Coimisiún na Scrúduithe Stáit
State Examinations Commission

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Fisic *Gnáthleibhéal*

Marking Scheme *Leaving Certificate Examination, 2005*

Physics *Ordinary Level*

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Leaving Certificate

2005

Physics – Ordinary Level

Marking Scheme

Introduction

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.

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.

Section A

Three questions to be answered.

Question 1 40 marks

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

labelled diagram to show

trolley and runway // rider and air track 3

timer device e.g. tickertimer / photogates (and timer) / powdertrack / motion sensor 3

means of applying force e.g. weights / elastic bands / (newton) balance 3

NOTE: no labels, deduct 2

Outline how the student measured the applied force **6 or 3**

used newton weights, weight in correct context, (force) sensor,

(electronic) balance / *mg* any one 6

partial answer e.g. mentions newtons or mass in the pan (3)

Plot a graph on graph paper of the acceleration against the applied force **4 × 3**

label axes correctly, (name / symbol / unit acceptable) 3

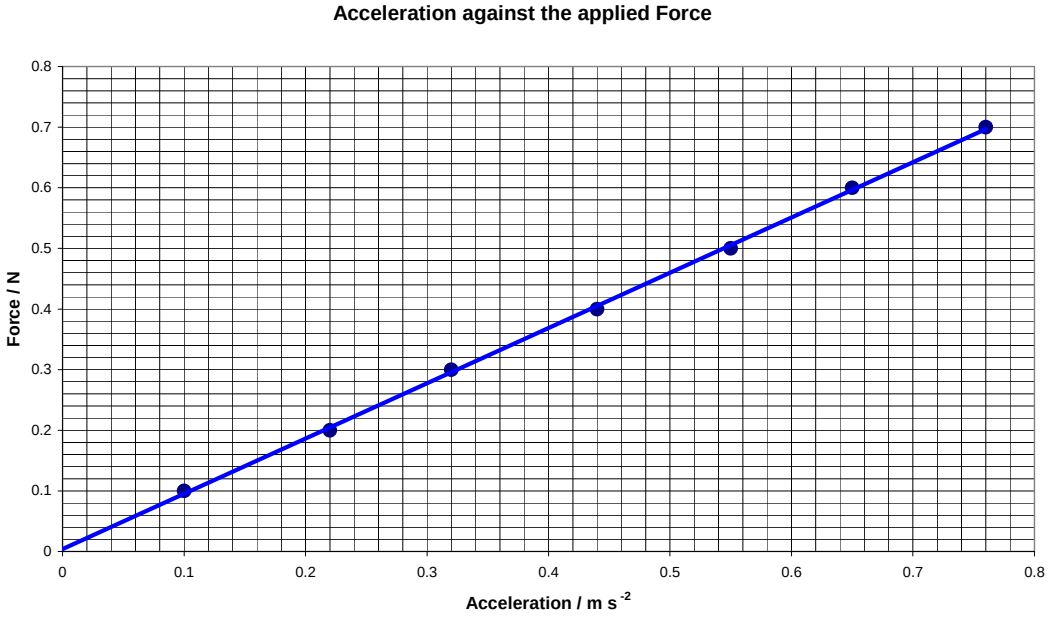
plot three points correctly 3

plot another three points correctly 3

straight line 3

if graph paper is not used, maximum mark 3 × 3

if acceleration is on the Y-axis, maximum mark 3 × 3



Calculate the slope of your graph and hence determine the mass of the body **3 × 3**

answer e.g. (m =) 0.8 -1.0 (kg) or value consistent with the graph 3 × 3

correct substitution into slope formula (2 × 3)

slope formula // two points highlighted on the graph (3)

Give one precaution that the student took during the experiment **4 or 2**

any valid specific precaution e.g. oil the trolley wheels, dust the runway,

oil pulley, tilt the runway / level the air track, etc. any one 4

partial answer (2)

Question 2 40 marks

In a report of an experiment to measure the specific latent heat of vaporisation of water

"Steam at 100 ^{o}C was added to cold water in a calorimeter.

When the steam had condensed, measurements were taken.

