



# **Coimisiún na Scrúduithe Stáit** **State Examinations Commission**

*Scéim Mharcála*

*Fisic agus Ceimic*

*Marking Scheme*

*Physics & Chemistry*

*Scrúdú na hArdteistiméireachta 2006*

*Gnáthleibhéal*

*Leaving Certificate Examination 2006*

*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 must appear in the correct context in the candidate's answer in order to merit the assigned marks.
2. Marks shown in brackets represent marks awarded for partial answers as indicated in the scheme.
3. Words, expressions or statements separated by a solidus, /, are alternatives which are equally acceptable.
4. Answers that are separated by a double solidus, //, are answers which are mutually exclusive. A partial answer from one side of the // may not be taken in conjunction with a partial answer from the other side.
5. The descriptions, methods and definitions in the scheme are not exhaustive and alternative valid answers are acceptable.
6. The context and the manner in which the question is asked and the number of marks assigned to the answer in the examination paper determine the detail required in any question. Therefore, in any instance, it may vary from year to year.
7. Where indicated deduct 1 mark for incorrect/no units.

## Question 1

(a) **What is meant by potential energy?**

energy due to // stored // example ...3

position // energy // ...3

[equation ...6]

(b) **A car has a mass of 950 kg. What force is needed to give it an acceleration of  $6 \text{ m s}^{-2}$ ?**

$F = ma / F = 950 \times 6$  ...3

5700 (N) ...3

(c) **Calculate the work done when a force of 5 N moves an object a distance of 3 m.**

$W = F \times d / W = 5 \times 3$  ...3

15 (J) ...3

(d) **What is meant by an ideal gas?**

obeys Boyle's law / gas laws / satisfies K.T. assumptions ...3

always / exactly / at all temperatures and pressures ...3

(e) **Give one use of a concave mirror.**

shaving (make-up) mirror / searchlights / floodlights /

torch / headlights / dentist / microscope etc. any one ...6

(f) **How would you show that white light is a mixture of colours?**

pass the light through ...3

a prism / diffraction grating / spectrometer ...3

[example ...3]

(g) **The diagram shows waves passing through a narrow opening. Name the phenomenon that takes place.**

diffraction ...6

[bending / spreading ...3]

(h) **Copy and complete the following statement: "In the photoelectric effect  
..... are released from the surface of a metal when ..... falls on it."**

electrons / charged particles / rays ...3

radiation (light) ...3

- (i) **Fig. 2 shows a 2  $\mu\text{F}$  capacitor connected in parallel with a 6  $\mu\text{F}$  capacitor. Calculate the effective capacitance of the combined capacitors.**  
 $C = C_1 + C_2 / C = 2 + 6$  ...3  
 8 ( $\mu\text{F}$ ) ...3
- (j) **State Ohm's law.**  
 voltage (V) // current (I) // resistance (R) ...3  
 $\alpha I / RI // V \div R // V \div I$  ...3
- (k) **Calculate the number of units (kW h) used by a 2 kW electric fire left on for 3 hours.**  
 $2 \times 3$  ...3  
 6 (kW h) ...3
- (l) **Draw a diagram showing the magnetic field pattern due to a current flowing in a straight conductor.**  
 conductor showing current ...3  
 circles (with arrows) ...3
- (m) **State one of the laws of electromagnetic induction.**  
 emf / current ...3  
 $\alpha$  change of magnetic flux / opposes the change ...3
- (n) **Who discovered the equation  $E = mc^2$  ?**  
 Einstein ...6
- (o) **Explain the term nuclear fission.**  
 nuclei / atoms / elements ...3  
 split up ...3  
 [example ...3]

## Question 2

### (a) Define (i) velocity

rate of change // change of displacement // speed //  $s \div$  ...3

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

### (ii) acceleration.

rate of change / change in velocity (speed) /  $\frac{v-u}{t}$  ...3

of velocity (speed) / w.r.t. time /  $t$  ...3

[  $F = ma$  / units ...3]

