

2001 Physics
Intermediate 2 (Section B) and A
Finalised Marking Instructions

Strictly Confidential

These instructions are **strictly confidential** and, in common with the scripts entrusted to you for marking, they must never form the subject of remark of any kind, except to Scottish Qualifications Authority staff. Similarly, the contents of these instructions must not be copied, lent or divulged in any way now, or at any future time, to any other persons or body.

Markers' Meeting

You should use the time before the meeting to make yourself familiar with the question paper, instructions and any scripts which you have received. Do **not** undertake any final approach to marking until **after** the meeting. Please note any points of difficulty for discussion at the meeting.

Note: These instructions can be considered as final only after the markers' meeting when the full marking team has had an opportunity to discuss and finalise the document in the light of a wider range of candidates' responses.

Marking

The utmost care must be taken when entering and totalling marks. Where appropriate, all summations for totals must be carefully checked and confirmed.

Where a candidate has scored zero marks for any question attempted, "0" should be entered against the answer.

Recording of Marks

The mark for each **question**, where appropriate, should be entered **either** on the grid provided on the back page of the answer book, **or** in the case of question/answer books, on the grid (if provided) on the last page of the book. Where papers assess more than one element, care must be taken to ensure that marks are entered in the correct column.

The **Total** mark for each paper or element should be entered (in red ink) in the box provided in the top-right corner of the front cover of the answer book (or question/answer book).

Always enter the **Total** mark as a **whole number**, where necessary by the process of rounding up.

The transcription of marks, within booklets and to the Mark Sheet, should always be checked.

Centre No

Total

X069/INT 2

NATIONAL
QUALIFICATIONS
2001

MONDAY, 4 JUNE
9.00 AM - 11.00 AM

PHYSICS
INTERMEDIATE 2
(Section A)

ANSWER SHEET

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

Using ink, indicate your choice of answer by a single stroke joining the two dots in the box, as in the following example:

A	B	C	D	E
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	A	B	C	D	E		A	B	C	D	E
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	11	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	15	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	16	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	17	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	19	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION B

		<i>Marks</i>
21. (a) $E_p = mgh$	(½)	
$= 0.5 \times 10 \times 6$	(½)	
$= 30 \text{ J}$	(½)(½)	2
(b) $W = Fd$	(½)	
$= 7 \times 6$	(½)	
$= 42 \text{ J}$	(½) (½)	2
(c) <u>Heat</u> (energy) has been produced OR work has been done	(1)	
because of <u>friction</u>	(1)	2
(No marks for lifting the rope)		(6)

NOTES

- (a) use of 9.8 N/kg giving $E_p = 29.4 \text{ J}$ acceptable
- (b)
 - statement that E_w or $W = 30 \text{ J}$ with no working gets zero marks
 - any other figure than 30 J or 42J with no working gets 1/2 mark for unit.
- (c)
 - FRICTION independent 1 mark
 - Heat (energy) or heat & sound (energy) but not sound (energy) alone.

22. (a) (i) 800 N (1) 1

(ii) $a = \frac{v-u}{t}$ (½)

$= \frac{7-5}{12}$ (½)

$= 0.17 \text{ m/s}^2$ (½) (½) 2

Accept 0.2, 0.17, 0.167, $\frac{1}{6}$, m/s^2

Do not accept 0.166, 0.1667 etc, $\frac{2}{12} \text{ m/s}^2$

(iii) $F = ma$ (½)

$= 400 \times 0.17$ (½)

$= 67 \text{ (N)}$ (½)

forward force = 800 + 67 (½)
 $= 867 \text{ N}$ (½) (½) 3

(iv) distance = area under graph (½)

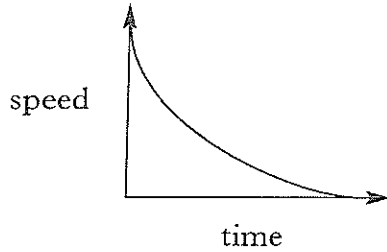
$\frac{1}{2} \times 8 \times 7$ (½)

$= 28 \text{ m}$ (½) (½) 2

Equations of motion acceptable (if correct signs used).