The specific latent heat of vaporisation of water was then calculated."

Draw a labelled diagram of the apparatus used **6 + 2 × 3**

labelled diagram to show

water in a calorimeter 6

thermometer / temperature sensor 3

insulation / stirrer / steam generator / steam delivery tube 3

incorrect experiment, maximum mark 6 + 3

NOTE: no labels, deduct 2

List two measurements that the student took before adding the steam to the water **6 + 3**

mass calorimeter, mass calorimeter + water / mass water,
initial temperature of water, initial temperature of steam any two 6 + 3
any one (6)

How did the student find the mass of steam that was added to the water? **3 × 3**

final mass water (+ calorimeter) 3
minus 3
initial mass water (+ calorimeter) 3

How did the student make sure that only steam, and not hot water, was added to the calorimeter? **2 × 3**

slope delivery tube // insulate 3
back to steam generator / away from calorimeter // delivery tube 3
allow steam to flow for some time before inserting into water (2 × 3)
steam trap (2 × 3)
answer may be implied from the diagram

Give one precaution that the student took to prevent heat loss **4 or 2**

lagging, insulation, lid, carry out measurements quickly any one 4
partial answer (2)

the precaution can be implied from the diagram if it has not already been awarded marks

Question 3 40 marks

Draw a labelled diagram of the apparatus that you used in the experiment **6 + 2 × 3**

converging lens 6

object e.g. pin, raybox, crosswires, slit, bulb (filament)
screen // pin for no parallax
metre stick

any two lines 2 × 3

NOTE: no labels, deduct 2

Describe how you found the position of the image formed by the lens **2 × 3**

moved the screen/object /lens 3
until there was a clear image // no parallax 3
partial answer e.g. reference to movement (3)

What measurements did you take? **6 + 3**

distance from object to the lens // u
distance from the screen/ image to the lens // v

two correct 6 + 3
any one (6)

transpose of u and v, maximum 6

How did you get a value for the focal length from your measurements? **3 × 3**

$f =$	$// \frac{1}{f} =$	// substitute	3
uv	$// \frac{1}{u}$	// values	3
$\frac{1}{u+v}$	$// \frac{1}{v}$	// into the equation / formula	3

partial answer e.g. from the graph (3)

Give one precaution that you took to get an accurate result **4 or 2**

one specific precaution e.g. ensure that the crosshairs are in focus, repeat and find the average, avoid error of parallax, etc. 4
partial answer e.g. repeat the experiment (2)

Question 4 40 marks

In an experiment to measure the resistivity of the material of a wire a student measured the length, diameter and the resistance of a sample of nichrome wire.

(i) Describe how the student measured the resistance of the wire **6 or 3**

ohmmeter / multimeter 6

reference to measuring voltage / V e.g. voltmeter or current / I (3)

(ii) Name the instrument used to measure the diameter of the wire **6 or 3**

micrometer 6

(vernier) callipers (3)

Why did the student measure the diameter in three different places? **6 or 3**

(wire / diameter) not uniform / to calculate an average diameter 6

partial answer (3)

(iii) Using the data, calculate the diameter of the wire **2 × 3**

0.20 (mm) // 0.60 ÷ 3 2 × 3

partial answer e.g. 0.19, 0.21 // 0.19 + 0.20 + 0.21 (3)

Hence calculate the cross-sectional area of the wire ($A = \pi r^2$) **2 × 3**

$A = 3.14 \times 10^{-8}$ (m^2) // answer consistent with above 2 × 3

$A = \pi (0.0002)^2$ / $A = 1.26 \times 10^{-7}$ (3)

r = 0.1 (mm) / 0.0001 (m) (3)

(iv) Calculate the resistivity of nichrome using the formula $\rho = \frac{RA}{L}$. **2 × 3**

$\rho = 1.21 \times 10^{-6} / (26.4)(3.14 \times 10^{-8}) \div 0.685$ (Ω m) // answer consistent with A 2 × 3

partial answer e.g. two quantities correctly substituted into the equation (3)

