Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2012

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, 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.

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 racing bicycle of mass 8 kg. What is the weight of the racing bicycle? [acceleration due to gravity, $g = 9.8$ m s^{-2}]** **2×3**
(W) = mg …3
= 8 × 9.8 = 78.4 (N) …3

(*b*) **A person pushes a fridge 2 m across a kitchen floor with a force of 160 N Calculate the work done.** **2×3**
(W) = Fs …3
= 160 × 2 = 320 (J) …3
[80 J) …3]

(*c*) **Normal body temperature is 37 ºC. What is this temperature on the Kelvin scale?**
273 …3
+ 37 = 310 (K) …3
[236 (K) or –236 (K) (–1)]

(*d*) **Give one example of a thermometric property.** **6**
volume or height of liquid (in a column), volume of gas (at constant pressure), pressure of gas (at constant volume), product of pressure and volume of a gas, emf (generated in a thermocouple), resistance (of metal or thermocouple), colour, etc.
any one …6

(*e*) **Figure 2 shows a ray of light passing through a glass prism. Name the phenomenon that occurs at X.** **1, 5**
total internal …1
reflection …5
[refraction …3]

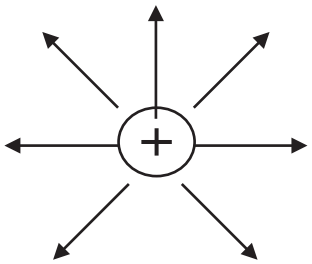
(*f*) **Give one use for a concave mirror.** **6**
to produce magnified image, to produce upright image, shaving mirror, make-up mirror, dentist's mirror, to reflect a beam of light, (reflector in) spotlight or torch or car headlamps or microscope, reflecting telescope, etc any one…6
[use for a convex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

(*g*) **Copy and complete the statement:**
"When light is reflected, the angle of ……. equals the angle of ……." **2×3**
Incidence / i ……3
Reflection / r …3

(*h*) Figure 3 shows an isolated positive point charge. Sketch in your answerbook the electric field pattern around the charge. **5, 1**

radial field lines …5

arrows pointing out …1



(*i*) In the equation for *Coulomb's law*, $F = \frac{1}{4\pi\varepsilon}\frac{q_1 q_2}{d^2}$, what does *d* represent? **6**

distance …6

(*j*) Figure 4 shows a 4 Ω and a 12 Ω resistor connected together. What is the effective resistance of the combined resistors? **6**

16 (Ω) …6

[attempt involving fractions …3]

(*k*) A kettle, rated at 3000 W, is left on for five minutes. Calculate the number of units (kW h) used. **6**

0.25 (kW hr) …6

[250 …5, 15 …5]

[15, 000 …3, 3000W …3, 1/12 = 0.083 hour …3]

(*l*) Why is electricity transmitted over long distances at high voltages? **6**

more efficient, wastes less energy, less power lost, less heat in cables, costs less, less waste, etc any one …6

(*m*) Name one device containing an electrical transformer. **6**

phone charger, lap-top charger, travel adaptor, television, doorbell, etc any one …6

(*n*) A sample of a radioactive isotope has a half-life of 15 minutes. What fraction of the sample will remain after 60 minutes? **2×3**

4 half lives …3

one-sixteenth …3

(*o*) State Einstein's famous equation of mass-energy conservation. **2×3**

E …3

$= mc^2$ …3

Question 2

Define (i) acceleration, **2×3**
rate of change / $(v - u)$ …3
of velocity / $\div t$ …3
[speeding up / going faster …3]

(ii) *kinetic energy*. **2×3 or 6**
energy due to // work …3
motion or movement // done …3
[example …3]

or

$(E_k =) \frac{1}{2}mv^2$ …6

What is the SI unit of kinetic energy? **6**
joule / J …6
[kilojoule, kJ …5]

Describe an experiment to measure the acceleration due to gravity, g. **6×3**
string, bob // ball, trapdoor // any free falling object …3
method of suspension // electromagnet // light gates …3
arrangement correctly described or drawn …3
pendulum length, l // distance from electromagnet to trapdoor, s // distance between light gates, s …3
[may be marked in diagram]
time / t (for n oscillations, for fall) / time between light gates) …3
use formula $T = 2\pi\sqrt{\frac{l}{g}}$ / find slope from graph of l versus T^2 // use formula $s = \frac{1}{2}gt^2$ / find slope from graph of s versus t^2 // $v^2 = u^2 + 2gs$ …3
[trolley on a slope with timer max …15]

