(F)

SCOTTISH
QUALIFICATIONS
AUTHORITY

2000 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.

SECTION A

Answer questions 1–20 on the answer sheet.

1. C
2. D
3. D
4. B
5. B
6. B
7. D
8. E
9. A
10. A
11. D
12. E
13. E
14. D
15. E
16. A
17. C
18. D
19. B
20. D

1 mark each

SECTION B

Marks

21. (*a*) (i) Steady — Constant speed (1 or 0) **OR** Steady — Constant velocity
or speed of 9 m/s

(ii) Steady — constant (½) deceleration (½) — Slowing down
or constant acceleration — **OR** Speed decreases = ½

NOTE: First ½ mark depends on second word — 2

(*b*) $a = \frac{v-u}{t}$ (½)

$= \frac{9-0}{20}$ (½)

$= 0 \cdot 45\ m/s^2$ (½) (½) — 2

(*c*) d = Area under graph (½)

$= \frac{1}{2} \times 20 \times 9$ (½) $+ 40 \times 9$ (½) $+ \frac{1}{2} \times 15 \times 9$ (½)

=517·5 m (½) (½)

517·5 m 518 m 520 m
all acceptable — 3

(*d*) Gravitational Force (½) **OR** weight
is balanced by (1)
(Force of) Friction (½)
] Independent Marks — 2

(9)

Notes

(*c*) If d = *vt* method used, this is only correct for 2nd part of distance
ie 40 × 9 = 360 m Award ½ mark.

(*c*) If area method used deduct ½ mark. for **Arith** slip.

Marks

22. (a) (i) $F = 4 \times 170$

$= 680\,\text{kN}$ ($\frac{1}{2}$) ($\frac{1}{2}$)

(ii) $F = ma$ ($\frac{1}{2}$)

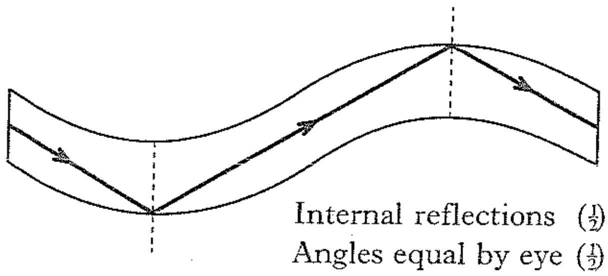
$= 185\,000 \times 3{\cdot}2$ ($\frac{1}{2}$)

$= 592\,000$ (N) ($\frac{1}{2}$)

Friction Force $= 680\,000 - 592\,000$ ($\frac{1}{2}$)

$= 88\,000\,\text{N}$ ($\frac{1}{2}$) ($\frac{1}{2}$) 4

(b) (i) (A)



Internal reflections ($\frac{1}{2}$)
Angles equal by eye ($\frac{1}{2}$)

(B) Total internal ($\frac{1}{2}$) reflection ($\frac{1}{2}$)

(ii) $t = \frac{d}{v}$ ($\frac{1}{2}$)

$= \frac{62}{2 \times 10^8}$ ($\frac{1}{2}$)

$= 3{\cdot}1 \times 10^{-7}$ s ($\frac{1}{2}$) ($\frac{1}{2}$) 4

(8)

Notes

(a) (ii) 592 000 N for final answer with no working = $1\frac{1}{2}$ marks
592 000 for final answer with no working = 1 mark.

(b) (i) (A) Accept candidate's version of copied diagram of fibre unless outrageously different then apply mark scheme.

			Marks
23. (*a*)	$\omega = mg$ $(\frac{1}{2})$ $= 90 \times 10$ $(\frac{1}{2})$ $= 900\,N$ $(\frac{1}{2})\,(\frac{1}{2})$	Accept 9·8 N/kg	2