- (b) (i) time will be longer (1)
 (ii) shape (1)

2



(note: straight line not acceptable)

Ignore any values on graph
 No labels on axes acceptable
 Wrong labels on axes not acceptable

(10)

NOTES

- (a) (iii) if candidate stops at 67N then unit must be shown for 1 ½ marks.
 (iv) if candidate has added more areas, then ½ for area and ½ for unit provided that area D is correct

$$\begin{aligned}
 23. \quad (a) \quad d &= vt && (\frac{1}{2}) \\
 &= 340 \times 0.005 && (\frac{1}{2}) \\
 &= 1.7 \text{ (m)} && (\frac{1}{2}) \\
 \text{sensor to trolley} &= \frac{1.7}{2} && (\frac{1}{2}) \\
 &= 0.85\text{m} && (\frac{1}{2}) (\frac{1}{2})
 \end{aligned}$$

3

$$\begin{aligned}
 (b) \quad \text{momentum before} &= 1.5 \times 6 && (\frac{1}{2}) \\
 &= 9 \text{ (kg m / s)} && (\frac{1}{2})
 \end{aligned}$$

$$\text{momentum after} = 9 \text{ (kg m / s)} \quad (\frac{1}{2})$$

$$\text{or conservation statement OR } M_1 V_1 + M_2 V_2 = (M_1 + M_2) V_3$$

$$\begin{aligned}
 \text{total mass} &= \frac{9}{2} \\
 &= 4.5 \text{ (kg)} && (\frac{1}{2})
 \end{aligned}$$

$$\text{mass of second trolley} = 3 \text{ kg} \quad (\frac{1}{2}) (\frac{1}{2})$$

3

(6)

NOTES

- (a) • Wrong speed of sound gets $\frac{1}{2}$ formula mark only
- if candidate stops at 1.7m then unit must be shown for $1 \frac{1}{2}$ marks.
- (b) • conservation statement gets $\frac{1}{2}$ mark only if some attempt has been made to use numbers.
- if candidate stops at 4.5 kg then unit must be shown for $1 \frac{1}{2}$ marks.
 - if candidate gets 9 (kgm/s) in amongst wrong physics they can still get 1 mark, or $1 \frac{1}{2}$ marks if conservation statement correct.
 - watch for $9 = 1.5m \times 2 \Rightarrow m = 3\text{kg}$ this is wrong physics.

	<i>Marks</i>
24. (a) $E_H = cm \Delta T$	(½)
$= 4200 \times 2.40 \times 12.0$	(½)
$= 120\,960$	(½)
$= 121 \text{ kJ}$	(½)
	2
(b) (i) $E = Pt$	(½)
$121\,000 = 100 t$	(½)
$t = 1210 \text{ s}$	(½) (½)
$t = 1209.6 \text{ s acceptable}$	
	2
(ii) heat (energy) must be removed from air/bottles/other items in compartment	(1)
OR	
hot air/warm air/heat getting into compartment	(5)

NOTES

- (a) • 4180 J/kg °C not acceptable – ½ formula mark only
- if lines 1, 2 and 4 only shown then 1½ marks maximum
 - if lines 1 and 4 only shown then ½ mark maximum
- (b) • do not allow - cold air gets out of compartment (on its own).

25. (a) 230 V applied to each lamp (1)

OR if one blows, others stay on

OR so each lamp can operate at 200W

1

$$(b) \quad P = \frac{V^2}{R} \quad (\frac{1}{2}) \quad \text{or} \quad P = IV$$

and $V = IR$ usual marking

$$200 = \frac{230^2}{R} \quad (\frac{1}{2})$$

$$R = 265 \, \Omega \quad (\frac{1}{2}) \quad (\frac{1}{2})$$

$$R = 264.5 \, \Omega \quad \text{acceptable}$$

2

$$(c) \quad V = IR \quad (\frac{1}{2}) \quad \text{or} \quad P = I^2R \quad \text{or} \quad P = IV$$

$$230 = I \times 265 \quad (\frac{1}{2}) \quad 200 = I^2 \times 265 \quad 200 = I \times 230$$

$$I = 0.87 \, \text{A} \quad (\frac{1}{2}) \quad I = 0.87 \, \text{A} \quad I = 0.87 \, \text{A}$$

$$\begin{aligned} \text{for 3 lamps} \quad I &= 0.87 \times 3 \quad (\frac{1}{2}) \\ &= 2.61 \, \text{A} \quad (\frac{1}{2}) \quad (\frac{1}{2}) \end{aligned}$$

3

- (d) (i) X = variable resistor (1)
 Y = (n-channel enhancement) MOSFET (1)

2

(ii) when it gets dark resistance of LDR increases. (1)