Give one precaution to ensure an accurate result. **6**
find average time for an oscillation (instead of time for one oscillation), use heavy bob, inelastic string, long drop, smallest time or average time for drop , etc
any valid precaution…6

Figure 5 shows an athlete of mass 65 kg running on a track. On the final length of the track, the athlete accelerates from a velocity of 6 m s^{-1} to 7 m s^{-1} in two seconds.
Calculate
(iii) the acceleration of the athlete **2×3**
$v = u + at$ / $a = (v - u) \div t$ …3
$a = (7 - 6) \div 2 = 0.5$ m s^{-2} …3

(iv) the net force produced by the athlete in accelerating **2×3**
$(F) = ma$ …3
$65 \times 0.5 = 32.5$ N …3

(v) the change in kinetic energy of the athlete on the final length of the track. **3×3**
$(\Delta KE =) \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ …3
$= \frac{1}{2}\ 65\ (49 - 36) = 422.5$ (J) / $1592.5 - 1170 = 422.5$ (J) …6
[square shown but omitted in calculation 32.5 (J) (–1)] [square not shown, 32.5 (J) …3]
[1592.5 or 1170 …max 6][accept negative answer obtained from $\frac{1}{2}mu^2 - \frac{1}{2}mv^2$]

What is the net force on the athlete when she is moving at constant velocity? **3**
zero …3

Question 3

Figure 6 shows a ray of light undergoing refraction as it enters and leaves a glass block.

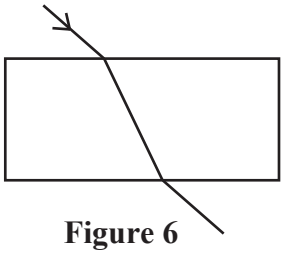


Figure 6

State one of the *laws of refraction of light.* **2×3**

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

or

the sine of the angle of incidence is proportional to // sin$i$ $\propto$ // sin$i$ / sin$r$ = …3
the sine of the angle of refraction // sin$r$ // constant / n or μ …3
[reflection instead of refraction (–1)] [sines omitted (–1)]

During an experiment to find the refractive index of the glass in the block the following data were recorded:

angle of incidence, *i*	**angle of refraction, *r***
35°	**22°**

Copy the diagram in Figure 6 and mark (i) the angle of incidence, (ii) the angle of refraction. **2×6**

angle of incidence marked correctly …6
angle of refraction marked correctly in glass …6
[angle of incidence in air adjacent to glass/air boundary …3]
[angle of refraction in glass adjacent to glass/air boundary …3]

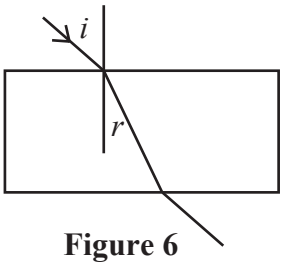


Figure 6

Use the data to calculate the refractive index of the glass. **6, 2×3**

$$(n) = \frac{\sin i}{\sin r}$$ …6

$$(n) = \frac{\sin 35}{\sin 22}$$

or

$$(n) = \frac{0.5736}{0.3746}$$ …3

= 1.5(3) …3

[accept 35 ÷ 22 = 1.59 …6]

Figure 7 shows a pin O placed 6 cm from a converging (convex) lens of focal length 12 cm.
Copy and complete the diagram in Figure 7 to show the formation of the image by the lens. **2×6, 2 ×3**