(*b*) (i) $E_p = mgh$ $(\frac{1}{2})$

$= 3000 \times 90 \times 10 \times 400$ $(\frac{1}{2})$

$= 1{\cdot}08 \times 10^9\,J$ $(\frac{1}{2})\,(\frac{1}{2})$

(ii) $P_{out} = \frac{E}{t}$ $(\frac{1}{2})$

$= \frac{1{\cdot}08 \times 10^9}{3600}$ $(\frac{1}{2})$

$= 3 \times 10^5\ (W)$ $(\frac{1}{2})$

$\%\ \text{efficiency} = \frac{P_{out}}{P_{in}} \times 100$ $(\frac{1}{2})$

$67{\cdot}5 = \frac{3 \times 10^5}{P_{in}} \times 100$ $(\frac{1}{2})$

$P_{in} = 4{\cdot}44 \times 10^5\ W$ $(\frac{1}{2})$ **5**

$4 \times 10^5\,W$ $4{\cdot}4 \times 10^5\,W$ $4{\cdot}44 \times 10^5\,W$ $4{\cdot}444 \times 10^5\,W$ **(7)**

All acceptable

Notes

(*b*) (i) Calculation for one skier only ($E_p = 3{\cdot}6 \times 10^5\,J$) gives $1\frac{1}{2}$ out of 2.

(*b*) (ii) Can be done using energy instead of power

$\%\ \text{eff} = \frac{E_{out}}{E_{in}} \times 100$ could get formula $\frac{1}{2}$

If **correct** energy calculation stops at $E_{in} = 1{\cdot}6 \times 10^9\,J$ give $1\frac{1}{2}$ out of 3.

Final answer—deduct $\frac{1}{2}$ if **not** watts.

Marks

24. (a) $I = \frac{Q}{t}$ (½) ($I = \frac{c}{t}$ OK if rest is correct)

$= \frac{300}{0 \cdot 12}$ (½)

$= 2500$ A (½) (½) 2

(b) Total Resistance $= 50 \times 0 \cdot 08$ (½)

$= 4(\Omega)$ (½)

$P = I^2R$ (½)

$= 2500^2 \times 4$ (1)

$= 2 \cdot 5 \times 10^7$ W (½)

OR

$V = IR$ (½ both equations)

$= 2500 \times 4$ (½)

$= 10\,000$ V

$P = IV$

$= 2500 \times 10\,000$ (½)

$= 2 \cdot 5 \times 10^7$ W (½) 3

(c) (i) $E = Pt$ (½)

$= 2 \cdot 5 \times 10^7 \times 0 \cdot 12$ (½)

$= 3 \times 10^6$ (J) (½)

$\Delta t = \frac{E_H}{cm}$ (½)

$= \frac{3 \times 10^6}{385 \times 100}$ (½)

$= 77 \cdot 9$ °C (½)

(ii) No loss of heat (energy) (½) to surroundings (½) 4

(9)

Notes

(b) Carry (a) → (b) R value → (b) P value even if answer not 25MW.

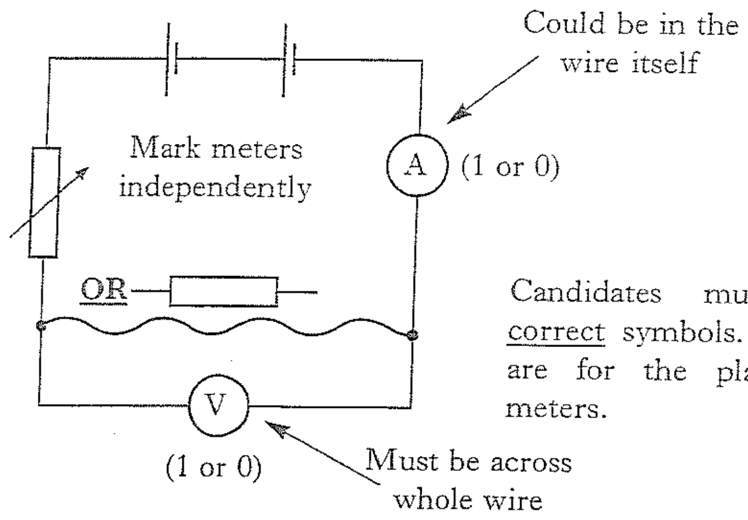
(c) (i) If 25 MW not used then max of 2 out of 3.

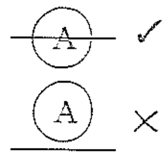
Using $\Delta T = \frac{E_H}{cm} = \frac{25 \times 10^6}{385 \times 100} = 649$ °C gets ½ out of 3.