**An ostrich starting from rest reaches a speed of  $18 \text{ m s}^{-1}$  in 3 seconds.**

### Calculate (i) the acceleration of the ostrich

$$a = (v - u) \div t \quad / \quad a = (18 - 0) \div 3 \quad \dots 6$$

$$6 \text{ (m s}^{-2}\text{)} \quad \dots 3$$

### (ii) the distance covered by the ostrich in 3 second

$$s = ut + \frac{1}{2}at^2 \quad / \quad s = 0 + \frac{1}{2}(6)(3)^2 \quad \dots 6$$

$$27 \text{ (m)} \quad \dots 3$$

### (iii) the time taken for the ostrich to cover 20 m.

$$20 = 0 + \frac{1}{2}at^2 \quad / \quad 2.6 \text{ (s)} \quad \dots 3$$

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

momentum before /  $m_1u_1 + m_2u_2$  // total ...6

equals / = // momentum ...3

momentum after / =  $m_1v_1 + m_2v_2$  // remains constant ...3

[in a closed system ...3]

**Sphere B is at rest and sphere A is approaching it with a velocity of  $5 \text{ m s}^{-1}$ .**

**The mass of each sphere is 2 kg. After the collision both spheres move in the same direction and the velocity of sphere A is  $1.5 \text{ m s}^{-1}$ . Calculate**

### (i) the momentum of sphere A before the collision

$$p = m \times v \quad / \quad p = 2 \times 5 \quad \dots 3$$

$$10 \text{ (kg m s}^{-1}\text{)} \quad \dots 3$$

### (ii) the velocity of sphere B after the collision

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \quad / \quad (2)(5) + 0 = (2)(1.5) + (2)v_2 \quad \dots 3$$

$$3.5 \text{ (m s}^{-1}\text{)} \quad \dots 3$$

### (iii) the momentum of sphere B after the collision.

$$P = (2)(3.5) \quad / \quad 7 \text{ (kg m s}^{-1}\text{)} \quad \dots 3$$

**What type of energy is lost by sphere A in the collision?**

kinetic / heat / sound ...6

### Question 3

#### State the laws of refraction of light.

- I incident ray, normal, refracted ray ...3  
on the same plane ...3
- II  $\sin i$  ...3  
 $\propto \sin r$  ...3  
[ $\sin i \div \sin r \dots 3$ ]

#### Copy the diagram and label (i) the angle of incidence $i$ , (ii) the angle of refraction $r$ .

- first angle correct ...6  
second angle correct ...3  
[correct rays indicated ...3]

#### Describe an experiment to show how a ray of light passes through a glass block.

- draw the outline of the glass block  
mark incident ray  
mark emergent ray  
remove the glass block  
draw the incident ray  
draw the emergent ray  
join the incident and emergent rays 1<sup>st</sup> correct point ...6  
two additional points ...2×3

#### Calculate the refractive index of the glass.

- $n = \sin i \div \sin r / = (\sin 30^\circ) \div (\sin 19^\circ) / = (0.5) \div (0.3256) \dots 6$   
1.5 ...3

#### Name the type of lens shown.

- convex / converging ...3

#### Copy and complete the diagram showing the paths of the rays after they pass through the lens.

- show rays bending as they pass through the lens ...3  
show rays meeting at a point ...3

#### Give one use of this type of lens.

- camera / telescope / microscope / spectacles etc any one ...6  
[use of curved mirror ...3]

#### Draw a ray diagram showing how a lens can form a magnified image.

- lens ...3  
object ...3  
two correct rays ...3

#### Question 4

(a) State Boyle's law.

fixed mass / constant temperature /

pressure

$$// pV // p_1V_1$$

inversely proportional to volume ( $\propto 1/V$ )  $// = k // = p_2V_2$

any three ...3×3

**Describe an experiment to verify Boyle's law.**

Apparatus: pressure gauge // J tube

pump / plunger // mercury

enclosed volume of air

any two ...2×3

Method: correct arrangement

read pressure (p)

read volume (V)

vary pressure

repeat (for different values) // any valid precaution

any three ...3×3

**The balloon contains 2 m<sup>3</sup> of helium gas when the pressure is 100 kPa. The balloon reaches a height where the pressure is 50 kPa. Calculate the volume of the balloon at this height.**

$$p_1V_1 = p_2V_2 / 100 \times 2 = 50 \times V_2 \quad \dots 3$$

$$4 \text{ (m}^3\text{)} \quad \dots 3$$

[1 m<sup>3</sup> ...3]