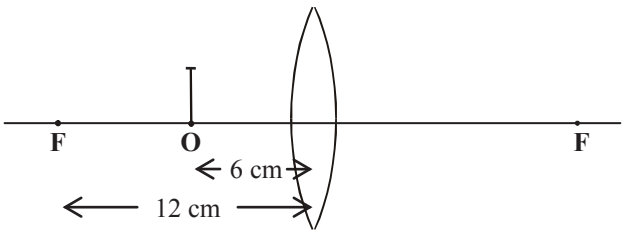


Figure 7

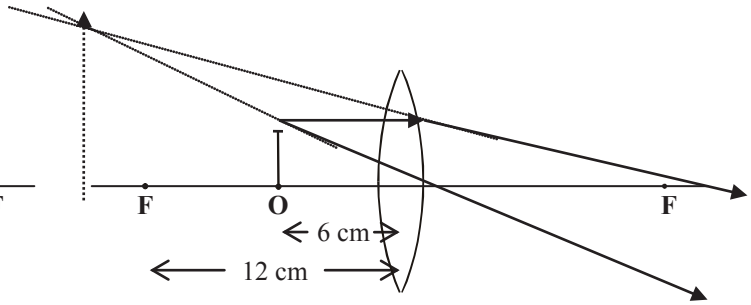


Figure 7

one ray refracted correctly …6
second ray refracted correctly …6
at least one ray projected backwards …3
large (virtual) image on same side of lens as object . ..3

Is this image *real* or *virtual*? **3**
virtual …3

Give a reason for your answer. **3**
caused by the apparent intersection of light rays / rays (forming image) do not meet / upright / cannot be formed on a screen …3

How does the size of the image compare with the size of the pin? **6**
(image) larger or magnified …6

Give one use of a converging lens based on this property. **6**
magnifying glass, glasses, microscope, etc

any one …6

[use of a mirror …3]

Question 4

(*a*) State *Boyle's law*. **3×3**

volume of a (fixed mass) of gas …3
is inversely proportional …3
to its pressure at constant temperature …3
[*at constant temperature* omitted (–1)]

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

Apparatus: pressure gauge // J tube …3
pump / plunger //mercury …3
sealed mass of gas …3

Method: measure volume
measure pressure
vary pressure/ vary volume
pV constant / graph of p and V inversely proportional
any valid precaution

any three…3×3

What is meant by an *ideal gas*? **5, 1**

obeys gas laws / obeys Boyle's law / obeys kinetic theory …5
at all temperatures and pressures …1

(*b*) The *kinetic theory* is used to explain the behaviour of gases.
State two assumptions of the kinetic theory of gases. **6, 3**

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

first correct point…6, second correct point …3

What is *Brownian motion*? **2×3**

motion …3
of particles / molecules …3

How would you demonstrate Brownian motion? **4×3**

Apparatus: microscope, smoke cell, lamp // microscope, pollen grains, water …3

any two…2×3

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

any one…3

Observation: description of motion observed …3

What does Brownian motion tell you about the behaviour of gases? **6**

molecules in rapid or random motion, molecules follow kinetic theory, molecules collide with each other, etc

any one…6

Question 5

(*a*) Figure 8 shows a toaster with a heating element of resistance 46 Ω connected across a potential difference (voltage) of 230 V.

When a <u>current</u> flows through the <u>circuit</u> of the toaster, the toaster gets hot.

(i) Explain the underlined terms. **<u>2×6</u>**

current: flow of charge / flow of electrons …6
[flow of electricity ...3]

circuit: conducting path / wires and components the current flows through / metallic loop …6

(ii) Calculate the current in the element of the toaster. **<u>6, 3</u>**

$V = IR \;/\; I = \frac{V}{R}$ …6

$= \frac{230}{46} = 5.0(\text{A})$ …3

(iii) Why does the current in a toaster change when the toaster is in use? **<u>6</u>**

resistance changes / it gets hot …6

(iv) What is the purpose of the fuse in the plug of the toaster? **<u>6</u>**

safety / to melt when current is too high / to blow if a fault develops / to prevent electrocution …6

(*b*) What is *electromagnetic induction*? **<u>3, 6</u>**

production of current / voltage / emf (in a conductor or coil) …3
when a magnetic field changes or moves (nearby) …6

State one of the laws of electromagnetic induction. **<u>6</u>**

voltage / current / emf …3
proportional to change in magnetic flux / / opposes change that causes it …3
[increases or is equal to instead of proportional (–1)]

Figure 9 shows a galvanometer connected across the ends of a coil of wire.
When the string is cut, the bar magnet falls through the coil.
As the bar magnet enters the coil, the needle of the galvanometer deflects to the right.