(c) (ii) All electrical energy converted to heat (energy) (½) in rod (½)
Temp rise not sufficient to reach m.pt. of copper (½)

Marks

25. (*a*)





Candidates must use the correct symbols. The marks are for the placing of the meters. **2**

(*b*) (i) Use variable resistor (to change current in circuit) (1)
Take voltmeter and ammeter readings (½) **OR** voltage + current readings
For each setting of the variable resistor (½)

(ii) $R = \frac{V}{I}$ (½)

$= \frac{4}{1}$ (1)

$= 4\ (\Omega)$ (½)

OR any other correct combination of V + I.

R of one metre $= \frac{4}{0 \cdot 2}$

$= 20\ \Omega$ (½) (½) **5**

(*c*) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ (½)

$\frac{1}{R} = \frac{1}{2} + \frac{1}{6}$ (½)

$R = 1 \cdot 5\Omega$ (½) (½)

$R_T = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{6} = 0 \cdot 67\Omega$ 0 marks

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{6} = 0 \cdot 67\Omega$ 1 mark

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{6} = \frac{2}{3} + \frac{3}{2} = 1 \cdot 5\Omega$ 1½ marks **2**

(9)

Notes

(*b*) (i) Last ½ mark is for some indication of more than one reading
"Adjust variable resistor" ⇒ last ½ mark + first 1 mark
Voltage "through" loses middle ½ mark
"Adjust lab pack to get different current & voltage readings" 1 mark.

Marks

26. (*a*) (i) A helium ($\frac{1}{2}$) nucleus ($\frac{1}{2}$)
or 2 Protons + 2 Neutrons (1)

(ii) Removal / OR addition of electrons ($\frac{1}{2}$) from atom ($\frac{1}{2}$) OR to leave ion

(iii) α is much more ionising than β or γ (1)
OR α is less penetrating than β or γ (1)

(iv) C (1)
Because other two have very short half-lives (1) 5

(*b*) (i) A resistor **NOT** variable resistor (1)

(ii) V across resistor = 9 – 1·9 ($\frac{1}{2}$)
= 7·1 (V) ($\frac{1}{2}$)

$R = \frac{V}{I}$ ($\frac{1}{2}$)

$= \frac{7 \cdot 1}{20 \times 10^{-3}}$ ($\frac{1}{2}$)

$= 355\,\Omega$ ($\frac{1}{2}$) ($\frac{1}{2}$)

4

(9)

Notes

(*a*) (ii) If charge of ion is specified it **must** be correct.

(*a*) (iii) There must be a **comparison** between α and β, γ.

(*a*) (iv) Any indication of longer time, greater length of use etc qualifies for second mark.
Second mark only available following C for first mark.

(*b*) (ii) Voltage must be 7·1 V
Otherwise $\frac{1}{2}$ formula mark only.
(Only exception is a clear arith. slip trying to get 7·1 V)

Marks

27. (*a*) (i) (n-channel enhancement) MOSFET (1)

(ii) Voltage divider (1)
or potential divider — 2

(*b*) (i) 2·0 V Range 2·0 – 2·1 V (1) (½) unit deduction

(ii) $V_1 = \left(\frac{R_1}{R_1 + R_2}\right) \times Vs$ (½)

$2 = \left(\frac{R_1}{R_1 + 20}\right) \times 9$ (½)

$R_1 = 5 \cdot 71\ k\Omega$ (½) (½) — 3

(*c*) In darkness the resistance of LDR = 10kΩ **OR** increases (1)
Voltage across LDR is greater than 2 V (1)
MOSFET will conduct **OR** be switched on (1)

(Independent marks) — 3

(8)

Notes

(*a*) (i) Not transistor
Be sympathetic to MOSPHET
Be sympathetic to (slight) variations on n-channel enhancement.