(v) Give one precaution when measuring the length of the wire **4 or 2**

avoid parallax error when using metre stick, keep wire straight (no kinks**)**,

measure only the length of wire between leads to ohmmeter, etc. any one 4

partial answer (2)

SECTION B (280 Marks)

Five questions to be answered

Question 5 any *eight* parts 56 marks

Take the best 8 from 10 parts

(a) **State the principle of conservation of momentum** **7 or 4**

momentum before = momentum after // $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$ 7

(total) momentum is conserved (7)

partial answer e.g. incomplete equation, in a closed system (4)

(b) **What is the acceleration?** **7 or 4**

(a =) 4 (m s^{-2}) 7

partial answer e.g. two values correctly substituted into equation, definition of acceleration (4)

(c) **Which of the following is the unit of power?** **7 or 4**

watt 7

joule (4)

(d) **Name two methods by which heat can be transferred** **7 or 4**

conduction, convection, radiation, valid examples any two 7

any one (4)

(e) **Calculate the speed of the wave** **7 or 4**

(c) = 1000 (m s^{-1}) 7

40 (m s^{-1}) (4)

(f) **Name two other radiations that are part of the electromagnetic spectrum** **7 or 4**

radiowaves, microwaves / radar, infrared, (visible) light, ultraviolet, gamma rays, X-rays any two 7

any one of the above or any named light colour (4)

(g) **Name the electrical component used in the diagram** **7 or 4**

diode, accept LED, p-n (junction) 7

partial answer e.g. semiconductor, transistor (4)

(h) **Name two safety devices that are used in domestic electric circuits** **7 or 4**

fuse, trip switch / miniature circuit breaker / MCB, residual current device / RCD, earthing, bonding, etc. any two 7

any one (4)

(i) **What is the photoelectric effect** **7 or 4**

(emission of) electrons due to light / radiation 7

partial answer (4)

(j) **Name a material used as shielding in a nuclear reactor** **7 or 4**

lead / concrete 7

partial answer e.g. metal (4)

Question 6 56 marks

Define pressure and give the unit of pressure **3 × 3 + 3**

force / *F* 3
per / divided by 3
unit area / *A* 3

N m^{-2} / Pascal / Pa, bar, etc. 3

Name an instrument used to measure pressure **5 or 3**

(pressure) gauge, (bourdon) gauge, manometer, pressure sensor, barometer any one 5
partial answer (3)

What holds this layer of air close to the Earth? **6 or 3**

gravity / gravitational force / weight 6
partial answer e.g. mass (3)

Describe an experiment to show that the atmosphere exerts pressure **4 × 3**

apparatus: can (containing water) // can (of air) // glass of water 3

procedure: boil water in can // pump // cardboard / lid 3
seal / invert in cold water // air out // invert 3

observation/conclusion: can crushes / collapses // lid supported 3

labelled diagram may merit marks
accept valid alternatives

Describe the kind of weather we get when the atmospheric pressure is high **6 or 3**

dry, good, clear skies, little wind, settled / calm, etc. any one 6
partial answer (3)

An elephant weighs 40 000 N and is standing on all four feet each of area 0.2 m^2

Calculate the pressure exerted on the ground by the elephant **3 × 3**

50 000 (Pa) 3 × 3
correctly substituted equation e.g. 10 000 ÷ 0.2 / 40 000 ÷ 0.8 (2 × 3)
partial answer (3)

Why would the pressure on the ground be greater if the elephant stood up on just two feet? **2 × 3**

area / *A* 3
less / smaller 3
partial answer (3)

Question 7 **56 marks**

What is meant by the reflection of light? **2 × 3**

sending back / returning /bouncing (of light) 3
from a mirror / (shiny) surface 3
a diagram may merit full marks

State the laws of reflection of light **6 + 3**

incident ray, normal, reflected ray are in the same plane
angle of incidence is equal to the angle of reflection // $i = r$ two lines 6+3
one line (6)