OR Voltage across LDR increases
V₁ increases and when it reaches 2.4 V MOSFET
switches on (1)

Independent
 Marking

Current in the relay closes switch S and
completes lamp circuit (1)

OR Allows/causes current to flow in lamp circuit

3

(11)

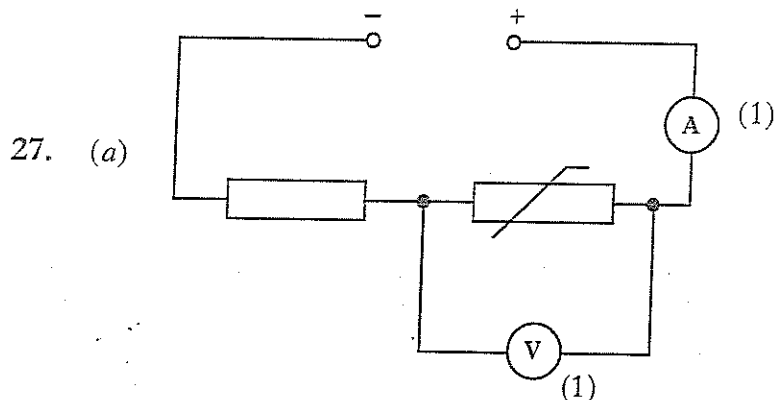
NOTES

- (a) • Do not accept “they will have the same voltage” unless 230 V stated.
- do not accept “voltage through”.
- (b) • if candidate gets 265 Ω and divides by 3 to get 88 Ω give maximum of 1 mark.
- (c) • if candidate stops at 0.87A the unit must be shown for 1 ½ marks.
- (d) • do not accept X = resistor (alone) X = potentiometer Y = transistor (alone)
- be sympathetic to MOSPHET and MOSSFET

			<i>Marks</i>	
26.	(a)	$\frac{N_s}{N_p} = \frac{V_s}{V_p}$	(½)	
		$\frac{N_s}{1150} = \frac{12}{230}$	(½)	
		$N_s = 60$	(1)	2
	(b)	(i) direct current	(1)	1
		(ii) (the electrons) flow in <u>one direction only</u>	(1)	1
	(c)	$Q = It$	(½)	
		$= 0.4 \times 18000$	(½)	
		$= 7200 \text{ C}$	(½) (½)	2 (6)

NOTES

- (a) $N_s = 60$ loses ½ mark
- (b) (ii) statement like “constant flow of electrons” not acceptable.
- (c) if candidate makes two conversion errors (400 mA and 5h) deduct one ½ mark only.



Accept

Do not accept

must be correct symbols
mark independently

2

(b) $R = \frac{V}{I} = \frac{7.2}{0.060} = 120 (\Omega)$ (1)

If incorrect unit conversion for mA used twice, only penalise one ½ mark.

$R = \frac{V}{I} = \frac{7.23}{0.059} = 123 (\Omega)$ (1)

resistance increases when force applied (1)

OR when force applied strain gauge gets greater share (1) of supply voltage (1)
resistance (of gauge) must have increased (1)

OR current has decreased (1) so TOTAL resistance has increased (1)

(resistance of series resistor is constant) so resistance (of strain gauge) increased (1)

3

(c) $R = \frac{V}{I}$ (½) or $R = \frac{V}{I}$

$= \frac{1.8}{0.06}$ (1) $\frac{1.77}{0.059}$
(½)

$= 30\Omega$ (½) (½) $= 30\Omega$

3

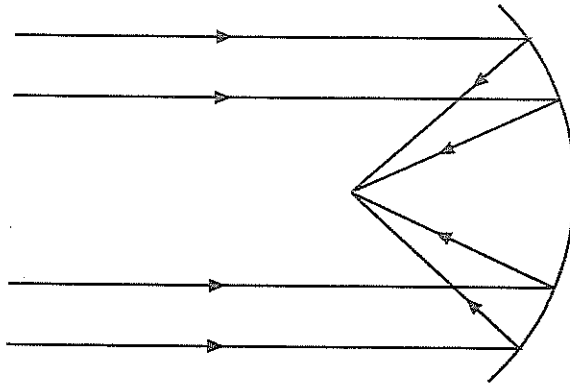
NOTES

(8)

(b) candidate MUST JUSTIFY why resistance has increased.

(c) any other value of voltage than 1.80V or 1.77 V gets maximum formula ½ mark.