(*b*) (ii) Version $\frac{V_1}{V_2} = \frac{R_1}{R_2}$ (½)

$\frac{2}{7} = \frac{R_1}{20}$ (½)

$R_1 = 5 \cdot 71\ k\Omega$ (½) (½)

(*b*) (i) + (*c*) **Must** match

Marks

28. (*a*) 3×10^8 m/s (1) ($\frac{1}{2}$) unit deduction 1

(*b*) $\lambda = \frac{v}{f}$ ($\frac{1}{2}$)

$= \frac{3 \times 10^8}{4 \cdot 6 \times 10^{14}}$ ($\frac{1}{2}$)

$= 6 \cdot 52 \times 10^{-7}$ (m) (1) For those with wrong speed

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Light is red (1)

Note: Red on its own = zero 3

(4)

Notes

(*b*) There **must** be a complete calculation with answer before candidate can choose a colour.

(*b*) Allow frequency calculation from each wavelength to find $4 \cdot 6 \times 10^{14}$ Hz.

Marks

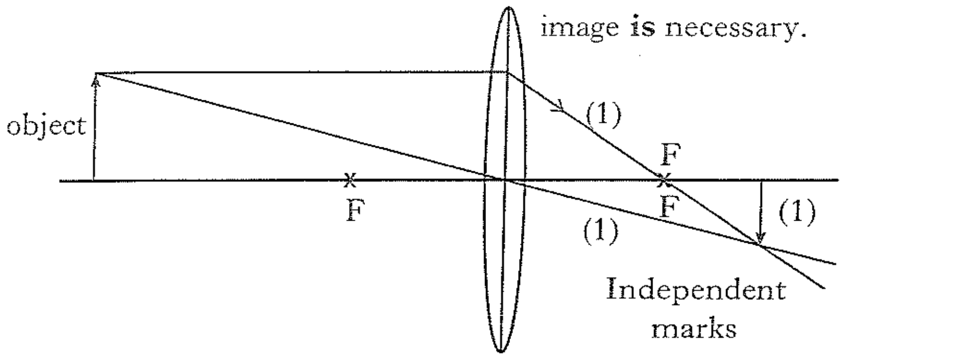
29. (*a*) $P = \frac{1}{f}$ ($\frac{1}{2}$)

$= \frac{1}{0 \cdot 03}$ ($\frac{1}{2}$)

$= 33$ D ($\frac{1}{2}$) ($\frac{1}{2}$) 2

Non use of metres for f loses $\frac{1}{2}$ mark.

(*b*) (i)



(ii) Any **two** from
Image is smaller (1)
Image is inverted (1)
Laterally inverted (or reversed) 5

(*c*) 30 mm (1) **OR** one focal length

Because light will be focused at focal point (1)
or focused at one focal length
or focused at principal focus

Note: The two marks are independent. 2

(9)

Notes

(*b*) (i) Object must be U > 2*f* but diagram needn't be exactly to scale
(If U < 2*f* then deduct 1 mark)

(*b*)(i) → (*b*)(ii) **must** be consistent with candidates image **but** if no image shown then start remarking at (*b*)(ii)

Marks

30. (*a*) Nucleus fissions (1) **OR** nucleus splits (**not** atom)
Release of neutrons ($\frac{1}{2}$) and energy ($\frac{1}{2}$) **2**

(*b*) Control rods absorb fewer neutrons (1)
More fissions take place (1)
Increase in temperature of coolant **OR** hotter (1)
] Independent marks

Note: "There are more neutrons" will get half mark in place of first full mark.

3

(*c*)

$$D = \frac{E}{m} \quad (\tfrac{1}{2})$$

$$= \frac{8 \cdot 4 \times 10^{-3}}{70} \quad (\tfrac{1}{2})$$

$$= 1 \cdot 2 \times 10^{-4} \text{ (Gy)} \quad (\tfrac{1}{2})$$

$$Q = \frac{H}{D} \quad (\tfrac{1}{2})$$

$$= \frac{336 \times 10^{-6}}{1 \cdot 2 \times 10^{-4}} \quad (\tfrac{1}{2})$$

$$= 2 \cdot 8 \quad (\tfrac{1}{2})$$

Note: Deduct half mark if unit given

3
(8)

[*END OF MARKING INSTRUCTIONS*]

Notes

(*c*) Very common:-

$$Q = \frac{H}{D} = \frac{336 \times 10^{-6}}{8 \cdot 4 \times 10^{-3}} = 0 \cdot 04$$

gets formula $\frac{1}{2}$ mark **only**.