What does the galvanometer detect? **<u>6</u>**

(induced) current …6
[emf or voltage …3]

In which direction does the needle of the galvanometer move as the bar magnet leaves the coil? **<u>6</u>**

left / opposite / back …6

Why would the needle show no deflection, if the bar magnet were stationary in the coil? **<u>6</u>**

no induction / no movement / no change of magnetic flux …6
[no current / emf / voltage …3]

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 // $m_1v_1 + m_2v_2$ …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 10 shows a shark of mass 12 kg moving in a straight line at a constant velocity of 1.1 m s^{-1} towards a stationary fish of mass 2.5 kg, which the shark swallows.

Calculate

(i) the initial momentum of the shark **2×3**
mv / 12 × 1.1 …3
= 13.2 (kg m s^{-1}) …3

(ii) the velocity of the shark immediately after swallowing the fish. **3×3**
($m_1u_1 + m_2u_2$ =) (12 × 1.1) + (2.5 × 0) = 13.2 …3
($m_1v_1 + m_2v_2$ =) 12 v + 2.5 v (= 14.5 v) / ($m_1 + m_2$)v = (12 + 2.5) v (= 14.5 v) …3
v = 13.2 / 14.5 = 0.91 (0.86 – 0.94) (kg m s^{-1}) …3

Why does a moving container ship stop its engines, when it is some distance away from its destination port? **6**
momentum allows it to complete journey / it decelerates as it docks / it cannot stop quickly / to avoid crashing into dock, etc …6

(*b*) Ultraviolet radiation is part of the electromagnetic spectrum.
Name two other radiations that are part of the electromagnetic spectrum. **2×6**
visible, radio (waves) TV waves, x-rays, gamma (rays), infrared, microwaves
any two… 2×6

Figure 11 shows a piece of freshly cleaned zinc on the cap of a negatively charged electroscope.
Describe how the electroscope was charged negatively. **3×3**
bring positively charged rod nearby …3
touch (cap) with finger / earth (cap) …3
take away finger / take away rod …3
[allow induction …6] [touch with negatively charged rod …3] [attach to negative of battery …3]

When ultraviolet radiation was shone on the zinc, the leaf in the electroscope dropped.
What is the name of this phenomenon? **6**
photoelectric effect …6

Explain why the leaf dropped. **6**
electrons escaped / electrons released / charge lost / charge changed …6

(*c*) Copy the circuit and show the distribution of charges on the plates of the capacitor. **2×6**

positive charge indicated on LHS …6
negative charge indicated on LHS …6
[reversed …6][correct charge on battery …9, reversed …6]

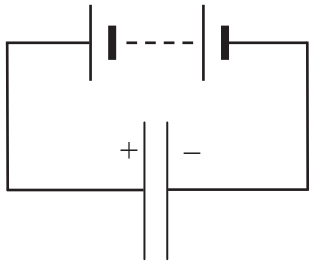


Figure 12

Give one way to change the capacitance of a parallel plate capacitor. **6**

move plates closer together / increase common area of plates / use medium of greater permittivity
any one… 6

Calculate the effective capacitance of two 3 μF capacitors when they are connected
(i) in series, **2×3**

$\frac{1}{3}+\frac{1}{3}=\frac{2}{3}\ /\ \frac{1}{C_1}+\frac{1}{C_2}=\frac{1}{C}$ …3

(C) = 3/2 = 1.5 (μF) ...3
[attempt using fractions of one-third (–1)]

(ii) in parallel. **6**

3 + 3 = 6 (μF) …6
[answers (i) and (ii) reversed (–1)]

Give one use of a capacitor. **3**

tuning radio or TV stations, flash bulb in a camera, timer switches, to separate ac from dc, rectification, smoothing direct current, to reduce interference in radio signal, to prevent sparking in an induction coil, to start a motor, to store charge, etc …3

(*d*) 'Alpha particles, a type of nuclear radiation, were used to examine the structure of the atom during experiments in the early twentieth century.'

