



AN ROINN OIDEACHAIS  
AGUS EOLAÍOCHTA | DEPARTMENT OF  
EDUCATION  
AND SCIENCE

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*Fisic*

*Gnáthleibhéal*

*Marking Scheme*

*Leaving Certificate Examination, 2001*

*Physics*

*Ordinary Level*

# **AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA**

**Leaving Certificate Examinations 2001**

**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 detail required in any question is determined by the context and the 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 (120 MARKS)

All questions to be answered.

Any five parts in each question to be answered.

1. Any *five* parts 5×6
2. Any *five* parts  
(i) 2×3      (ii) 6 or 3    (iii) 2×3    (iv) 2×3    (v) 2×3    (vi) 2×3
3. Any *five* parts  
(i) 2×3      (ii) 6 or 3    (iii) 6 or 3    (iv) 2×3    (v) 2×3    (vi) 2×3
4. Any *five* parts  
(i) 2×3      (ii) 6          (iii) 6          (iv) 6 or 3    (v) 6          (vi) 6 or 3

## SECTION B (82 MARKS)

Any two questions to be answered.

5		6		7	
Apparatus	3×3	Apparatus	4×3	Apparatus	4×3
Force measured	6 or 3	Measurements	3×3	Diagram	6 or 3
Plot	5×3	Ice at 0°C	2×3	Measure <i>R</i>	6 or 3
Conclusion	2×3	Mass of ice	3×3	Measure <i>T</i>	6
Precaution	5 or 3	Precaution	5	Sketch Graph	3+2+(2×3)

**SECTION C (198 marks)**

**Any three questions to be answered**

8		9		10	
Define	(i) 2×3 (ii) 2×3	State laws	2(6 or 3)	Explain	3(2×3)
Experiment	7×3	Prism diagram	6 + 3	Demonstrate	3×3
Calculate height	4×3	Apparatus	2×3	Name X	6 or 3
Describe speed	2×3	Draw apparatus	3×3	No. of wavelengths	6 or 3
Calculate time	3×3	What readings	2×3	Name factor	6 or 3
How long	6 or 3	Find $n$	6 or 3	Experiment	7×3
		Telescope	6×3		

11		12	
Explain resistivity	2×3	Demonstration	6×3
Experiment	6×3	$F = IIB$	3×3
Calculate resistance	4×3	Motor	3×3
Explain	6 or 3	Explain turning	6 or 3 +
Give colour	3×3		2×3
What current	3×3	Function of brush	6 or 3
Explain	6 or 3	Use of motor	6 or 3
		Name device	6

**Q 13: any two parts**

13 (a)		13 (b)		13 (c)		13 (d)	
Heat transfer	3×3	State laws	2(6 or 3)	Capacitor	2×3	Semiconduct	2×3
How	6 or 3	Angle $i$	6 or 3	Experiment	5×3	Difference	6 + 3
Solar heating	4×3	Diagram	3×3	Name factor	6	Rectifier	3×3
U-value	2×3	Use of mirror	6	Charge	2×3	Sketch $V_{out}$	3×3

**SECTION A (120 Marks)**

**EACH QUESTION TO BE ANSWERED**

<b>Question 1</b>	<b>any five items</b>	<b>30 marks</b>	
(i)	B		6
(ii)	D		6
(iii)	C		6
(iv)	D		6
(v)	B		6
(vi)	E		6
<b>Question 2</b>	<b>any five items</b>	<b>30 marks</b>	
(i)	atmospheric / air pressure		3 3
(ii)	352 (K) / $T = 79 + 273(.15)$ 273(.15) / range 21567 to 21580 / 3.46		6 (3)
(iii)	cosmic / $\gamma$ - rays / X-rays / UV / light / IR radio / TV correct answer in reverse order / sound	<b>any one</b>	3 3 (3)
(iv)	magnetic meridian / magnetic north / magnetic south / true north geographic meridian / geographic north / true south either order		3 3
(v)	mass / weight charge / current / time		3 3
(vi)	electrons UV / (high energy) (electromagnetic) radiation / light / photons reverse order		3 3 (3)

