



AN ROINN OIDEACHAIS
AGUS EOLAÍOCHTA | DEPARTMENT OF
EDUCATION
AND SCIENCE

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Scrúduithe Ardteistiméireachta, 2001

Fisic

Ardleibhéal

Marking Scheme

Leaving Certificate Examination, 2001

Physics

Higher Level

AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA

Leaving Certificate Examinations 2001

Physics

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Marking scheme

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

OUTLINE MARKING SCHEME

SECTION A

All questions to be answered
Any five parts in each question to be answered.

1	Any FIVE parts	5 x 6		
2	Any FIVE parts			
	(i) 6 or 3	(ii) 2 x 3	(iii) 6	
	(iv) 2 x 3	(v) 2 x 3	(vi) 6 or 3	
3	Any FIVE parts			
	(i) 2 x 3	(ii) 6	(iii) 6	
	(iv) 2 x 3	(v) 2 x 3	(vi) 2 x 3	
4	Any FIVE parts			
	(i) 6	(ii) 6	(iii) 6	
	(iv) 6	(v) 6 or 3	(vi) 2 x 3	

SECTION B

Any TWO questions to be answered.

5		6		7	
Use	6 x 3	Draw	3 x 3	Graph	6 x 3
Apparatus	3 x 3	Give	3 x 3	Determine	3 x 3
Explain	3 x 3	Describe	2 x 3	Describe	3 x 3
Explain	1 x 5	State	1 x 6	Why	1 x 5
		Explain	1 x 6		
		What	1 x 5		

SECTION C

Any THREE questions to be answered.

8 (a)

Define 3 + 3

Show 4 x 3

Swing 4 x 3 deduct 2 marks for incorrect units or omission of units

(b)

Expression 6

Show 5 x 3

Height 5 x 3 deduct 2 marks for incorrect units or omission of units

9	10	11	12
Diagram 2(2 x 3)	Define 2(2 x 3)	Describe 5 x 3	What 2 x 3
Describe 4 x 3	Describe 8 x 3	Name 2 x 3	Describe 6 x 3
What 4 x 3	Calc. (i) 3 x 3	Give 6	Calculate 3 x 3
Draw 3 x 3	Calc.(ii) 4 x 3	Explain 2 x 3	What 2 x 3
Adjust 3 x 3	Calc.(iii) 3 x 3	Prove 4 x 3	Draw 3 x 3
Give 2 x 6		What 6	Explain 3 x 3
		Draw 2 x 3	Calculate 3x 3
		Explain 3 x 3	

13a	13b	13c	13d
Define 2 x 3	Describe 3 x 3	Disting. 2 x 3	What 2 x 3
State 2 x 3	What 2 x 3	Describe 4 x 3	Draw 3 x 3
Calculate 2 x 3	Use 3 x 3	Outline 5 x 3	Draw 2 x 3
Calculate 3 x 3	Calculate 3 x 3		What 1 x 3
What 2 x 3			Explain 3 x 3

Section A 120 Marks
EACH QUESTION TO BE ANSWERED

30 MARKS PER QUESTION

No penalty for incorrect units or omission of units

Each time an arithmetical slip occurs in a calculation deduct one mark and show the appropriate intermediate mark as (3-1) in the right hand column.

Section B 82 Marks
ANY TWO QUESTIONS TO BE ANSWERED

41 MARKS PER QUESTION

Deduct 2 marks for incorrect units or omission of units and show the mark for the final answer as (3-2) in the right hand column.

Each time an arithmetical slip occurs in a calculation deduct one mark and show the appropriate intermediate mark as (3-1) in the right hand column.

Section C 198 Marks
ANY THREE QUESTIONS TO BE ANSWERED

66 MARKS PER QUESTION

Deduct 2 marks for incorrect units or omission of units and show the mark for the final answer as (3-2) in the right hand column.

Each time an arithmetical slip occurs in a calculation deduct one mark and show the appropriate intermediate mark as (3-1) in the right hand column.

