SCOTTISH QUALIFICATIONS AUTHORITY

2003 Physics

Higher

Finalised Marking Instructions

Scottish Qualifications Authority
Detailed Marking Instructions — Higher Physics 2003

1. General Marking Instructions

SQA published *Physics General Marking Instructions* in July 1999. Please refer to this publication when interpreting the detailed marking instructions that follow.

2. Recording of marks

The following additional advice was given to markers regarding the recording of marks on candidate scripts.

(a) The total mark awarded for each question should be recorded in the outer margin. The inner margin should be used to record the mark for each part of a question as indicated in the detailed marking instructions.

(b) The fine divisions of marks shown in the detailed marking scheme may be recorded within the body of the script beside the candidate's response. Where such marks are shown they must total to the mark in the inner margin.

(c) Numbers recorded on candidate scripts should always be the marks being awarded. Negative marks or marks to be subtracted should not be recorded on scripts.

(d) The number out of which a mark is scored should **never** be recorded as a **denominator**. ($\frac{1}{2}$ mark will always mean one half mark and never 1 out of 2)

(e) Where square ruled paper is enclosed inside answer books it should be clearly indicated that this item has been considered by the marker. The mark awarded should be transferred to the script booklet inner margin and marked **G**.

(f) The mark awarded for each question should be transferred to the grid on the back of the script. When the marker has completed marking the candidate's response to all questions, the marks for individual questions are added to give the total script mark.

(g) The total mark awarded for an individual question may include an odd half mark – $\frac{1}{2}$. If there is an odd half mark in the total script mark, this is rounded up to the next whole number when transferred to the box on the front of the script.

2003 Physics Higher

Marking scheme

Section A

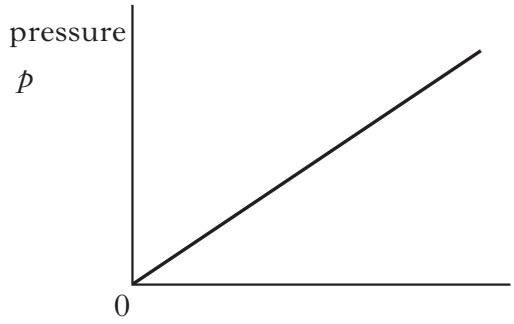
1.	D	11.	D
2.	E	12.	E
3.	A	13.	C
4.	D	14.	B
5.	A	15.	B
6.	C	16.	B
7.	E	17.	D
8.	C	18.	A
9.	B	19.	E
10.	E	20.	A

Sample Answer and Mark Allocation	Notes	Marks	
21. (*a*) (i) $v_h = v\cos\theta$ $= 35{\cdot}0 \cos 40°$ **(½)** $= 26{\cdot}8\ \text{m s}^{-1}$ **(½)**	unit needed for second **(½)** allow 26·812 to 27 for sig figs	**1**	**7**
(ii) $v_v = v\sin\theta$ $= 35{\cdot}0 \sin 40°$ **(½)** $= 22{\cdot}5\ \text{m s}^{-1}$ **(½)** $23\ \text{m s}^{-1}$ loses **(½)**	unit needed for second **(½)** allow 22·498 to 22 for sig figs 22·49 no unit/working – **(0)** 22·49 m s^{-1} **(½)** truncating error	**1**	
(iii) $v = u + at$ **(½)** $0 = 22{\cdot}5 - 9{\cdot}8\,t$ **(½)** (g = 10 deduct **(½)**) $\Rightarrow t = \frac{22{\cdot}5}{9{\cdot}8}$ $t = 2{\cdot}3$ s **(½)(½)** deduct **(½)** if go on eg $\frac{2{\cdot}3}{2}$	$v^2 = u^2 + 2as \Rightarrow s = 25{\cdot}8$ (m) **OR** $s = \bar{v}t$ | $s = \left(\frac{u+v}{2}\right)t$ **(½)** $25{\cdot}8 = \frac{22{\cdot}5}{2}t$ | $25{\cdot}8 = \frac{22{\cdot}5}{2}t$ **(½)** $t = 2{\cdot}29$ s | $t = 2{\cdot}29$ s **(½)(½)** **OR** u consistent with (*a*)(ii) u and a must have opposite signs in substitution otherwise formula **(½)** only watch for $v = u + at$ $22{\cdot}5 = 0 + 9{\cdot}8t$ $t = 2{\cdot}3\ s$ get **(½)** **unless** explain that time to fall from maximum height is the same	**2•**	