**Question 3 any five items 30 marks**

- (i) ability (to do) 3  
work 3  
energy equation:  $mgh, \frac{1}{2}mv^2$  (3)
- (ii) joule / J 6  
equivalent units N m, etc. (3)
- (iii)  $E = mc^2 / E = mv^2$  6  
 $mc^2$  (3)
- (iv) energy cannot be created or destroyed // in a closed system 3  
(can be)converted from one form to another // total energy is conserved 3
- (v) any named form of energy except for electrical e.g. kinetic / mechanical 3  
energy / power 3
- (vi) potential // kinetic 3  
kinetic / heat / sound // heat / sound 3  
reverse order (3)

**Question 4 any five items 30 marks**

- (i)  $\alpha, \beta, \gamma$ , neutron, proton, electron **any two** 2×3
- (ii) cloud chamber / ionisation chamber / Geiger Muller tube / GM tube /  
solid state detector./ photographic plate / etc. **any one** 6
- (iii) any valid precaution 6  
e.g. use thongs / store securely / shielding / protective clothing / no eating / no  
drinking etc.
- (iv) one specific use 6  
e.g. detect disease / treat cancer / sterilise instruments / smoke detectors /  
trace flow of liquids / detect leaks / estimating ages of fossils or rocks etc.  
one general use e.g. medicine / industry / agriculture /energy etc. (3)
- (v) Becquerel / Curie 6
- (vi) 5 (g) /  $\frac{1}{4}$  / 25% 6  
15 (g) /  $\frac{3}{4}$  / 75% / 20 (g) (3)

**Section B (82 marks)**

**Two questions to be answered.**

**Question 5 41 marks**

**Apparatus 3 × 3**

labelled diagram to show:

trolley and runway / air track and rider 3

ticker timer / (photo) gates and timer / other valid variation 3

means of applying force 3

**NOTE:** no labels, deduct 2

**Force measured 6 or 3**

weight in pan (+ weight of pan) // newton balance // electronic balance 6

weight / weighed / balance (3)

**Plot 5 × 3**

label axes correctly 3

suitable scale 3

plot three points correctly 3

plot another three points correctly 3

line of best fit 3

if graph paper is not used, maximum mark 4×3

**Conclusion 2 × 3**

(straight) line 3

implies Newton's second law is verified / verifies acceleration is proportional to force /  $a$  proportional to  $F$  / they are proportional 3

**Precaution 5 or 3**

any valid specific precaution e.g. oil the trolley wheels / level the air track / tilt runway 5