Give two properties of an alpha particle. **2×6**

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, etc.
any two…2×6

Name two other types of nuclear radiation. **2×6**

beta / β …6
gamma / γ …6

Give two other uses of nuclear radiation. **6, 3**

detecting leaks, medical (diagnosis), radiation therapy or cancer (treatment), smoke alarm, carbon dating, preserve food, produce energy or electricity, nuclear plant, nuclear weapon, etc
first …6, second…3

Question 7

Any eleven parts **11×6**

(*a*) Figure 13 shows a block of the element gold. What is meant by the underlined term? 2×3
cannot be made simpler …3
chemically …3

(*b*) **Give one property of a proton.** **6**
positively charged / located in nucleus / mass of 1 (amu) …6

(*c*) **How many neutrons are in an atom of beryllium, $^{9}_{4}Be$?** **6**
5 …6

(*d*) **What is emitted when an electron in an atom returns to the ground state?** **6**
energy / light / photon …6

(*e*) **Copy and complete the statement:**
"Allotropes are different ……. forms of the same ……." **2×3**
physical …3
element …3

(*f*) **Calculate the percentage of sulfur by mass in sulfur dioxide (SO_2).**
[O=16; S=32] **2×3**
$M_r = 64$ …3
$\frac{32}{64} \times 100 = 50\%$ …3
[16 ÷ 32 also gives 50% …5]

(*g*) **Give one property common to transition elements.** **6**
coloured compounds / variable valency / good catalysts / metallic …6

(*h*) **What happens during electrolysis of acidified water?** **2×3**
water split into // see or observe or production of …3
its elements / into hydrogen and oxygen // bubbles or gas …3

(*i*) **Copy, complete and balance the following reaction:**
$CaCO_3$ + HCl → ____ + ____ + H_2O **5, 1**

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
one correct product …5
balanced …1

(*j*) **What is the pH of a 0.035 M solution of nitric acid (HNO_3)?** **2×3**
$pH = -\log[H^+]$ / $pH = -\log[0.035]$ …3
(pH =) 1.46 …3

(*k*) **List the following metals in order of *increasing* activity:**
zinc potassium silver **6**
potassium, zinc, silver …6
[reversed or one metal correct: Zn, Ag, K or Ag, K, Zn or K, Zn, Ag …5]

(*l*) **Give one example of an *amphoteric oxide*.** **6**
zinc oxide / ZnO / aluminium oxide / Al_2O_3 …6

(*m*) Calculate the number of molecules in 3 moles of ammonia gas.
[Avogadro constant = 6.0×10^{23} mol^{-1}] **2×3**

$3 \times 6.0 \times 10^{23}$ …3

$= 1.8 \times 10^{24}$ …3

(*n*) Give an example of an *alkene*. **6**

any alkene, e.g. ethene, propene, etc …6

(*o*) Identify the aromatic compound shown in Figure 14. **6**

benzene …6

Question 8

(*a*) What is an *atomic orbital*? **2×3**
region in space …3
where an electron is most likely to be found …3

Sketch the shape of
(i) an *s* orbital, **6**
circle or disc (to represent a sphere) …6

(ii) a *p* orbital. **6**
dumbbell …6

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

(*b*) Name two types of chemical bond that are formed when atoms combine. **2×6**
covalent …6
ionic …6

Use a diagram to show the formation of the bond formed when:
(i) two atoms of chlorine combine **2×3**

correct depiction of seven electrons in valence shell of a chlorine atom using dots and/or crosses or shells …3
covalent bond consisting of pair of electrons between the two chlorine atoms …3
[a line instead of a shared pair of electrons is acceptable for the bond pair, inner electrons need not be shown]

(ii) an atom of chlorine combines with an atom of sodium. **2×3**

correct depiction of one electron in valence shell of a sodium atom using dots and/or crosses or shells …3
ionic bond as result of transfer of an electron from sodium to chlorine …3
[crystal lattice …3]

(*c*) Electronegativity is a measure of the attraction of an atom of an element for a shared pair of electrons.

Identify the element in the periodic table with the highest electronegativity value. **6**
fluorine / F …6

Why is the element, argon, not given an electronegativity value? **6**
noble gas / inert gas / doesn't bond / doesn't react / has no attraction for (shared pair of) electrons
any one…6

[accept full outer shell …6]

Question 9

(*a*) Ethanoic acid is a <u>weak acid</u> found in vinegar.
What is meant by the underlined term? **<u>3×3</u>**
poor // slightly /partially / not fully …3
proton // dissociated …3
donor // to produce H^+ (ions in solution) …3

Give one example of a *strong* acid. **<u>3</u>**
hydrochloric acid / HCl / nitric acid / HNO_3/ sulfuric acid / H_2SO_4 …3