Sample Answer and Mark Allocation	Notes	Marks	
21. (*b*) time to Q = 2 × time to max height = 4·60 (s) **(½)** time of flight = 4·60 + 0·48 = 5·08 (s) **(½)** (5·07) (horiz) dist = (hor) speed × time (of flight) **(½)** **OR** $s = \left(\frac{u+v}{2}\right)t$ **OR** $s = ut + \frac{1}{2}at^2$ stop if $a \neq 0$ s = 26·8 × 5·08 **(½)** = 136 m **(½), (½)** (135·88 m)	**OR** time consistent with (*a*)(iii) **OR** speed consistent with (*a*)(i) **OR** (2·3 × 26·8) + (2·3 × 26·8) + (0·48 × 26·8) = 136 m	**3•+**	

Sample Answer and Mark Allocation	Notes	Marks	
22. (*a*) Change in momentum = $mv - mu$ **(½)** $= (38 \times 4{\cdot}6) - (38 \times 2{\cdot}2)$ **(½)** $= 91\ \text{kg m s}^{-1}$ **(½), (½)** accept N s but N s^{-1} loses **(½)**	$mu - mv$ **(0)** W. P. **OR** 174·8 – 83·6 allow 90 **OR** 91·2 for sig figs	**2**	**9**
(*b*) $F \times t = \Delta mv$ **(½)** $\Rightarrow 130 \times t = 91$ **(½)** $t = 0{\cdot}70\ \text{s}$ **(½), (½)**	$F = ma = \dfrac{m(v-u)}{t}$ **(½)** $130 = \dfrac{38(4{\cdot}6 - 2{\cdot}2)}{t}$ **(½)** $t = 0{\cdot}70\ \text{s}$ **(½) (½)** **OR** Δmv consistent with (*a*) (2·2 – 4·6) is W. P.	**2•**	
(*c*) **total** mom. before = **total** mom. after **(½)** $\Rightarrow (54 \times 2{\cdot}2) + (38 \times 2{\cdot}2) = 54v + (38 \times 4{\cdot}6)$ **(½)** $\Rightarrow 54v = 202{\cdot}4 - 174{\cdot}8$ $\Rightarrow \quad v = \dfrac{27{\cdot}6}{54}$ **(½)** $= 0{\cdot}51\ \text{m s}^{-1}$ **(½)** deduct **(½)** if v is negative	$a = \dfrac{F}{m}$ $\quad v = u + at$ **(½)** $a = \dfrac{-130}{54}$ $\quad v = 2{\cdot}2 - 2{\cdot}41 \times 0{\cdot}7$ **(½)** $a = -2{\cdot}41$ $\quad v = 0{\cdot}51\ \text{m s}^{-1}$ **(½) (½)** '*a*' must be negative in substitution l.h.s. could be $(92 \times 2{\cdot}2)$ **OR** 118·8 + 83·6 = 54v + 174·8 **OR** $Ft = (mv - mu)$ **(½)** $-130 \times 0{\cdot}7 = 54v - (54 \times 2{\cdot}2)$ **(½)** $-91 = 54v - 118{\cdot}8$ $v = 0{\cdot}51\ \text{m s}^{-1}$ **(½) (½)** **OR** original mom. of R = 118·8 **(½)** new mom. of R $= 118{\cdot}8 - 91{\cdot}2$ **(½)** $v = \dfrac{27{\cdot}6}{54} = 0{\cdot}51\ \text{m s}^{-1}$ **(½) (½)** allow 0·5 to 0·5111 for sig figs	**2**	