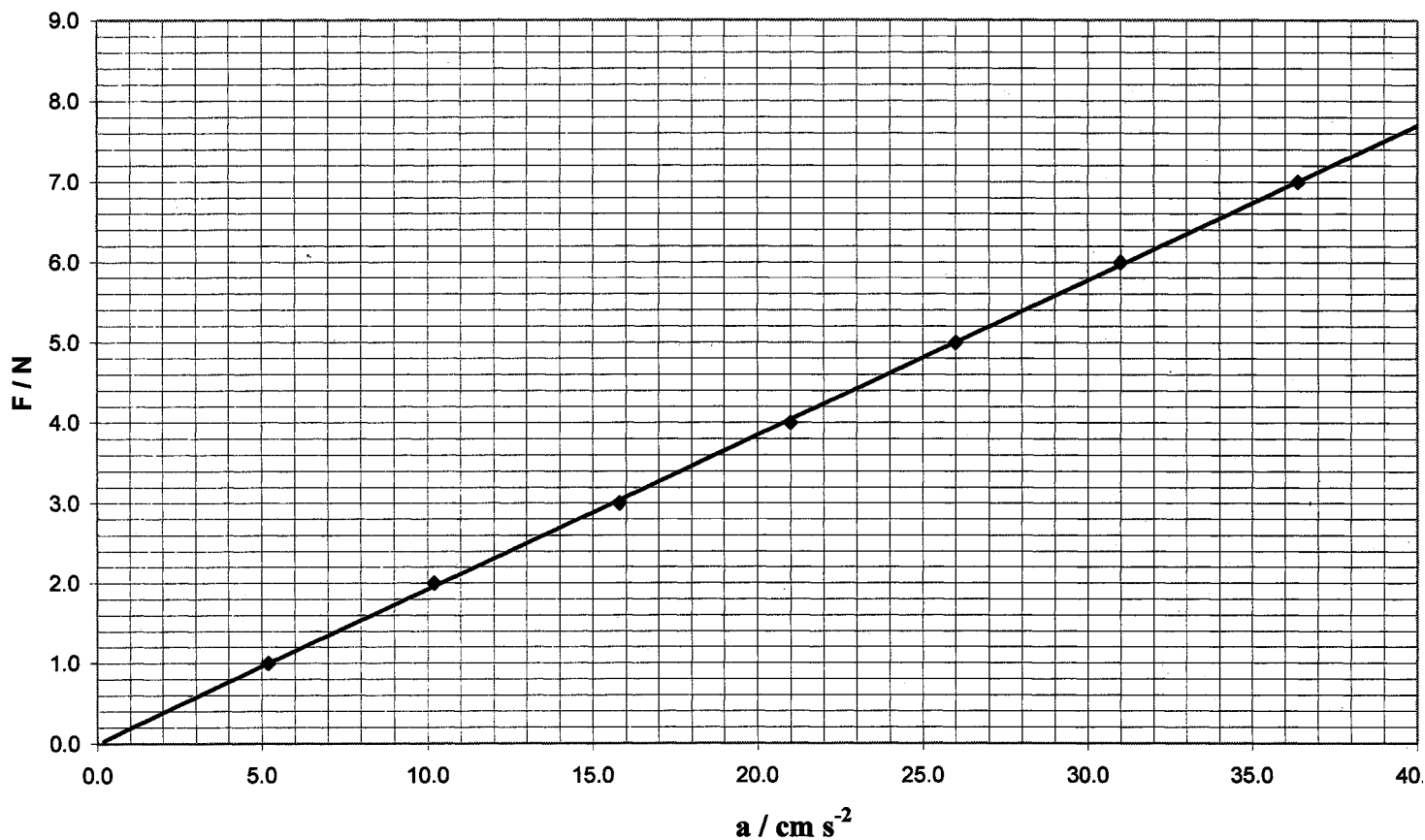
any valid general precaution e.g. reduce friction / repeat the experiment a number of times (3)



Q5.

Force/N	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Acceleration/cm s <sup>-2</sup>	5.2	10.2	15.8	21.0	26.0	31.0	36.4

**Force against acceleration**



**Question 6**      **41 marks**

**Apparatus**              **4×3**

labelled diagram to show  
calorimeter, (ice,) water, insulation                                      2×3  
polystyrene cup = calorimeter + insulation  
any two items merit 3 marks  
thermometer    3  
(electronic) balance    3

some of these items may be awarded from “What”, below

**NOTE:** no labels, deduct 2

**Measurements**              **3×3**

mass calorimeter    3  
mass calorimeter plus water / mass water    3  
temperature of water    3

**Ice at 0 °C**                      **2×3**

Leave the ice in water                                      // crushed ice                                      // wait                                      3  
for some time                                      // until it begins to melt      // until transparent                                      3  
use a thermometer / monitor temperature e.g. freezer at 0 °C                                      (3)

**Mass of ice**                      **3×3**

find/know mass of calorimeter plus water (at start)                                      3  
find mass of calorimeter plus water at end / mass of calorimeter plus water plus  
(melted) ice    3  
subtract    3

**Precaution**                      **5**

any valid precaution e.g. dry the ice / add quickly / use a sensitive thermometer /  
use a stirrer / repeat and get average / crush the ice / insulate the calorimeter                                      5  
the last two precautions must be stated not implied

**Question 7**      **41 marks**

**Apparatus**                      **4 × 3**

(coil of wire) in waterbath (with test tube of oil) / (coil of wire) in oilbath	3
thermometer	3
ohmmeter / multimeter / voltmeter + ammeter + power supply / etc.	3
heat source	3

**Diagram**                      **6 or 3**

proper arrangement of the above 4 items	6
any item missing deduct 3	

**NOTE:** a labelled diagram may merit 6 × 3

**Measure  $R$**                       **6 or 3**

ohmmeter	// multimeter in resistance/ohms scale / $\frac{V}{I}$ / etc.	6
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multimeter / $\frac{V}{I}$ inconsistent with method	(3)
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**Measure  $T$**                       **6**

thermometer (reads temperature of oil and coil)	6
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**Sketch graph**                      **3 + 2 + (2×3)**

label any axis correctly	3
label other axis correctly	2
line	3
correct shape i.e. $R$ rises with increasing $\theta$	3