Section A 120 Marks

All Questions to be answered

Question 1 Any 5 items 30 marks

- (i) E
- (ii) B
- (iii) D
- (iv) D
- (v) C
- (vi) E

Question 2 Any 5 items 30 marks

- (i) $a = -\omega^2 x$ / $a = -kx$ / $a \propto (-x)$ 6
 $a \propto x$ / $a = \omega^2 x$ / $a = (-)\omega x$ (3)
- (ii) (from) cold 3
(to) hot 3
(or example 2 x 3)
- (iii) e.m.f / voltage / p.d. 6
- (iv) amplitude / frequency / intensity 3
overtones / harmonics / waveform 3
- (v) resistance of coils / thickness of wire, close winding of coils ,
lamination , eddy current , core, hysteresis any two, 2 x 3
- (vi) $m = zit$ / $m = zQ$ / $7.3 \rightarrow 7.4 \times 10^x$ (3)
(7.3 – 7.4) (C) 6

Question 3. Any 5 items. 30 marks

- | | | |
|-------|---|--------|
| (i) | any two relevant differences | 2 x 3 |
| (ii) | Rontgen | 6 |
| (iii) | GM tube / solid state detector / phosphors / gold leaf electroscope
photographic emulsion / cloud chamber / fluorescent screen | 6 |
| (iv) | release of electrons
from hot metal (surface) / hot cathode | 3
3 |
| (v) | electric field / X plates / Y plates
magnet(ic field) | 3
3 |
| (vi) | $\Phi = hf$
1.04 \rightarrow 1.05×10^{15} Hz
(if a power other than 15 is given; (6 – 1) | 3
3 |

Question 4. Any 5 items. 30 marks

- | | | |
|-------|---|---------------|
| (i) | leaves separate | 6 |
| (ii) | separation lessens / collapse
capacitance increases / voltage decreases | 6
(3) |
| (iii) | $\frac{\epsilon A}{d}$ | 6 |
| (iv) | any two parts given correctly (e.g. A/d)
increased | (3)
6 |
| (v) | $\frac{1}{2} CV^2$
8.9×10^{-2} (J) | (3)
6 |
| (vi) | tuning radio, flash camera, storing charge / energy, smoothing,
prevent sparking, separate a.c. from d.c. / block d.c.,
in timing circuits , changing phase | any two, 2 x3 |

SECTION B**82 MARKS****Two questions to be answered****Question 5 41 Marks****Use data to verify 6 x 3**

$p = mv$ (stated or implied) 3

$v = \frac{s}{t}$ (stated or implied) 3

trial 1 9.9 and 10.1 3

trial 2 13.8 and 14 3

trial 3 16.8 and 17.2 3

(if either 3 on left or right are given 2 x 3)

total momentum after $\approx 0 =$ momentum before 3

Labelled apparatus 3 x 3

trolleys 3

timing device 3

runway / track / bench 3

*** for each missing label, deduct 1

Explain times 3 x 3

record time for 20 / 25 cm // measure fixed distance 3

through gates // count dots or stripes 3

using two/dual timer(s) // time = $n \times \frac{1}{50}$ 3

Explain minimising friction 5

Frictionless wheels, smooth runway, air track, oil wheels 5

Question 7 41 Marks

Draw suitable graph 6 x 3

- axes labelled as P and I^2 3
- 6 points plotted correctly 3
- relevant straight line 3
- good fit 3
- Straight line through origin 3
- $\Rightarrow P \propto I^2$ / Joule's law is verified 3
- (-6 if not on graph paper)

Determine resistance 3 x 3

- 2 points on graph 3
- method for slope 3
- $R = 7.95 \rightarrow 8.25 \Omega$ 3
- *** for incorrect units or omission of units, deduct 2

Diagram to describe how power is determined 3 x 3

- ammeter // $E = mc\Delta\theta$ // Joulemeter 3
- voltmeter // measure time // measure time 3
- $P = VI$ // $P = \frac{mc\Delta\theta}{t}$ // $P = \frac{E}{t}$ 3
- no diagram -3
- V in parallel // thermometer // Joulemeter // Wattmeter
- A in series // calorimeter // timer // coil
- coil // coil // coil
- 1 for each missing label

Why cool coil 5

- same starting conditions / reduce heat loss /
- resistance is constant / resistance changes with temperature / reduce evaporation 5

SECTION C 198 MARKS

Three questions to be answered.

Question 8 66 Marks

(a) Define 3 + 3

- | | |
|-------------------------------------|---|
| force by distance / Fs and notation | 3 |
| ability to do work | 3 |

Show loss of potential energy = gain in kinetic 4 x 3

- | | |
|-------------------|---|
| PE = mgh | 3 |
| $v^2 = u^2 + 2as$ | 3 |
| $v^2 = 2gh$ | 3 |
| KE = mgh | 3 |

Maximum speed of swing 4 x 3

- | | |
|--|---|
| height dropped = 5m | 3 |
| $\frac{1}{2}mv^2 = mgh$ | 3 |
| substitution | 3 |
| speed = 9.9 ms^{-1} / $\sqrt{10g} \text{ ms}^{-1}$ | 3 |