Sample Answer and Mark Allocation	Notes	Marks	
22. (*d*) E_k before $= \left(\frac{1}{2}mv^2\right)_R + \left(\frac{1}{2}mv^2\right)_S$ **(½)** $= \frac{1}{2}\left(54 \times 2{\cdot}2^2\right) + \frac{1}{2}\left(38 \times 2{\cdot}2^2\right)$ **(½)** $= 223$ (J) **(½)** E_k after $= \left(\frac{1}{2}\left(54 \times 0{\cdot}51^2\right)\right) + \frac{1}{2}\left(38 \times 4{\cdot}6^2\right)$ $= \left(7{\cdot}0\right) + 402$ **(½)** $(= 409$ (J)$)$ $\Rightarrow$ interaction is not elastic **(1)** not elastic as E_k lost loses **(1)**	If no E_k calculation **(0)** **OR** $\left(\frac{1}{2}m_{R+S}v^2\right)$ but $\frac{1}{2}mv^2$ gets **(0)** unless goes further **OR** $\frac{1}{2} \; 92 \times 2{\cdot}2^2$ If set out as E_k before = E_k after then show it is an inequality – ignore this bad form and award marks **OR** consistent with (*c*) Note – no sig. fig. penalty as final answer is not numerical 'inelastic' can get **(3)**	**3•+**	

Sample Answer and Mark Allocation	Notes	Marks	
23. (*a*) (i)  	**(0)** if not a straight line through origin deduct **(½)** if either/both labels(s)/ origin is/are missing	**1**	**7**
(ii) $(\Delta)p = \rho g h$ **(½)** $p = 1{\cdot}00 \times 10^3 \times 9{\cdot}8 \times 0{\cdot}25$ **(½)** $p = 2{\cdot}45 \times 10^3$ Pa **(½), (½)** (accept 2450/2500 Pa)	if **start** $(\Delta)p = \rho gh$ + atmospheric pressure **(0)** W.P. if $\rho = 1{\cdot}0 \rightarrow p = 2{\cdot}45$ kPa **(2)** ↓ $p = 2{\cdot}45$ Pa **(1½)** unit error if $g = 10$, deduct **(½)** once in question no data mark(s) if $g = -9{\cdot}8 \Rightarrow$ formula **(½)** only if **now** add atmospheric pressure deduct **(½)** ⇒ **(1½)** max	**2**	
(iii) the increased pressure has caused the volume of trapped air to decrease or air to be compressed **(1)**	**(1)** or **(0)**	**1•+**	

Sample Answer and Mark Allocation	Notes	Marks	
23. (*b*) $p = \dfrac{F}{A}$ **(½)**	$p = \rho gh + p_{ATM}$ **(0)** W.P. $h \neq 1{\cdot}1$ m $p = \rho gh + p_{ATM} + \dfrac{m_{TANK}g}{A}$ indep. **(½)**		
$F = (300 + 2700) \times 9{\cdot}8 = 29400$ (N) **(½)**	marks		
$A = 2{\cdot}0 \times 1{\cdot}5 = 3{\cdot}0$ (m^2) **(½)**			
$\Rightarrow \quad p = 9{\cdot}8 \times 10^3$ (Pa) **(½)**	if stop here, **(2)** max, but units must be given ie $p = 9800$ **(1½)**		
$\Rightarrow$ Total *pressure* $= 1{\cdot}01 \times 10^5 + 9{\cdot}8 \times 10^3$			
$= 1{\cdot}11 \times 10^5$ Pa $(= 1{\cdot}108 \times 10^5$ Pa)	**(1)** but deduct **(½)** if Pa **not** given	**3•+**	