Identify one acid and one base in the following reaction:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$ **<u>2×6</u>**

acid: H_2O / NH_4^+ …6

base: NH_3 / OH^- …6
[reversed …6]

Give one example of a conjugate acid-base pair in this reaction. **<u>9</u>**
NH_3 and NH_4^+ / H_2O and OH^- …9
[charge incorrect or omitted (–1)]
[H_2O and NH_3 or NH_4^+ and OH^- …6]

(*b*) In reacting with oxygen, magnesium is <u>oxidised</u> and the oxygen is <u>reduced</u>.
Explain the underlined words in terms of electron transfer. **<u>4×3</u>**
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]

Give the balanced chemical equation for this reaction. **<u>2×3</u>**
$2Mg + O_2 \rightarrow 2MgO$ $Mg + ½O_2 \rightarrow MgO$
correct reactants and products …3
balanced …3

A sample of black copper oxide reacts with hydrogen gas.
Copy and complete the chemical equation for this reaction:

$$CuO + H_2 \longrightarrow \_\_\_ + \_\_\_$$ **<u>6 or 2×3</u>**

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

State (i) the substance oxidised, **<u>3</u>**
hydrogen / H_2 …3

(ii) the substance reduced, in the reaction. **<u>3</u>**
copper oxide / CuO …3

What colour change will be observed during the reaction? **<u>3</u>**
black to red/brown …3

Question 10

A student carried out an experiment, using a solution of hydrochloric acid (HCl), to determine the concentration of a sodium hydroxide (NaOH) solution.

Figure 15 shows some of the glassware which the student used.

(i) What name is given to this type of experiment? **6**

titration …6

(ii) Identify the glassware A and the glassware B. **2×6**

A: pipette …6

B: conical flask …6

(iii) Describe how glassware A is used to give 20 cm^3 of the sodium hydroxide solution. **3×3**

rinse with deionised or distilled water …3

rinse with solution it is to contain or NaOH …3

fill using pipette filler …3

avoid air bubbles …3

fill to mark or until (bottom of) meniscus lies on mark ..3

release contents or release pipette filler …3

do not dislodge or blow out last drop …3

read at eye level …3

any three…3×3

[allow fill with NaOH or wash or rinse instead of first two points…3]

(iv) Explain why an indicator is used during this experiment. **6**

to find end point / to find neutralisation point / to know how much HCl to use …6

(v) Give two safety precautions that the student should have followed while carrying out this experiment. **2×6**

wear gloves, wear goggles or eye protection, tie back hair, wear lab coat, use a pipette filler, etc

any two…2×6

The student recorded the following data:
Concentration of HCl solution = 1.15 M
Volume of NaOH solution used = 20 cm^3
Volume of HCl used = 22.9 cm^3

(vii) Copy, complete and balance the chemical equation for this experiment:

HCl + NaOH ⟶ ____ + ____ **2×3**

NaCl / sodium chloride …3

H_2O / water …3

(vii) Use the data to calculate the concentration of the sodium hydroxide solution. **3×3**

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

$\frac{22.9 \times 1.15}{1} = \frac{20.0 \times M_2}{1}$ / 20 M_2 …3

(M_2 =) 1.32 (mole/l) (1.3 – 1.32 (mole/l)) …3

[correct formula, incorrect substitution …6 max]

(viii) How could the student improve the accuracy of the experiment? **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

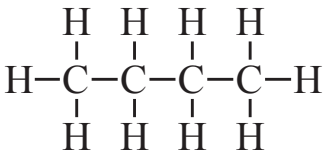
Figure 16 shows a cylinder containing butane (C_4H_{10}), which is the fourth member of a homologous series of hydrocarbons.