*** for incorrect units or omission of units, deduct 2
 arithmetical slip -1

(b) Expression for Newton's Law 6

- | | |
|--|-----|
| $F = \frac{Gm_1m_2}{d^2}$ / $F \propto \frac{m_1m_2}{d^2}$ | 6 |
| $\frac{Gm_1m_2}{d^2}$ | (3) |

Show the period 5 x 3

- | | |
|--|---|
| Centripetal force = Gravitational force | 3 |
| $MR\omega^2$ / $M \frac{v^2}{R}$ | 3 |
| $\omega = \frac{2\pi}{T}$ / $v = \frac{2\pi R}{T}$ | 3 |
| $\frac{Gm_1m_2}{R^2} = MR \frac{4\pi^2}{T^2}$ | 3 |
| $T^2 = \frac{4\pi^2 R^3}{GM}$ | 3 |

Final 3 marks only awarded if other 12 have been awarded

Height of orbit 5 x 3

- | | |
|--|---|
| time = 5760 s | 3 |
| correct substitution into equation | 3 |
| $R^3 = 3.36 \times 10^{20}$ | 3 |
| $R = 6.95 \times 10^6 \text{ m}$ | 3 |
| $h = 560 \rightarrow 570 \text{ km} / (5.6 \rightarrow 5.7) \times 10^5 \text{ m}$ | 3 |
- *** for incorrect units or omission of units, deduct 2
 arithmetical slip -1

Question 9**66 Marks****(a) Ray diagrams 2 x (2 x 3)**

concave mirror and parallel ray 3
 indication of convergence 3

convex mirror and parallel ray 3
 indication of divergence 3
 (if convex mirror is drawn first it must be clearly shown as such otherwise 0)

Measure focal length 4x 3

apparatus 3
 arrangement 3
 measurements 3
 calculations 3
 *** approximate method maximum; first 2 x 3

What is focal length 4 x 3

$$m = \frac{v}{u} \quad 3$$

$$v = 6 \text{ (cm)} \quad 3$$

$$\frac{1}{24} - \frac{1}{6} = \frac{1}{f} \quad 3$$

$$f = 8 \text{ cm} \quad 3$$

*** for incorrect units or omission of units, deduct 2

(b) Draw spectrometer 3 x 3

telescope 3
 collimator 3
 table and scale 3
 *** -1 for each missing label

Adjustments to spectrometer 3 x 3

focus telescope, focus collimator, width of slit,
 focus cross-wires /focus eyepiece, level table any three, 3 x 3

Give differences in spectra 2 x 6

prism gives only one spectrum, whereas the grating gives many 6
 prism deviates red least, whereas the grating deviates red most /order reversed 6

Question 10. 66 Marks

Define 2 x (2 x 3)

(i) work done // $V = \frac{W}{q}$ and notation 3

unit charge from one point to another // between 2 points 3

(ii) work done // $E = \frac{W}{q}$ and notation / sum of p.d.s 3

unit charge around loop // loop 3

Describe how to measure r 8 x 3

cell, resistor, voltmeter // cell, resistor, potentiometer 3

high resistance voltmeter // galvanometer and driver cell 3

circuit 3

measure E correctly // find I_1 correctly 3

measure V correctly // find I_2 correctly 3

relevant equation 3

repeat using different resistor(s) / using a rheostat 3

get average value 3

(i) Calculate potential difference 3 x 3

$E = (R + r)I$ 3

$I = 8.70 \text{ A}$ 3

13.05 V 3

***arithmetical slip -1

(ii) Calculate total current 4 x 3

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ 3

$R_p = 0.176 \Omega$ 3

$R_T = 0.256 \Omega$ 3

$52.9 \rightarrow 55.0 \text{ A}$ 3

(any 3 correct Kirchoff equations merit 3 x 3)

*** for incorrect units or omission of units, deduct 2

*** arithmetical slip -1

(iii) Calculate 3 x 3

$V = E - rI$ / other relevant equation / solve for I (starter) 3

Substitution / $V = RI$ 3

$9.4 \rightarrow 9.5 \text{ V}$ 3

*** for incorrect units or omission of units, deduct 2

***arithmetical slip -1

Question 11. 66 Marks

Describe an experiment 5 x 3

magnet, cell, Al foil / other valid method	2 x3
circuit	3
switch on current	3
foil moves	3

Name two devices 2 x 3

loudspeaker, d.c. motor, moving coil meter / galvanometer, ammeter, voltmeter, ohmmeter	any two 2 x3
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Give an expression 6

$F = qvB$	6
$F = euB$	(3)

Explain circular path 2 x 3

force is perpendicular	3
to velocity /	3

Prove $p = BqR$ 4 x 3

centripetal force = $\frac{mv^2}{R}$	3
--------------------------------------	---