Sample Answer and Mark Allocation	Notes	Marks	
24. (*a*) $\frac{p_1}{T_1} = \frac{p_2}{T_2}$ **(½)** $\Rightarrow \frac{1{\cdot}56\times10^5}{300} = \frac{p_2}{350}$ **(½)** $\Rightarrow p_2 = 1{\cdot}82\times10^5$ Pa **(½) (½)**	$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$ **(½)** formula **(½)** max if T not in K $T_2 = 50°$ C/323 K → formula **(½)** max unless state T_2 = 27 + 273 + 50 = 323 K max **(½)** arith	**2**	**6**
(*b*) (i) $P = \frac{V^2}{R}$ **(½)** { $V_{\text{lamp}} = 30\times\frac{0{\cdot}50}{2{\cdot}0}$ $= 7{\cdot}5$ (V)} $\Rightarrow P = \frac{(7{\cdot}5)^2}{0{\cdot}50}$ **(1)** for 7·5 (V) **(½)** for 0·50 (Ω) = 113 W (112·5 W) **(½) (½)** [note – $\frac{30^2}{0{\cdot}50}$ = 1800 W is W.P., but **(½)** can get **(½)** for (implied) formula] **(1)** max But if 450 W then divide by 4 can get full marks	$P = \frac{30^2}{2} = 450$ W **(½)** implied formula P = 450 W **(½)** for correct units Summary: **(½)** for power formula → needed before any marks awarded **(1)** for first calculated subst. V or I **(½)** for other subst. **(½) (½)** for answer Alt 1: $P = VI$ **(½)** $= 7{\cdot}5\times15$ **(1)** + **(½)** (V or I)(other) = 113 W **(½) (½)** Alt 2: $P = I^2R$ **(½)** $= (15)^2\times0{\cdot}50$ **(1)** + **(½)** = 113 W **(½) (½)** $P = VI = 30\times15 = 450$ W **(1½)** $P = VI$ = 450 W **(1)**	**3•+**	

Sample Answer and Mark Allocation	Notes	Marks	
24 (*b*)(ii) the internal resistance would decrease the current in the circuit/proportion of V across the element **(½)** and so would reduce the power output **(½)** [or a complete recalculation as in (*b*)(i) with increased total circuit resistance] but no W. P. {there **must** be an attempt at a reason (and not W. P.) to get second **(½)** mark} ie power output reduces	Power constant or increases **(0)** Required for any marks "overall resistance increases, e.m.f. constant gives power less as $P = \frac{V^2}{R}$ **(½)** voltage: flowing through restricted W. P. **(0)**	**1•+**	

