

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
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	A	B	C	D	E		A	B	C	D	E
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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"/>
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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)
	<b>2</b>
(b) $W = Fd$	(½)
$= 7 \times 6$	(½)
$= 42 \text{ J}$	(½) (½)
	<b>2</b>
(c) <u>Heat</u> (energy) has been produced	
OR work has been done	(1)
because of <u>friction</u>	(1)
(No marks for lifting the rope)	
	<b>2</b>
	<b>(6)</b>

### 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,  $\frac{1}{6}$ ,  $\text{m/s}^2$

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)

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

(iv) distance = area under graph (½)

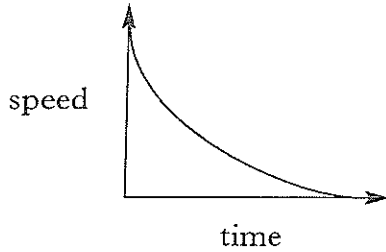
$\frac{1}{2} \times 8 \times 7$  (½)

$= 28 \text{ m}$  (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)      2
	$t = 1209.6 \text{ s acceptable}$	
(ii)	heat (energy) must be removed from air/bottles/other items in compartment	(1)      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)  $P = \frac{V^2}{R}$  (½) or  $P = IV$   
 and  $V = IR$  usual marking

$$200 = \frac{230^2}{R} \quad (½)$$

$$R = 265 \Omega \quad (½) (½)$$

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

2

(c)  $V = IR$  (½) or  $P = I^2R$  or  $P = IV$

$$230 = I \times 265 \quad (½) \quad 200 = I^2 \times 265 \quad 200 = I \times 230$$

$$I = 0.87 \text{ (A)} \quad (½) \quad I = 0.87 \text{ (A)} \quad I = 0.87 \text{ (A)}$$

for 3 lamps  $I = 0.87 \times 3$  (½)  
 $= 2.61 \text{ A}$  (½) (½)

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  
V<sub>1</sub> 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

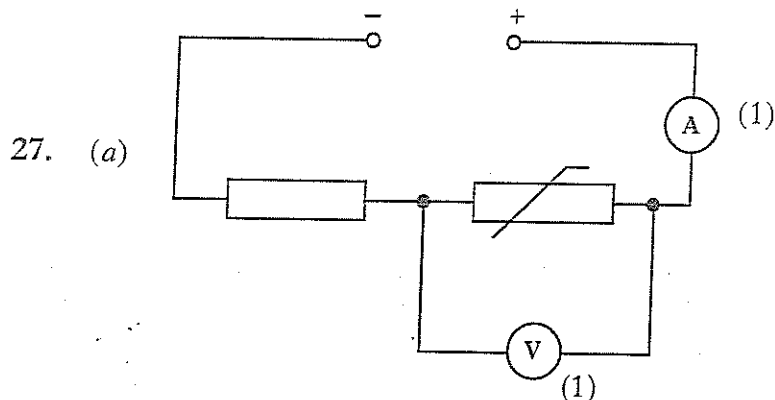
- (a) • Do not accept “they will have the same voltage” unless 230 V stated.
- do not accept “voltage through”.
- (b) • if candidate gets 265 Ω and divides by 3 to get 88 Ω give maximum of 1 mark.
- (c) • if candidate stops at 0.87A the unit must be shown for 1 ½ marks.
- (d) • do not accept X = resistor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

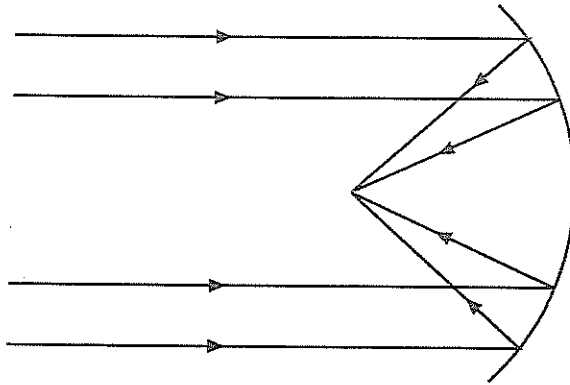
NOTES

(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)

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

3

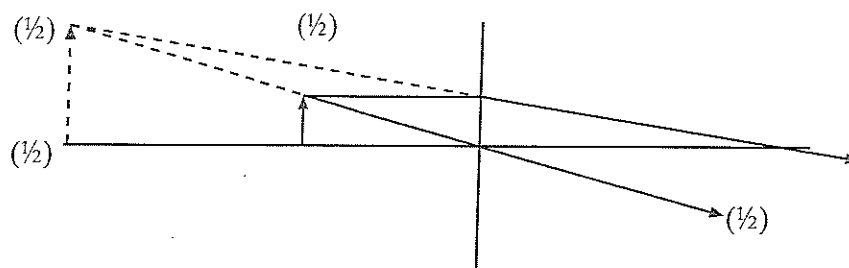
(d) Any reasonable answer (1)  
(Source or piece of equipment)

1

(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)  $1.11 \times 10^9$  (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)	$28 \pm 1$ year	(2)	2
	(ii)	$76 \pm 2$ year	(1)	1
	(iii)	any suitable storage method eg    underwater in concrete underground etc	(1)	1
				<b>(8)</b>

#### 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]