**What happens to the volume of the balloon as it continues to rise?**

increases

3

(b) **“Two fixed points and a thermometric property are needed to set up a temperature scale.” Explain the underlined terms.**

freezing and boiling points

...3

changes

...3

with temperature (heat)

...3

**What are the values of the fixed points on the Celsius scale?**

0°C ...3

100°C ...3

**Give one example of a thermometric property.**

length / emf (voltage) / colour / volume / pressure/ resistance etc.

any one ...6

**Describe an experiment to mark the position of the lower fixed point on a mercury thermometer.**

Apparatus: mercury thermometer / beaker / ice

any two ...2×3

Method: place thermometer in ice

wait until mercury has stopped moving

mark the position of the mercury

any two ...2×3

[steam point ...(-3)]

## Question 5

(a) Copy and complete the following statement of *Coulomb's law*:

“The force between two point charges is directly proportional to the . . . . . of the charges and inversely proportional to the . . . . . of the . . . . . between them.”

product

square

distance

1<sup>st</sup> correct ...6

remaining two ...2×3

**Draw a labelled diagram of a gold leaf electroscope.**

cap / leaves / case / metal rod / insulating plug

1<sup>st</sup> correct ..6

two additional parts ...3

[no labels (-1)]

**Give one use for a gold leaf electroscope.**

detect charge / show size (type) of the charge / measure p.d. /

test if an object is an insulator or conductor etc.

...6

**Name a suitable material for the handle. What will be observed as the charged disc brought close to an uncharged electroscope?**

any named insulator e.g wood / plastic etc.

leaves will separate (rise)

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

(b) “An electric current is a flow of charge in a circuit.” Give two ways of increasing the current in a circuit.

reduce the resistance / adjust the rheostat

increase the p.d.

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

**Name a device used to measure electric current.**

ammeter

...3

**In diagram A the resistors are arranged *in series*.**

**How are the resistors arranged in diagram B?**

parallel

...9

**Calculate the effective resistance of the combined resistors.**

one correct equation / substitution

...6

(i) **A**  $R = R_1 + R_2$  /  $R = 6 + 12$

(ii) **B**  $1/R = 1/R_1 + 1/R_2$  /  $1/R = 1/6 + 1/12$

18 (ohms)

...3

4 (ohms)

...3

[18 (ohms) only ...6]



## Question 6

(a) Describe an experiment to measure the acceleration due to gravity,  $g$ .

apparatus: pendulum / string / stand / cork / ruler / timer //  
electromagnet / ball / stand / ruler / timer  
1<sup>st</sup> correct ...6  
two additional parts ...2×3

method: arrangement of apparatus  
set the pendulum swinging // release the ball  
measure the length / height  
time the oscillations // time for ball to fall  
correct equation  
any three ...3×3

What do the symbols  $G$ ,  $M$  and  $r$  stand for?

Gravitation constant  
mass  
distance / radius  
1<sup>st</sup> correct ...6  
remainder ...2×3

(b) The diagram shows part of the electromagnetic spectrum in order of increasing wavelength. Explain the underlined term.

distance ...3  
between two crests ( troughs) ...3

Give two properties common to all regions of the electromagnetic spectrum.

speed / reflection / refraction / polarisation / diffraction / interference, etc  
1<sup>st</sup> correct ...9  
2<sup>nd</sup> correct ...3

Name the regions labelled (i) A, (ii) B.