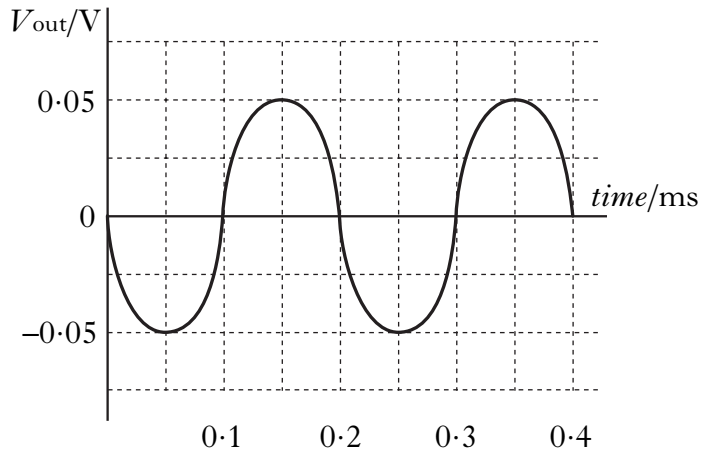
Sample Answer and Mark Allocation	Notes	Marks	
25. (*a*) (i) y-gain $= \frac{15}{3}$ **(½)** $= 5$ (V div^{-1}) **(½)**	setting = 5 V **(½)** Vcm^{-1} loses second **(½)** bare "5 Vcm^{-1} gets **(½)**	**1•**	**9**
(ii) $f = \frac{1}{T}$ **(½)** $f = \frac{1}{2{\cdot}5 \times 1 \times 10^{-3}}$ **(½)** = 400 (Hz) **(1)** any other unit loses **(½)**	using $v = f\lambda$ W. P. **(0)** $\frac{1}{2{\cdot}5}$ = 0·4 (Hz) **(1½)** 0·4 kHz **(1½)** 2·5± 0·2 370 to 435 (Hz)	**2•**	
(*b*) (i) $V_{rms} = \frac{V_p}{\sqrt{2}}$ **(½)** $= \frac{12}{\sqrt{2}}$ **(½)** = 8·5 V Accept 8·4 V (12 × 0·7) **(½), (½)**	**must be** 12 V otherwise formula **(½)** only if left as $\frac{12}{\sqrt{2}}$ V **(1½)**	**2**	
(ii) $E = \frac{1}{2}C \times V^2$ **(½)** $= \frac{1}{2}220 \times 10^{-6} \times 12^2$ **(½)** = 0·016 J **(½), (½)** (= 0·01584 J) (= 0·02 J)	must be 12 V otherwise formula **(½)** only **OR** $E = \frac{1}{2}\ QV$ & $Q = VC$ **(½)** $Q = 12 \times 220 \times 10^{-6}$ $Q = 2{\cdot}64 \times 10^{-3}$ $E = \frac{1}{2}\ 2{\cdot}64 \times 10^{-3} \times 12$ **(½)** E = 0·016 J **(½) (½)**	**2•+**	
(iii) it increases	**(1)** or **(0)** **(1)** "increases" + irrel. Phys "increases" + WP **(0)** eg as V increases	**1**	
(vi) the capacitor **repeatedly**/keeps on/continually/again and again charges and discharges (allowing the flow of charge at all times)	**(1)** or **(0)** could be by diagram (charges on plates) current flows backwards and forwards changing direction regularly **(0)** capacitors block d.c. but not a.c. **(0)**	**1•+**	

Sample Answer and Mark Allocation	Notes	Marks	
26. (*a*) $\frac{R_{LDR}}{5500} = \frac{150}{330}$ **(1)** $\Rightarrow R_{LDR} = 2500\Omega$ **(½)(½)**	no "formula" **(½)** allocated ie $\frac{R_1}{R_2} = \frac{R_3}{R_4}$ not given mark Accept $\frac{15}{33}$ but $\frac{15}{330}$ **(0)**	**2**	**8**
(*b*) (i) (n channel enhancement) MOSFET	mosfet **(1)** "transistor" gets **(0)** MOSFIT/MOSVET/ MOSPHET **(0)**	**1**	
(ii) $V_o = (V_2 - V_1) \times \frac{R_f}{R_{in}}$ **(½)** $V_o = (1{\cdot}50 - 1{\cdot}28) \times \frac{22{\cdot}5}{1{\cdot}5}$ **(½)** $V_o = 3{\cdot}3$V **(½), (½)**	$(1{\cdot}28 - 1{\cdot}50)\ \frac{22{\cdot}5}{1{\cdot}5} \rightarrow$ formula **(½)** max if formula written but **(0)** if 1st line is as above	**2•**	
(iii) R_{LDR} increases **(½)** ⇒ p. d. across LDR increases /V_1 increases **(½)** ⇒ smaller V_{out} from op-amp **(½)** ⇒ transistor/MOSFET switches off **(½)** ⇒ no current (in solenoid) **(½)** 2 marks for 1st 4 statements or last 4 statements voltage flowing – W. P. stop marking but give marks already allocated	If R_{LDR} *decreases* **(0)** total W. P. "R_{LDR} changes" keep marking **OR** p. d. between X and Y becomes zero/bridge balances again negative voltage to MOSFET is W. P. **(1)** max **OR** V_{out} becomes zero next **(½)** mark depends on this being gained use of switching at 0·7 V loses last **(½)** ⇒ **(1½)** max Explanation of why valve is **open** does not answer the question **(0)**	**2•+**	