Describe an experiment to show demonstrate one of the laws of reflection **4 × 3**

apparatus: raybox // drawing pins 3
mirror 3

procedure: mark the position of the rays / pins / measure i and r 3

observation/conclusion: $i = r$ / incident ray, normal and reflected ray in same plane 3

accept valid alternatives
a labelled diagram may merit full marks

Explain what is meant by refraction **2 × 3**

bending /change of direction / velocity (of light waves) 3
at surface / boundary // as it passes from one medium to the other 3

What special name is given to the angle of incidence *i* ? **6 or 3**

critical (angle) / c 6
definition of critical angle without naming it (3)

Calculate a value for the refractive index of the glass **6 or 3**

(n =) 1.5 // $\frac{1}{0.67}$ 6

partial answer e.g. Sin 41.8° / 0.67 (3)
(C in grad. n =) 1.64 // (C in rad. N =) 1.22 (6-1)

Draw a diagram to show what happens when *i* is increased to 45° **6 or 3**

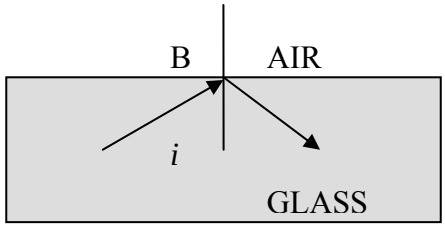


diagram showing ray reflected at boundary 6
partial answer (3)

Give one application of the effect **5 or 3**

optic fibres / telecommunications, binoculars / periscope, medicine / endoscope /
correct specific ornament /correct specific toy, etc. any one 5
partial answer e.g. toys, ornaments, prisms, phones, situation where refraction occurs (3)

Question 8 56 marks

State Ohm's Law. **3× 3**
voltage / pd / V 3
proportional to / $\propto$ / $= R$ 3
current / I 3
partial answer e.g. when the temperature is kept constant, (3)

Which conductor obeys Ohm's law? Explain your answer **6 + 2 × 3**
graph *(a)* / metal 6
straight line 3
through origin // shows proportionality 3

Calculate, **3(2× 3)**

(i) the total resistance of the circuit
600 (Ω) 2× 3
100 + 500 (3)

(ii) the current flowing in the circuit
0.01 (A) 2× 3
$6 \div 600$ / $I = \frac{V}{R}$ or variation thereof (3)

(iii) the potential difference across the 100 Ω resistor
1 (V) 2× 3
partial answer e.g. mention of $\frac{1}{6}$, mention of ratio 5:1 (3)

As the thermistor is heated, what happens to **2(6 or 3)**

(iv) the resistance of the circuit?
decreases / increases 6
partial answer e.g. varies, indication of change in resistance (3)

(v) the potential difference across the 100 Ω resistor?
answer consistent with (iv) 6
partial answer e.g. varies, indication of change in the voltage (3)

Give a use for a thermistor **5**
thermometer / heat sensor / temperature control / circuit control 5
partial answer e.g. change the resistance/voltage in circuits (3)

Question 9 56 marks

What is a magnetic field? **2 × 3**

region (where) / space 3
magnetism is experienced // force is detected 3

Draw a sketch of the magnetic field around a bar magnet **6 + 3**

diagram to show

magnet

two field lines
correct direction on field lines any two 6 + 3

any one (6)

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

apparatus: power supply/ battery / voltage, conductor, magnet any two 2 × 3
any one (3)

procedure: set up the circuit / turn on the power supply / current 3

observation / conclusion: conductor moves / conductor deflects 3

accept valid alternatives

a labelled diagram may merit marks

State two factors on which the size of this force depends **2 × 3**
current / *I*, strength of magnetic field / *B*, length of conductor / *l*, angle / θ any two 2 × 3
any one (3)

accept voltage / resistance for current

What is observed when the magnet is moving towards the coil? **2 × 3**
needle / pointer / galvanometer // current 3
deflects // induced 3

Explain why this occurs **6 or 3**
emf / voltage / current / electromagnetic induction 6
partial answer (3)

Describe what happens when the speed of the magnet is increased **2 × 3**
deflection / emf / current 3
greater / faster 3

Give one application of the effect shown in the diagram **5**
dynamo, generator, induction motor, induction cooker, etc. any one 5