= qvB	3
---------	---

$\frac{mv}{R} = qB$ / $v = \frac{BqR}{m}$	3
---	---

$p = BqR$	3
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Final 3 marks only subsequent to earlier 3 x 3

What path 6

straight line / original path	6
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Draw relay 2 x 3

coil / solenoid and core	3
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pivot / armature / rocker and points	3
--------------------------------------	---

***-1 for each missing label

*** no diagram 0 marks

How it works 3 x 3

(small) current in coil	3
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magnetises core and attracts armature	3
---------------------------------------	---

points closed / completes second circuit	3
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Question 12. 66 Marks

(a) What is half-life 2 x 3

Time taken 3
Half of nuclei (or atoms) to decay / activity to be reduced to half 3

Describe experiment 6 x 3

Apparatus; source, cell / container, detector, counter (and timer) 3
arrangement 3
readings (to get activity) 3
graph of activity v time 3
explain how to find time for activity to be halved 3
repeat from graph (for other starting activity) and get average 3

Calculate half-life 3x 3

1200 600 300 150 3
3 x half life 3
2 (minutes) 3

(b) What is fission 2 x 3

break up of (large) nucleus 3
two smaller nuclei and energy 3

Draw fission reactor 3 x 3

fuel rods 3
control rods 3
moderator 3
****-1 for each missing label

Explain how rate is controlled 3 x 3

control rods 3
absorb neutrons 3
can be moved up / down 3

Calculate the number of fissions 3 x 3

No. of joules per fission = $1.60 \times 10^{-19} \times 180 \times 10^6$ 3

No. of fissions = $\frac{150 \times 10^6}{1.60 \times 10^{-19} \times 180 \times 10^6}$ 3

5.2×10^{18} 3

*** arithmetical slip -1

Question 13.**66 Marks****Any TWO parts****13 Part (a) 33 Marks****Define 2 x 3**

(i) mass divided by volume / equation 3

(ii) force per unit area / equation 3

State Archimedes principle 2 x 3when a body is immersed in a fluid, the upthrust / buoyancy / loss of weight
is equal to weight of fluid / water displaced 3**(i) Calculate upthrust 2 x 3**

upthrust = weight of air displaced / equation 3

183.75 (N) 3

(ii) Calculate total weight 3 x 3

Mass of Hydrogen = 1.8 kg 3

Total mass = 7.8 kg 3

Total weight = (7.8 × 9.8) = 76.44 (N) 3

(iii) What is maximum load 2 x 3

upthrust – weight of balloon 3

107.3 N / 10.9 kg 3

*** for incorrect units or omission of units, in part (iii) only, deduct 2.

13 Part (b) 33 Marks**Describe experiment 3 x 3**

apparatus 3

mention of smoke / pollen 3

observe motion 3

What conclusion 2 x 3

molecules / atoms / small particles 3

rapid / random motion 3

Expression for pressure 3 x 3

$$p = \frac{1}{3} \frac{Nm}{V} \overline{c^2}$$
 3

$$\rho = \frac{Nm}{V}$$
 3

$$p = \frac{1}{3} \rho \overline{c^2}$$
 3

Calculate density 3 x 3

$$\overline{c^2} = 390^2$$
 3

substitute 3

$$1.97 \text{ kg m}^{-3}$$
 3

*** for incorrect units or omission of units, deduct 2

*** arithmetical slip –1

(if candidate does not square 390 they may still merit 2 x 3)

13 Part (c) 33 Marks

Distinguish between longitudinal and transverse 2 x 3

Longitudinal; vibration /disturbance parallel to direction of the wave	3
Transverse; vibration /disturbance perpendicular to direction of wave	3

Light is transverse or longitudinal 4 x 3

apparatus	3
procedure	3
observation	3
conclusion	3

Outline how to measure c 5 x 3

apparatus	3
arrangement	3
speed up rotation so that light is visible	3
measure distance and frequency / speed of rotation	3
formula	3

13 Part (d) 33 Marks

What is a diode 2 x 3

a device which allows current to flow // p-type and n-type	3
in only one direction // in contact	3

Draw circuit for photodiode 3 x 3

symbols for photodiode and cell	3
circuit with reverse bias on diode	3
microammeter / milliammeter / galvanometer	3

Draw l.e.d. circuit 6

signal generator and l.e.d in working circuit	6
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What is observed 3

light goes off and on / flashes	3
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Explain 3 x 3

a.c. reverses polarity (stated or implied)	3
in forward bias it is on	3
in reverse bias it is off	3