**SECTION C (198 Marks)**  
**THREE QUESTIONS TO BE ANSWERED**

**Question 8 66 marks**

<b>Define</b>	<b>2(2 × 3)</b>	
(i) velocity:	rate of change // distance ÷ time / speed	3
	(of) displacement //in particular direction	3
	correct units	(3)
(ii) acceleration:	rate of change // change in velocity	3
	of velocity // per second	3
	$a = \frac{v - u}{t}$	(2×3)
	correct units	(3)

<b>Experiment</b>	<b>7 × 3</b>	
• apparatus:	falling object // pendulum	3
	Timer	3
	stop-start mechanism / (photo)gates // detail e.g. fixed point	3
	apparatus may be listed or drawn	
• procedure:	allow object to fall // allow pendulum to swing	3
• measurements:	record $t$ // record $t$	3
	record $s$ // record $l$	3
• appropriate equation e.g.	$g = \frac{2s}{t^2}$ // $g = \frac{4\pi^2 l}{T^2}$ or correct variation	3

<b>Calculate height</b>	<b>4 × 3</b>	
	$a = -g = -9.8$	3
substitute	$s = (25)(2) - \frac{1}{2}(9.8)(2)^2$	2×3
any two quantities substituted correctly		(3)
$s = 30.4$ (m) / consistent answer		3
correct answer on its own merits	$4 \times 3$	

<b>Describe speed</b>	<b>2 × 3</b>	
	slows down	3
	until it stops / until zero	3

<b>Calculate time</b>	<b>3 × 3</b>	
substitute	$0 = 25 - (9.8)t$	2 × 3
any two quantities substituted correctly		(3)
$t = 2.6$ (s) / consistent answer		3
correct answer on its own merits	$3 \times 3$	
$t = -2.5 - 2.6$ s	$2 \times 3$	

<b>How long</b>	<b>6 or 3</b>	
	same time as above or twice above e.g. 2.6 s or 5.2 s	6
valid partial answer using	$s = ut + \frac{1}{2}(a)(t)^2$	(3)

**Question 9 66 marks**

**State Laws 2(6 or 3)**

incident ray, normal and refracted ray are all in the same plane	6
only one slip / omission	(3)
$\sin i \propto \sin r$ / equivalent expression	6
only one slip / omission	(3)

**Prism diagram 6 + 3**

one of the rays refracted correctly	6
second ray refracted correctly	3
both rays refracted towards the top of the prism i.e in the wrong direction / overall deviation down	(3)

**Apparatus 2 × 3**

glass block // beaker of water // etc.	3
pins / raybox / ruler(s) / (travelling) microscope	3

**Diagram 3 × 3**

two pins in front of glass block // raybox in front of glass block // etc	3
two pins behind glass block // emerging ray // search pin // etc.	3
detail e.g. pins at angles / sheet of paper under glass block / correct deviation of rays / pins labelled correctly etc.	3

**NOTE:** a labelled diagram may merit  $5 \times 3$

**What readings 2 × 3**

angle of incidence // real depth	3
angle of refraction // apparent depth	3
measure angles	(3)

**Find  $n$  6 or 3**

$\frac{\sin i}{\sin r}$ // $\frac{\text{real}}{\text{apparent}}$	6
reverse order	(3)
$\frac{i}{r}$ (0)	

**Telescope 6 × 3**

two converging /convex lens	3
distant object stated or implied e.g. parallel rays	3
two rays drawn from object and refracted correctly at objective	3
rays converging after passing through the objective	3
two rays drawn from (image) and refracted through the eyepiece	3
(inverted/ virtual) final image far away / emerging rays parallel or divergent	3

**Question 10 66 marks**

**Explain 3(2×3)**

- (longitudinal wave motion): vibration/oscillation/ disturbance (is in same direction as motion) 3
- (constructive interference): (waves) add together bigger (resultant amplitude) 3
- (destructive interference): (waves) add together smaller (resultant amplitude) 3

marks may be obtained from diagrams or valid examples  
principle of superposition statement merits 2 × 3