Question 10 56 marks

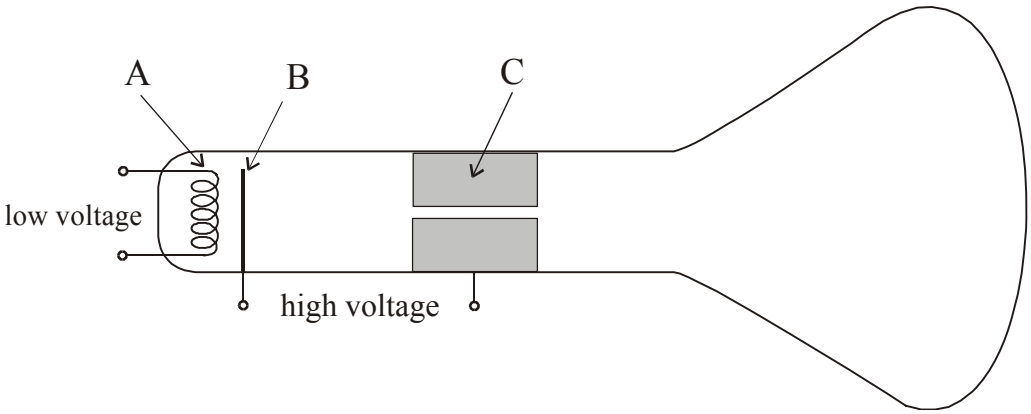
Give two properties of the electron **6 + 3**

negative, small mass, orbits/outside nucleus, no internal structure, lepton — any two 6 + 3; any one (6)

Name another sub atomic particle **3**

proton, neutron, positron, muon, baryon, any other correct "particle zoo" particle — 3

Name the parts labelled A, B and C **6 + 2 × 3**



A = (heating) filament/coil, B = cathode, C = anode — 6 + 2 × 3

any two correct — (6 + 3)

any one correct — (6)

correct names mismatched deduct 3

gives the function of two or more instead of naming maximum 6

(i) Explain how the electrons are emitted from A **6 + 3**

current

heats (filament electrons emitted) — two lines 6 + 3; one line (6)

thermionic emission — (6 + 3)

(ii) What causes the electrons to be accelerated across the tube? **2 × 3**

high / positive / anode — 3

voltage — 3

(iii) What happens when the electrons hit the screen? **6 or 3**

light (is emitted) — 6

partial answer — (3)

(iv) How can a beam of electrons be deflected? **2 × 3**

electric / magnetic // X / Y / + / - — 3

field // plates — 3

(v) Give one use of a cathode ray tube **5 or 3**

TV / CRO / monitor / ECG — 5

partial answer — (3)

Question 11 56 marks

Read the following passage and answer the accompanying questions.

> There are different forms of energy. Fuels such as coal, oil and wood contain chemical energy. When these fuels are burnt, the chemical energy changes into heat and light energy. Electricity is the most important form of energy in the industrialised world, because it can be transported over long distances via cables. It is produced by converting the chemical energy from coal, oil or natural gas in power stations.
>
> In a hydroelectric power station the potential energy of a height of water is released as the water flows through a turbine, generating electricity.
>
> Energy sources fall into two broad groups: renewable and non-renewable. Renewable energy sources are those which replenish themselves naturally and will always be available – hydroelectric power, solar energy, wind and wave power, tidal energy and geothermal energy. Non-renewable energy sources are those of which there are limited supplies and once used are gone forever. These include coal, oil, natural gas and uranium.
>
> (Adapted from the Hutchinson Encyclopaedia of Science, 1998).