Sample Answer and Mark Allocation	Notes	Marks	
26. (*c*) There is no longer **total** internal reflection **(½)** as the refractive index of the water is greater than that of air/critical angle increased **(½)** If "angle of incidence changes" or "critical angle decreased" or "total internal reflection now happens" all W. P. **(0)**	Independent **(½)** marks **OR** Angle of <u>incidence</u> is no longer greater than critical angle "as angle of incidence at Q is now less than critical angle" **(½)**	**1•**	

Sample Answer and Mark Allocation	Notes	Marks	
27. (*a*) (i) E_4 to E_3 **(½)** as this is the smallest ΔE **(½)** or $E = \frac{hc}{\lambda}$ giving smallest freq. **(½)** and $f \propto \frac{1}{\lambda}$ $v = f\lambda$ needs backing up (eg v constant) **(½)**	Between E_3 and E_4 is acceptable **(0)** if not E_4 to E_3 E_3 to E_4 **(0)** Bare E_4 to E_3 no explanation **(0)** $E_4 \rightarrow E_3$ as smallest ΔE, largest f **(1)** $E_4 \rightarrow E_3$ as largest ΔE **(0)** W. P. as explanation (there **must** be an attempt at a reason (and not WP) to get first **(½)** mark)	**2•**	**9**
(ii) $(\Delta)E = -2{\cdot}4 \times 10^{-19} - (-)\ 5{\cdot}6 \times 10^{-19}$ **(½)** $(\Delta)E = hf$ **(½)** – independent $\Rightarrow 3{\cdot}2 \times 10^{-19} = 6{\cdot}63 \times 10^{-34} \times f$ **(½)** if omit $\times 10^{-19}$ – W. P. **(½)** $f = 4{\cdot}83 \times 10^{14}$Hz **(½)(½)** ($2{\cdot}07 \times 10^{-15}$Hz can get **(2½)**)	ignore –ve here (substitution) (for data, clearly identified **anywhere**) look anywhere for $E = hf$ $h = 6{\cdot}63 \times 10^{-34}$ **(½)** $E = 8 \times 10^{-19}$ J is W. P. stop marking deduct **(½)** if still –ve	**3•+**	
(*b*) (i) same **(1)** $4{\cdot}74 \times 10^{14}$ Hz **(½)(½)**	+ irrel Physics **(1)** (eg "f same because the direction changes") but W. P. **(0)**	**1**	

Sample Answer and Mark Allocation	Notes	Marks	
27. (*b*) (ii) $\frac{v_1}{v_2} = n$ **(½)** $\Rightarrow v_2 = \frac{3{\cdot}0\times10^8}{1{\cdot}60}$ **(½)** (for substitution) $v_2 = 1{\cdot}88\times10^8\ (\text{m s}^{-1})$ $\lambda = \frac{v}{f}$ **(½)** $\lambda = \frac{1{\cdot}88\times10^8}{4{\cdot}74\times10^{14}}$ **(½)** $\lambda = 3{\cdot}97\times10^{-7}\,\text{m}$ **(½)(½)** **OR** $\lambda = \frac{v}{f}$ **(½)** $\lambda = \frac{3{\cdot}0\times10^8}{4{\cdot}74\times10^{14}}$ **(½)** (for substitution) $\lambda = 6{\cdot}33\times10^{-7}\,(\text{m})$ $\frac{\lambda_1}{\lambda_2} = n$ **(½)** $\lambda_2 = \frac{6.33\times10^{-7}}{1{\cdot}60}$ **(½)** $\lambda_2 = 3{\cdot}96\times10^{-7}\,\text{m}$ **(½)(½)**	if freq. from (*b*)(i) is wrong need to work through (or $3{\cdot}96\times10^{-7}\,\text{m}$) $3{\cdot}9\times10^{-7}\,\text{m}$ loses **(½)** accept $4\times10^{-7}\,\text{m}$ Summary: $v = f\lambda$ **(½)** * $\frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = n$ **(½)** * subst. in each formula * **(½)(½)** final answer **(½)(½)**	**3•+**	

