) …3

Question 10

In a titration experiment, a standard solution of hydrochloric acid (HCl) was used to find the concentration of a potassium hydroxide (KOH) solution.
Explain the underlined term. **2×3**
a solution of known / a solution of exact …3
concentration …3
[solute and solvent mixed together …3]

Figure 13 shows some items of equipment used.
(i) Name each of the items labelled A and B. **2×6**
A: pipette …6
B: burette …6
[reversed ..9][either word alone …6]

(ii) Describe the procedure for preparing and filling B. **3×3**
rinse with deionised or distilled water …3
rinse with solution it is to contain or HCl …3
fill using a funnel …3
fill part below the tap …3
avoid air bubbles …3
remove funnel before zeroing …3
fill to mark or until (bottom of) meniscus lies on mark ..3
clamp vertically …3
read at eye level …3
any three…3×3
[allow fill with KOH][allow wash or rinse instead of first two points…3]

(iii) State one precaution required when taking a reading of the volume of the liquid in B. **6**
read at eye level / bottom of meniscus lies on mark / burette vertical or straight / no air bubbles …6

(iv) Name one piece of safety equipment that should be worn during a titration experiment. **6**
lab coat / goggles or safety glasses / gloves / hair tie …6

(v) Name the item of equipment where the liquids mix together during the titration. **2×3**
conical …3
flask …3
[beaker…3]

In the titration, the end-point was reached when 22.5 cm^3 of 0.16 M hydrochloric acid solution reacted with 20.0 cm^3 of the potassium hydroxide solution.
(vi) How was the 'end-point' identified? **6**
colour change in flask / indicator changed colour / any named indicator changed colour /pH changed rapidly …6

(vii) Copy and complete the equation for the titration reaction:

HCl + KOH ⟶ ____ + ____ **2×3**
KCl / potassium chloride …3
H_2O / water …3

(viii) Calculate the molarity of the potassium hydroxide solution. **3×3**
$\frac{V_1M_1}{n_1} = \frac{V_2M_2}{n_2}$ / 3.6 …3

$\frac{22.5 \times 0.16}{1} = \frac{20.0 \times M_2}{1}$ / 20 M_2 …3

(M_2 =) 0.18 (mole/l) (0.18 – 0.2 (mole/l)) …3
[correct formula, incorrect substitution …6 max]

Question 11

Ethyne (acetylene) (C_2H_2) is the first member of a homologous series of hydrocarbons.
Explain the underlined terms. **4×3**
series of compounds …3
with similar properties / same functional group / differ by CH_2 / have same method of preparation …3

(compound of) hydrogen …3
and carbon (only) …3

Name the homologous series of which ethyne is a member. **6**
alkynes …6

Sketch the structural formula of ethyne. **6**
$HC \equiv CH$ …6
[triple bond, no hydrogens drawn…3]

Name one other homologous series of hydrocarbons. **6**
alkanes or alkenes …6

What is the first member of this series? **6**
methane or ethene …6
[if not matched to previous answer (–1)]

Figure 14 shows part of the apparatus used to prepare a sample of ethyne gas.
Name the liquid X and the solid Y. **2×6**
X: water / H_2O …6
Y: calcium carbide or calcium dicarbide / CaC_2 …6

What is observed when a sample of ethyne gas
(i) is burned in air **6**
smoke / smoky flame / bright or luminous flame …6
[water or carbon dioxide released …3]

(ii) is tested with a bromine water solution? **6**
decolourised / yellow or red or brown colour disappears / colour changes ...6

Ethyne gas burns at a very high temperature with excess oxygen.
Give an application of this process. **6**
(oxy-acetylene) welding or cutting …6

Question 12
Answer any **two** parts. **2×33**

(*a*) Define a *mole* of a substance. **2×3**
Avogadro number // molecular mass // same number of particles …3
of particles // in grams // as 12 g carbon …3
[amount of a (chemical or substance) ..5]

Describe the appearance of sodium and chlorine at room temperature. **2×3**
grey or white / metal / solid …3
green /gas …3

Sodium and chlorine react together to form sodium chloride as follows:

$$2Na + Cl_2 \longrightarrow 2NaCl$$

Give one use of sodium chloride. **3**
flavouring food / preserving food / household salt or kitchen salt, thawing ice on roads, etc …3

34.5 g of sodium was used in this reaction, calculate
(i) the number of moles of sodium used **3×3**
(A_r =) 23 …3
34.5 ÷ 23 …3
= 1.5 (moles) …3
[0.666 (moles) (–1)]

(ii) the mass of sodium chloride produced **3×3**
(M_r =) 58.5 …3
58.5 × 1.5 …3
= 87.75 (g) …3
[38.61(g) …9]

(*b*) Figure 15 shows carbon dioxide (CO_2) gas being prepared.
Name the liquid A and the solid B. **2×6**
A: any acid …6
B: any carbonate or hydrogen carbonate / marble or limestone (chips) …6

Describe a test to show when the gas jar is full of carbon dioxide. **2×3**
extinguishes // turns limewater …3
a (lighting) taper (held near the mouth) // milky …3

What is observed when carbon dioxide is bubbled through a solution of blue litmus? **6**
red colour (appears) / blue changes to red ...6

What does this tell you about carbon dioxide? **6**
it is acidic / it has low acidity …6
[it is basic…3]

Give one commercial use for carbon dioxide. **3**
fire extinguishers / carbonated drinks /dry ice / stage effects / smoke effects / refrigerant / photosynthesis …3

(*c*) What is meant by *electrolysis*? **6, 3**

using electricity
to bring about a chemical reaction / to separate compound into its elements

first correct…6
second correct…3

[plating one metal with another..6]

Figure 16 shows an apparatus used to demonstrate the electrolysis of water.
Name a suitable metal used for the electrodes. **6**

platinum …6
[carbon or graphite …5]

Why is a small amount of sulfuric acid usually added to the water? **3**

pure water is a poor conductor / to improve conductivity /to reduce resistance …3

Name
(i) gas A **6**

hydrogen …6
[oxygen …3]

(ii) gas B **3**

oxygen ...3
[hydrogen …3]

Describe a test to identify gas A. **3**

burns with a pop …3
[if oxygen given for A, relights glowing splint …3]

Explain why one of the gases is produced at twice the rate of the other. **3**

ratio of hydrogen to oxygen in water is 2:1 / more hydrogen than oxygen in water …3