(i) ultra violet (ii) infra red  
1<sup>st</sup> correct ...6  
2<sup>nd</sup> correct ...3  
[reverse order ...3]

How would you detect the radiation found at A?

causes substances to fluoresce / effects photographic plates /  
causes sunburn / causes photoemission etc  
any one ...6

**Question 6 (continued)**

**(c) What is meant by a.c.?**

alternating ...3  
current ...3

**The diagram shows a transformer which converts a 230 V a.c. supply into 4600 V a.c. Name the parts labelled A, B, C.**

(i) **A** primary

(ii) **B** core/ frame / structure

(iii) **C** secondary

1<sup>st</sup> correct ...6  
remaining two ...3

[coil for A / C...3]

**If part A has 1500 turns calculate the number of turns on part C.**

$N_s/N_p = V_s/V_p$  /  $N_s/4600 = 1500/230$  ...6  
30 000 ...3

**Name one device that uses a transformer.**

battery charger / TV etc ...6

**Why does a transformer become warm during use?**

energy / eddy currents / heat etc. ...3

**(d) “Ionisation can be caused by the radiations emitted from radioactive substances.”**

**Explain the underlined terms.**

loss of // formation ...3

electrons // of ions ...3

decay (disintegration ) ...3

of nuclei (atoms) ...3

**Name the radiation emitted from radioactive substances which causes the greatest amount of ionisation? Give one other property of this radiation.**

alpha

low penetrating power / helium nucleus / charge of +2 etc 1<sup>st</sup> correct ...6  
2<sup>nd</sup> correct ...3

**Give two uses for radioactive substances.**

medical / cancer / carbon dating / detecting leaks / smoke detectors etc  
1<sup>st</sup> correct ...9  
2<sup>nd</sup> correct ...3

## QUESTION 7

(a) **What is an isotope?**

same number of protons/ same atomic number/ atoms of the same element ...3

different number of neutrons / different mass number ...3

[reverse ...3]

(b) **Name the two elements found in a molecule of methane.**

carbon ...3

hydrogen ...3

(c) **In the equation  $E = hf$ , what does  $f$  represent?**

frequency ...6

(d) **Name the type of bonding which exists between the particles in a salt crystal.**

ionic ...6

[chemical ...3]

(e) **Define electronegativity.**

attraction // EN difference ...3

for electrons //  $> 1.7$  ...3

[determines the type of bond formed ...3]

(f) **Calculate the percentage of carbon by mass in methanol ( $\text{CH}_3\text{OH}$ ).**

$M_r = 12 + 4 + 16 / M_r = 32$  ...3

$\% \text{ C} = 37.5$  ...3

(g) **What is meant by an *endothermic reaction*?**

heat/ energy //  $\Delta H$  ...3

taken in // negative ...3

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

heat change ...3

independent of the path ...3

(i) **Give one example of a *weak acid*.**

vinegar / ethanoic (acetic) acid / carbonic acid / organic acid etc. ...6

[definition / orange (lemon) juice ...3]

(j) **Calculate the pH of a 0.01 M solution of hydrochloric acid (HCl).**

$\text{pH} = -\log_{10}[\text{H}^+] / \text{pH} = -\log_{10}[0.01]$  ...3

2 ...3

- (k) List the following elements in their order in the electrochemical series.  
potassium zinc copper ...6  
[reverse / any one correct ...3]
- (l) Give **two** uses of *electrolysis*.  
electroplating / extraction of metals / purification of metals /  
anodising / manufacture of chemicals etc any two ...2×3
- (m) The relative molecular mass of oxygen gas ( $O_2$ ) is 32.  
Calculate the number of molecules in 64 g of oxygen gas.  
2 moles ...3  
 $12 \times 10^{23}$  molecules ...3
- (n) Give **one** example of a neutral oxide.  
carbon / nitrogen // dinitrogen ...3  
monoxide // oxide ...3
- (o) Give **one** example of an aromatic compound.  
benzene / methylbenzene (toluene) / phenol / benzoic acid /  
benzaldehyde etc. any one ...6

## Question 8

**Sketch the shape of (i) an s-orbital, (ii) a p-orbital.**

(i) spherical shape (shown / stated)

(ii) dumb-bell shape (shown / stated)

1<sup>st</sup> correct ...9

2<sup>nd</sup> correct ...3

[reverse ...6]

**Name two other subatomic particles.**

proton

neutron

1<sup>st</sup> correct ...9

2<sup>nd</sup> correct ...3

**Give the electronic (s, p) configuration of (i) neon, (ii) chlorine.**

(i)  $1s^2$

$2s^2 2p^6$

(ii)  $1s^2 2s^2$

$2p^6 3s^2 3p^5$

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

[any two parts correct ...2×3]