**Demonstrate 3 × 3**

- apparatus: two coherent sources: e.g. tuning fork // speakers + signal generator // sodium lamp+ slits // laser + (diffraction) grating // water bath + oscillator 3
- procedure e.g. rotate // walk across room // set up spectrometer // shine laser through the grating // turn on motor (and strobe) 3
- observation/conclusion: e.g. loud and soft // bright-dark fringes // high-low waves 3

**Name X 6 or 3**

node 6  
minimum amplitude / minimum displacement / null points / antinode (3)

**No. of wavelengths 6 or 3**

two 6  
four (3)

**Named factor 6 or 3**

mass per unit length / tension / length **any one** 6  
partial answer e.g. mass / thickness / density (3)

**Experiment 7 × 3**

- apparatus: sonometer, movable bridge, tuning forks, weights/newton balance // sonometer, movable bridge, magnet, signal generator // other valid variation 3 × 3  
each item omitted deduct 3  
apparatus may be drawn or listed
- procedure: consistent with apparatus e.g. vary  $l$  to find resonance // vary  $T$  to find resonance etc. 3
- measurements: consistent with apparatus e.g. record  $f$  //  $T$  3  
record  $l$  // record  $f$  3
- plot suitable graph (state or sketch) 3

if the method is inconsistent with the named factor maximum mark 6 × 3

**Question 11**      **66 marks**

**Explain resistivity**      **2 × 3**

resistance      3

per cubic metre / of a length of 1 m and cross-sectional area 1 m<sup>2</sup>      3

is the proportionality constant for the expression  $R \propto \frac{l}{A}$  merits 2×3

**Experiment**      **6 × 3**

- apparatus: length of (nichrome) wire, micrometer, ohmmeter/multimeter, metre stick      2×3

any two (3)

- measure  $l$       3

- measure  $R$       3

- measure diameter / measure thickness      3

- correct equation. stated (cannot be implied from calculate below)      3

**Calculate resistance**      **4 × 3**

substitute in the quantities       $1.0 \times 10^{-6} = \frac{R(1.8 \times 10^{-6})}{0.8}$       2×3

two items correctly substituted      (3)

rearrange       $R = \frac{(0.8)(1.0 \times 10^{-6})}{1.8 \times 10^{-6}}$       3

consistent answer       $R = 0.44 (\Omega)$       3

**Explain**      **6 or 3**

to allow (large) current flow to earth / relevant reference to protection/safety      6  
some reference to earthing e.g. earth wire      (3)

**Give colour**      **3 × 3**

live is brown      3

neutral is blue      3

earth is green and yellow      3

three colours correctly identified but mismatched 2×3

two colours correctly identified but mismatched 1×3

**What current**      **3 × 3**

substitute in quantities       $1200 = (230)I$       3

rearrange       $I = 1200 \div 230$       3

answer       $I = 5.2 (A)$  / consistent answer      3

substituting 1.2 kW for the power maximum mark 2×3

**Explain**      **6 or 3**

prevent large current / (fuse) wire melts / breaks circuit      6

unqualified reference to safety      (3)

**Question 12 66 marks**

**Demonstration 6 × 3**

- apparatus: power supply 3  
conductor 3  
magnetic field 3
- procedure: working circuit 3  
turn on power supply unit 3
- observation/conclusion: conductor moves 3

**$F = IIB$  3 × 3**

- $l$  length (within magnetic field) 3
- $B$  magnetic (flux density) 3
- more detail e.g. . length “within field” /magnetic “flux / density” 3

**Motor: 3 × 3**

- A coil / armature / rotor 3
- B brushes / contacts 3
- C (split) ring (commutator) / commutator 3

**Explain turning 6 or 3 + 2 × 3**

- Current flowing in a magnetic field 6
- Mention of magnetic field (3)
- force (up on one side) 3
- force down (on other side) 3
- valid reference to torque/couple merits the last two three's

**Function of brush 6 or 3**

- any valid statement of function 6
- e.g. connect (split ring) with current supply / allow contact throughout rotation / allows coil to rotate without wire getting tangled
- ensures current changes direction every  $180^\circ$  / ensures force changes direction every  $180^\circ$  / ensures torque remains in same direction throughout rotation. etc. (3)