Sample Answer and Mark Allocation	Notes	Marks	
28. (*a*) (i) The detector passes through areas of constructive and destructive interference **(½)** Maxima/Constructive areas are where waves (from the two gaps) meet **in phase** **(½)** Minima/Destructive areas are where waves (from the two gaps) meet **out of phase** **(½)** alternatives { **in phase** = crest + crest **OR** path diff whole no. of λs **OR** in-step; **out of phase** = crest + trough **OR** path diff odd no. of half λs **OR** out of step accept not in phase	must be in terms of waves not sources indep **(½)**s can be shown by diagram but these two answers subsume the first **(½)**	**1½**	**7**
(ii) path diff. = $n\lambda$ **(½)** $766 - 682 = 3\lambda$ **(½)** (84) $\lambda = 28$ mm **(½)**	path difference = 84mm **(0)** on its own $n\lambda = d\sin\theta$ **(0)** bare "28" loses last **(½)**	**1½**	
(*b*) (i)  **(1)** for inversion + waveshape → **(½)** for same amplitude **(½)** for same frequency	**(0)** unless voltage/**time** graph if **units** and/or values missing from axes, deduct **(½)** for each axis unless overlayed on original trace lose this **(1)** if waves flattened, square waves, rectified etc	**2•**	
(ii) sound from headphones and noise are **out of phase**/in antiphase **(1)** this causes **destructive** interference **(1)**	independent marks "sounds cancel out" **(½)** "sounds are out of phase and cancel out" **(1½)**	**2•+**	

Sample Answer and Mark Allocation	Notes	Marks	
29. (*a*) (i) alpha **(1)** or α **(1)**	Helium **nucleus (1)** Helium/helium particle **(0)**	**1**	**8**
(ii) $A = \frac{N}{t}$ **(½)** $A = \frac{720000}{120}$ **(½)** A = 6000 Bq **OR** decays s^{-1} **(½)(½)**	360000 Bq can get **(1½)** as unit error but 360000 decays/min gets **(2)** counts/second ⇒ unit error deduct **(½)**	**2**	
(*b*) (i) 60 → 30 (or equivalent) **(1)** in 3·0 cm **(1)**	bare 3 gets **(1½)** missing unit bare "3·0 cm" gets **(2)** (2·8 to 3·2 cm)	**2•**	
(ii) uncertainties in measurements give a **range of possible values** /a range of values come from repeated measurements /there are random uncertainties in repeated readings /radioactive decay is a random process giving a range of values Examples: /to show error/uncertainty in each reading **(1)** /this is the error bar **(0)** /shows uncertainty in **reading** (and thickness) **(1)** /shows uncertainty in thickness **(0)** /shows the uncertainty **(0)**	**(1) OR (0)**	**1•**	
(*c*) $H = D_1Q_1 + D_2Q_2$ **(½)** $6{\cdot}4 \times 10^{-5} = D_1 \times 20 + 1{\cdot}2 \times 10^{-5} \times 1$ **(½)** $\Rightarrow 20D_1 = 5{\cdot}2 \times 10^{-5}$ $\Rightarrow D_1 = 2{\cdot}6$ μGy **(½)(½)** if use $\dot{H}$ and $\dot{D}$ accept as bad form	no **(½)** for just $H = DQ$ $H_2 = D_2Q_2 = 1{\cdot}2 \times 10^{-5}$ **(½)** $H_1 = (6{\cdot}4 - 1{\cdot}2) \times 10^{-5}$ **(½)** $D_1 = \frac{5{\cdot}2 \times 10^{-5}}{20}$ $= 2{\cdot}6 \times 10^{-6}$ Gy **(½)(½)**	**2•**	

[*END OF MARKING INSTRUCTIONS*]