**Will the element neon form a bond with other elements?**

**Give one reason for your answer.**

No

...3

it has a full outer shell / all valencies are satisfied / stable / inert gas / noble gas ...3

**Name the type of bond in a molecule of chlorine.**

covalent

...3

**Give two properties of this type of bond.**

liquids or gases / poor conductors of heat / poor conductors of electricity /

insoluble in water / slower reactions / shares electrons / weak bond etc. 1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

**Draw a diagram showing how this bond is formed in a molecule of chlorine.**

two atoms

...3

one pair of shared electrons / single bond

...3

**Give (i) the formula for the chloride of carbon**

**(ii) the shape of a molecule of the chloride of carbon.**

(i)  $CCl_4$

(ii) tetrahedral

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

### Question 9

Define (i) a base, (ii) a conjugate acid-base pair, using the Brønsted-Lowry theory.

- (i) proton // pH between 7 - 14 // high pH ...6  
acceptor ...3  
[example not in the question ...3]
- (ii) acid and a base (two species) which differ by a proton /  
example not in the question ...3

Identify two bases and one acid-base pair in the following reaction:



bases: H<sub>2</sub>O and HSO<sub>4</sub><sup>-</sup>

conjugate pairs: H<sub>2</sub>SO<sub>4</sub> and HSO<sub>4</sub><sup>-</sup> / H<sub>2</sub>O and H<sub>3</sub>O<sup>+</sup> 1<sup>st</sup> correct ...9  
2<sup>nd</sup> correct ...6  
3<sup>rd</sup> correct ...3

Water is an amphoteric substance. Explain the underlined term.

acts as an acid ...3  
or a base ...3

Give the chemical formula for an oxide of each of these elements.

**sodium          magnesium          sulphur**

Na<sub>2</sub>O / Na<sub>2</sub>O<sub>2</sub>

MgO

SO<sub>2</sub> / SO<sub>3</sub> 1<sup>st</sup> correct ...6  
remaining two ...3

From these oxides, name (i) an acidic oxide, (ii) a basic oxide.

(i) SO<sub>2</sub> / SO<sub>3</sub>  
(ii) Na<sub>2</sub>O / Na<sub>2</sub>O<sub>2</sub> / MgO 1<sup>st</sup> correct ...9  
2<sup>nd</sup> correct ...3

[reverse order ...6]

Describe a test to find out if an oxide is acidic or basic.

add indicator  
observe colour change 1<sup>st</sup> correct ...6  
2<sup>nd</sup> correct ...3

## Question 10

In a titration, a student used a standard solution of hydrochloric acid (HCl) to find the concentration of a potassium hydroxide (KOH) solution. Explain the underlined terms.

*s. solution*: molarity / concentration

known

*conc*: amount / moles / grams present

1<sup>st</sup> correct ...6

remainder ...2×3

Name the pieces of glassware labelled (i) A, (ii) B.

burette / tap funnel

pipette

1<sup>st</sup> correct ...9

2<sup>nd</sup> correct ...3

[reverse order ...6]

Describe the procedure used in preparing A to hold the acid.

place in (retort) stand / wash with water / wash with acid /

close the tap / fill (using a funnel) etc

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

Explain how 20 cm<sup>3</sup> portions of the potassium hydroxide solution can be accurately measured out.

pipette filler / fill pipette with base / no air bubbles /

meniscus / level with the mark /

allow base to run into flask /

don't blow out the last drop etc.

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

Why is an indicator used in a titration?

show end-point / show point of neutralisation etc

...3

Name a suitable indicator for this titration.

a named indicator

...6

Give one precaution taken to improve the accuracy of the titration.

add the acid slowly (drop-wise) / white tile /

swirl the flask / read bottom of the meniscus /

wash sides of flask / three accurate titrations /

rinse pipette with water (base)

any one ...6

[rough titre ...3]

Calculate the molarity of the potassium hydroxide solution.

$$\frac{V_1 \times M_1}{n_1} \quad / \quad \frac{17.5 \times 0.15}{1} \quad \dots 3$$

$$\frac{V_2 \times M_2}{n_2} \quad / \quad \frac{20 \times M_2}{1} \quad \dots 3$$

$$M_2 = 0.13 \text{ (M / moles per litre (dm}^3\text{))} \quad \dots 3$$

### Question 11

The gas ethyne (acetylene) (C<sub>2</sub>H<sub>2</sub>) is an unsaturated hydrocarbon.  
Explain the underlined terms.