**Use of motor 6 or 3**

- specific use of a device which contains a motor e.g. (electric) drill/ hair dryer / vacuum cleaner, etc. 6
- general use of a device which contains a motor e.g. car (3)

**Name device 6**

- device based on “force on current carrying conductor ” e.g. (moving coil) galvanometer, loudspeaker, ammeter, voltmeter, ohmmeter 6



**Question 13**      **66 marks**      **Any TWO parts**

**13 (a)**      **33 marks**

**Heat transfer**      **3 × 3**

conduction      3  
convection      3  
radiation      3

**How**      **6 or 3**

radiation      6  
rays / waves      (3)

**Solar heating**      **4 × 3**

- energy conversion e.g. sun's energy to electricity // sun's energy to heat      3
- apparatus e.g. solar cell      // water in (black) pipes      3
- detail e.g. glass covering // black pipe, narrow pipe, metal pipe, insulation, etc.      3
- form of storage e.g. battery, joined to hot cylinder/tank/radiator, walls      3

marks can be obtained from a diagram  
glass house/ greenhouse maximum mark 1×3

**U-value**      **2 × 3**

insulate walls, insulate ceiling, insulate attic, insulate floor, double glaze windows  
reduce window/door sizes, thicker insulation/walls/ceilings/doors      **any two** 2×3

**13 (b)**      **33 marks**

**State laws**      **2(6 or 3)**

incident ray, normal and reflected ray are in the same plane      6  
for each omission/error deduct 3  
angle of incidence = angle of reflection      6  
left hand side or right hand side of equation correct      (3)

**Angle *i***      **6 or 3**

52° / 90° - 38°      6  
38°      (3)

**Diagram**      **3 × 3**

concave mirror (in stand)      3  
ray box / pin(s)      3  
screen / search pin / way of holding pin      3  
an approximate method using a distant object maximum mark 2×3  
confuses the mirror with a lens maximum mark 2×3

**NOTE:** no labels, deduct 2

**Use of mirror**      **6**

dentist mirror / cosmetic mirror / shaving mirror/car headlights/ (reflecting)  
telescope etc.      6  
car mirror (0)

**13 (c) 33 marks****Capacitor 2 × 3**

(device) for storing	3
(small quantities of) charge	3
accept labelled diagram:-two metal sheets separated by insulator	(6)
valid example giving capacitor use	(6)
correct symbol	(3)

**Experiment 5 × 3**

• apparatus: capacitor meter / gold leaf electroscope / multimeter	3
• circuit / charge plates	3
• measure $C$ / relate $C$ to the gold leaf movement	3
• vary separation between plates (and repeat a number of times)	3
• observation / conclusion	3

**Name factor 6**

(common) area (of plates) // permittivity (of dielectric) // dielectric // medium	6
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**Charge 2 × 3**

correct substitution	$Q = (20 \times 10^{-6})(20) / Q = (20)(20)$	3
answer	$Q = 4 \times 10^{-4} \text{ (C)} / 400 \text{ (}\mu\text{C)}$	3

**13 (d) 33 marks****Semiconductor 2 × 3**

substance whose resistivity / conductivity / resistance	3
lies between that of a conductor and an insulator	3
not a good insulator and not a good conductor	(2 × 3)
example e.g. Si, Ge	(3)
p-n diode 0 marks	

**Difference 6 + 3**

one statement correct on p-type // one statement correct on n-type	6
second statement correct on n-type // second statement correct on p-type	3
p-type has more holes / majority charge carriers are holes	
p-type doped with group 3 element e.g. Boron, Indium, Gallium	
n-type has more electrons / majority charge carriers are electrons	
n-type doped with group 5 element e.g. Arsenic, Phosphorus, Antimony	
marks may be obtained from relevant examples	
valid reference to doping e.g. (different) doping (elements) / mention of minority charge carriers	(3)

**Rectifier 3 × 3**

to change / rectify	3
a.c.	3
(to) d.c.	3

**Sketch  $V_{\text{out}}$  3 × 3**

one axis labelled correctly	3
positive half wave	3
zero voltage for negative (half-wave)	3