(i) What is meant by the underlined term? **2×3**
(compound of) hydrogen …3
and carbon (only) …3

(ii) Name the homologous series to which butane belongs. **6**
alkanes …6

(iii) State the first member of this homologous series. **6**
methane …6

(iv) Sketch the structural formula of butane. **2×3**



4 carbon atoms …3
10 hydrogen atoms …3

(v) Explain why butane is a *saturated* compound. **6**
no double (or triple) bonds / doesn't undergo addition reactions …6

(vi) Give one everyday use for butane. **6**
fuel …6

Butane burns in air according to the following chemical equation:

$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ $\Delta H = -5750$ kJ

(vii) Is this reaction *exothermic* or *endothermic*? Give a reason for your answer. **6, 3**
Exothermic …6
negative ΔH / combustion reactions produce heat …3

(viii) What is meant by the *heat of combustion* of a substance? **2×3**
heat produced or heat evolved or heat given out or heat change when a mole of a substance …3
is completely burned / burned in excess oxygen …3
[completely or excess oxygen or one mole omitted (–1)]

(ix) Calculate the heat of combustion of butane. **2×3**
$-5750 \div 2$ …3
-2875 (kJ mol^{-1}) …3

(x) How would you detect the presence of carbon dioxide? **9**
extinguishes a flame / increase in mass of NaOH / universal indicator changes colour, etc
any one …9

Question 12

Answer any two parts **2×33**

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

Magnesium reacts with bromine according to the following chemical equation:

$$Mg + Br_2 \rightarrow MgBr_2$$

Describe the appearance of (i) magnesium, **6**
grey or white / metal / solid …6

(ii) bromine, at room temperature. **6**
red / brown / liquid …6

Give one use of magnesium. **3**
fireworks, camera flash cubes, aircraft bodies, lightweight alloy, etc …3

If 48 g of magnesium were used in this reaction, calculate:
(i) the number of moles of magnesium used **2×3**
(A_r =) 24 …3
48 ÷ 24 = 2 (moles) …3
[0.5 (moles) (–3)]

(ii) the mass of nagnesium bromide produced **2×3**
(M_r =) 24 + 80 + 80 = 184 …3
184 × 2 = 368 (g) …3

(*b*) Hydrogen peroxide is used in the laboratory preparation of oxygen as shown in Figure 17.

What is the molecular formula for hydrogen peroxide? **3**
H_2O_2 …3

Describe the appearance of hydrogen peroxide at room temperature. **6**
colourless / solution / liquid …6

Identify solid A. **6**
MnO_2 / manganese dioxide / manganese oxide ...6

What is the purpose of solid A? **6**
catalyst …6

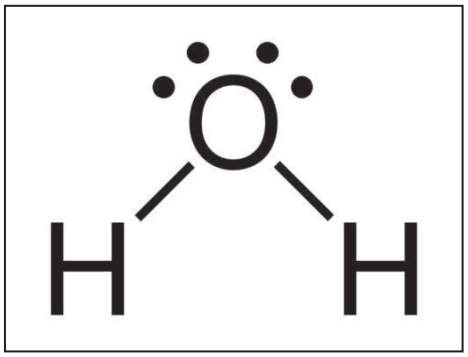
Describe a test for oxygen. **2×3**
relights …3
glowing splint …3

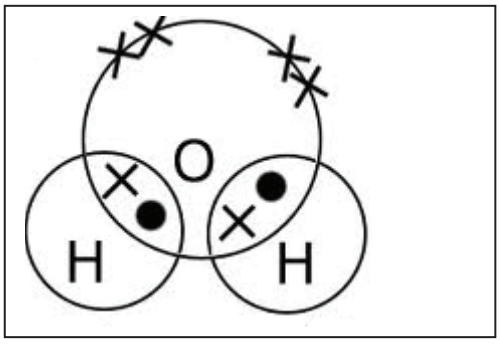
Give one commercial use oxygen. **6**
oxidising / steel making / rmedical use / respiration …6

(*c*) The shape of a molecule can be determined by using the number of lone pairs of electrons and the number of bonding pairs of electrons in the molecule.

What is meant by a 'lone pair of electrons'? **6**
(electrons) not involved in bonding …6

Sketch a diagram to show the arrangement of bonding pairs and lone pairs in a molecule of water (H_2O). **6, 3**





two OH covalent bonds indicated by a line or pair of dots or pair of crosses or a dot and a cross
two lone pairs on oxygen indicated by pair of dots

first correct…6, second correct..3

Copy and complete the following table: **6×3**

molecule	**number of bonding pairs**	**number of lone pairs**	**shape of molecule**
NH_3		1	
CH_4	4		
BeH_2			linear

molecule	**number of bonding pairs**	**number of lone pairs**	**shape of molecule**
NH_3	3		pyramidal or distorted tetrahedral
CH_4		0	tetrahedral
BeH_2	2	0	

each correct answer…3