28. (a)



- Deduct ½ mark for reversed arrows but allow no arrows.
- Deduct ½ mark for sound or light waves.
- Minimum 2 rays

parallel rays (diagram)	(½)	
reflected to focal point (diagram)	(½)	
aerial placed at focal point (diagram)	(½)	
stronger signal/more energy/more power	(½)	2

(b) $V = f \lambda$ (½)

$3 \times 10^8 = f \times 0.015$ (½)

$f = 2 \times 10^{10} \text{ Hz}$ (½)(½) 2

(c) $v = \frac{d}{t}$ (½)

$3 \times 10^8 = \frac{30000}{t}$ (1) (½)

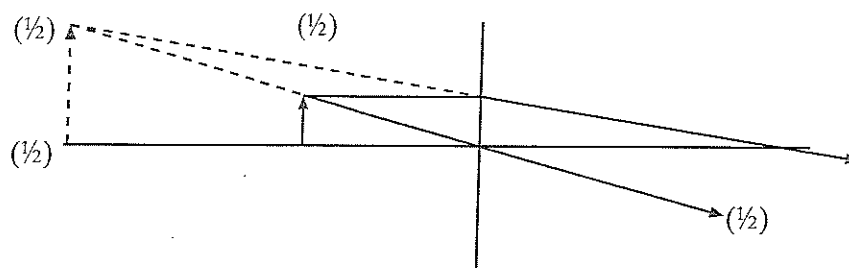
$t = 1 \times 10^{-4} \text{ s}$ (½) (½) 3

1 mark is for double distance (or double time) irrespective of any wrong physics.

(d) Any reasonable answer (1) 1
 (Source or piece of equipment) (8)

- | | |
|----------------|---------------------|
| <u>allow</u> | <u>not</u> |
| wind power | solar |
| wind generator | wind |
| solar power | solar panel |
| solar energy | hydro power station |
| solar cell | |
| generator | |
| battery | |

29. (a) (i)



second ray = half mark
 projecting rays back = half mark
 position of image = half mark
 attitude of image = half mark

mark in sequence and stop at wrong physics

2

(ii) $P = \frac{1}{f}$ (1/2)

$= \frac{1}{0.05}$ (1) (1/2)

$= 20 \text{ D}$ (1/2) (1/2)

Selection of 0.05m from Graph (50mm)
 Carries 1 mark irrespective of any wrong physics.

3

(b) difficulty in seeing objects a short distance from eyes (1)

OR eye not powerful enough to focus close objects on retina

OR eye focusses close objects behind retina

1

(6)

NOTES

- (a)(i) • candidates copy does not need to be strictly to scale as long as they have object distance < focal length.
- (ii) • wrong, or missing, unit conversion loses 1/2 mark.
- any other distance than 50mm (0.05m) is wrong physics.
- (b) • difficulty/clearly/blurred etc, must be included in answer – e.g. “cannot see close objects” gets zero marks.
- accept “can only see far away objects clearly/in focus”.

30. (a) 1.11×10^9 (1) decays per second (1) 2
or disintegrations
- (b) $H = DQ$ (½)
- $= 0.13 \times 10^{-3} \times 9$ (½)
- $= 1.17 \times 10^{-3} \text{ Sv}$ (½) (½) 2
OR 1.17 mSv
- (c) to ensure people are kept a safe(1) distance (1) from the source 2

(6)

NOTES

- (c) • Safe = health/stop harm/protect/lower absorbed dose etc.
- Distance = cannot touch/cannot get too close etc.
- Do not allow "to absorb radiation".

			<i>Marks</i>	
31.	(a) (i)	<u>to extract</u> the heat energy	(1)	1
	(ii)	to <u>slow down</u> (fast) <u>neutrons</u>	(1)	1
	(b)	some of the neutrons bombard other uranium nuclei and cause further fissions or splits	(1)	
		fissions produce more neutrons and maintain the reaction process.	(1)	2
	(c) (i)	28 ± 1 year	(2)	2
	(ii)	76 ± 2 year	(1)	1
	(iii)	any suitable storage method eg underwater in concrete underground etc	(1)	1
				(8)

NOTES

- (a) (i) must be extraction of heat energy and not control.
(ii) must be slowing neutrons not absorbing them
- (b) diagram acceptable
- (c) (i) evidence of attempt at working leading to wrong answer could get 1 mark.
(iii) • Lead container acceptable
• tank (alone) not acceptable

[END OF MARKING INSTRUCTIONS]