*unsaturated*: double / triple ...3  
bonds ...3  
[not all valencies satisfied ...3]

*hydrocarbon*: carbon ...3  
hydrogen compound (only) ...3  
[named example ...3]

**Describe a chemical test to show that ethyne is unsaturated.**

decolourises  
bromine / potassium permanganate 1<sup>st</sup> correct ...9  
2<sup>nd</sup> correct ...3

**Draw the structural formula of ethyne (C<sub>2</sub>H<sub>2</sub>).**

correct functional group  
H's attached (implied) 1<sup>st</sup> correct ...6  
2<sup>nd</sup> correct ...3

**Name the homologous series to which ethyne belongs.**

alkynes ...6

**Name another homologous series of 'unsaturated hydrocarbons'.**

alkenes / aromatic ...6  
[saturated organic compound ...3]

**Carbon dioxide is produced when ethyne reacts with oxygen.  
Name the other substance produced during this reaction.**

water ...6

**Write an equation to show this reaction.**

C<sub>2</sub>H<sub>2</sub> + O<sub>2</sub> = CO<sub>2</sub> + H<sub>2</sub>O ...6  
[any one correct ...3]

**Describe a test for the presence of carbon dioxide gas.**

limewater  
turns milky 1<sup>st</sup> correct ...6  
2<sup>nd</sup> correct ...3



## Question 12

**(a) Define (i) oxidation, (ii) reduction, in terms of electron transfer.**

(i) loss

(ii) gain

1<sup>st</sup> correct ...6

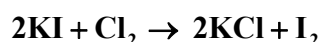
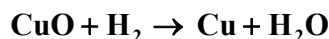
2<sup>nd</sup> correct ...3

of electrons

...3

[reverse order ...9: gain / loss of oxygen ...3]

**State the substance oxidised in each the following reactions:**



hydrogen

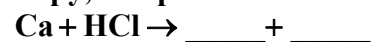
KI

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

[reverse ...6]

**Copy, complete and balance the following reaction of calcium with hydrochloric acid:**



CaCl<sub>2</sub>

H<sub>2</sub>

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

[incorrect subscript / not balanced (-1)]

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

HCl

3

**(b) What is the purpose of a catalyst?**

alters

...3

the rate of the reaction

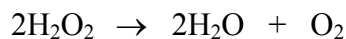
...3

**Name a suitable catalyst for this reaction.**

manganese dioxide

...6

**Write a balanced equation for the reaction.**



any one part correct ...6

remainder ...3

**How would you identify the gas produced?**

relights

glowing splint

1<sup>st</sup> correct ...6

2<sup>nd</sup> correct ...3

**Give one use for the gas produced.**

hospitals / mountain climbing / diving etc

...3

## Question12 (continued)

(c) Define heat of combustion.

heat change

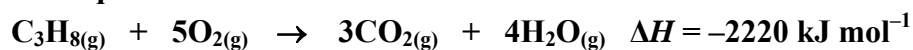
one mole

burned

1<sup>st</sup> correct ...6

remainder ...3

**Propane (C<sub>3</sub>H<sub>8</sub>) is a gas used as a camping fuel. Propane burns in air and the equation for the reaction is:**



**Calculate:(i) the quantity of heat released in the combustion of *two* moles of propane**

2×2220 / 4440

**(ii) the number of moles of oxygen needed for the combustion of *two* moles of propane**

2×5 / 10

**(iii) the quantity of heat released in the combustion of 22 g of propane.**

1110

[M<sub>r</sub> = 44 / 0.5 mole ...6]

1<sup>st</sup> correct ...12

2<sup>nd</sup> correct ...9

remainder ...3