(a) Define energy **7 or 4**

ability to do work — two lines 7; one line (4)

partial answer e.g. valid energy equation, states the law of conservation of energy (4)

(b) What energy conversion takes place when a fuel is burnt? **7 or 4**

chemical to heat / light — two lines 7; one line (4)

(c) Name one method of producing electricity **7 or 4**

solar, wind, wave, tidal, biomass, coal, oil, gas, hydroelectricity, geothermal, nuclear, uranium, turf, etc. — any one 7

partial answer e.g.: mention of generator / dynamo / power station /dams (4)

(d) Name one factor on which the potential energy of a body depends **7 or 4**

mass / m / weight, height / h, acceleration due to gravity / g — any one 7

partial answer e.g. gravity, position, condition (of object), example of potential energy, etc. (4)

(e) What type of energy is associated with wind, waves and moving water? **7**

mechanical, kinetic / E_k, renewable 7

(f) Give one disadvantage of non-renewable energy sources **7 or 4**

running out / won't be available for future generations, pollution 7

partial answer (4)

(g) How does the Sun produce heat and light? **7 or 4**

nuclear reactions / fusion / $E = mc^2$ 7

partial answer e.g. reference to mass, radioactivity, fission, hydrogen, burning gases (4)

(h) In Einstein's equation $E = mc^2$, what does c represent? **7 or 4**

speed of light / 3×10^8 7

partial answer e.g. speed (4)

Question 12 56 marks

Part (a)

What does a thermometer measure?		**6 or 3**
temperature / hotness		6
heat		(3)
What are the two fixed points on the Celsius scale?		**2 × 3**
melting point ice / 0 (°)		3
boiling point water / 100 (°)		3
Explain the term thermometric property		**2 × 3**
(property that) changes (measurably / continually)		3
with (changing) temperature		3
partial answer		(3)
Name the thermometric property used in mercury thermometer		**6 or 3**
length / height / volume (of mercury column)		6
expansion		(3)
Give an example of another thermometric property		**4**
resistance (of a thermistor / conductor), emf /voltage (generated by a thermocouple), colour (of certain crystals), volume (of a gas at constant pressure), pressure (of a constant volume of gas)	any one	4

Part (b)

What is meant by (i) diffraction (ii) interference, of a wave?		**2(2 × 3)**
What is meant by (i) diffraction, of a wave?		**(2 × 3)**
spreading out (of a wave)		3
around an obstacle / gap / slit		3
bending waves around corners		(2 × 3)
a labelled diagram or correct example may merit marks		
What is meant by (ii) interference, of a wave?		**2 × 3**
(waves) meet		3
add, change in amplitude, greater amplitude / constructive, lesser amplitude / destructive	any one	3
labelled diagram or correct example may merit marks		
Describe what the person hears		**2 × 3**
loudness		3
varies, increasing and decreasing, changing	any one	3
What does this experiment demonstrate about the nature of sound?		**6 or 3**
(sound is a) wave		6
partial answer e.g. interference		(3)
What is meant by the amplitude of a wave?		**4**
height, accept loudness		4

Part (c)

Name the GLE parts labelled A and B **2 × 3**

A = insulation, any named insulator 3

B = metal/glass/plastic case 3

Give one use of an electroscope **2 × 3**

measure/ detect // identify 3

voltage / potential / charge // sign of charge 3

Explain why the gold leaf diverges when a positively charged rod is brought close to the metal cap **3 × 3**

electrons attracted up / positive charge repelled down 3

leaves more positive 3

leaves repel 3

labelled diagram may merit marks

The positively charged rod is held close to the electroscope and the metal cap is then earthed. Explain why the gold leaf collapses **4 + 3**

charge / any named charge carrier 4

flows to ground 3

Part(d)

What is meant by radioactivity? **2 × 3**

break up of nucleus / atoms 3

emission of radiation /energy // emission of α /β /γ 3

decay of unstable nuclei (2 × 3)

Name a detector of radioactivity **6 or 3**

Geiger-Muller tube, Geiger counter, solid state detector, cloud chamber, bubble chamber, photographic film, radioactive sensor, etc. any one 6

partial answer e.g. badges (3)

Explain the term half life **2 × 3**

time taken 3

for half (radioactive) nuclei / element / substance / atoms to decay // activity to half 3

What fraction of a sample of Na–25 remains after 3 minutes? **2 × 3**

1/8 2 × 3

partial answer e.g. indication of 3 half lives (3)

Give one use of a radioactive isotope **4 or 2**

detect disease, cure cancer, sterilise instruments, smoke detectors, detect leaks, trace flow of liquids, carbon dating, etc. any one 4

partial answer (2)