SCOTTISH
QUALIFICATIONS
AUTHORITY

2005 Physics

Advanced Higher

Finalised Marking Instructions

These Marking Instructions have been prepared by Examination Teams for use by SQA Appointed Markers when marking External Course Assessments.

Detailed Marking Instructions – AH Physics 2005

1. **Numerical Marking**

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

   (b) Negative marks or marks to be subtracted should not be shown. An inverted vee may be used instead.

   (c) The number recorded should always be the marks being awarded.
   The number out of which a mark is scored SHOULD NEVER BE SHOWN AS A DENOMINATOR. (½ mark will always mean one half mark and never 1 out of 2.)

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

   (e) Fractional marks, if awarded to individual questions, should be recorded in the grid, but the total script mark must be rounded up to the next whole number when transferred to the box at the top of the script.

2. **Other Marking Symbols which may be used**

TICK	–	Correct point as detailed in scheme, includes data entry
SCORE THROUGH	–	Any part of answer which is wrong. (For a block of wrong answer indicate zero marks.)
INVERTED VEE	–	A point omitted which has led to a loss of marks.
WAVY LINE	–	Under an answer worth marks which is wrong only because a wrong answer has been carried forward from a previous part.
"G"	–	Reference to a graph on separate paper. You MUST show a mark on the graph paper and the SAME mark on the script.

3. **Marking Symbols which may <u>not</u> be used.**

"WP"	–	Marks not awarded because an apparently correct answer was due to the use of "wrong physics".
"ARITH"	–	Candidate has made an arithmetic mistake.
"SIG FIGS or SF"	–	Candidate has made a mistake in the number of significant figures for a final answer.

4. **General Instructions (Refer to National Qualifications Booklet)**

(a) No marks are allowed for a description of the wrong experiment or one which would not work.
Full marks should be given for information conveyed correctly by a sketch.

(b) Surplus answers: where a number of reasons, examples etc are asked for and a candidate gives more than the required number then wrong answers may be treated as negative and cancel out part of the previous answer.

(c) Full marks should be given for a correct answer to a numerical problem even if the steps are not shown explicitly. The part marks shown in the scheme are for use in marking partially correct answers.

(d) Where 1 mark is shown for the final answer to a numerical problem ½ mark may be deducted for an incorrect unit.

(e) Where a final answer to a numerical problem is given in the form 3^{-6} instead of 3×10^{-6} then deduct ½ mark.

(f) Deduct ½ mark if an answer is wrong because of an arithmetic slip.

(g) No marks should be awarded in a part question after the application of a wrong physics principle (wrong formula, wrong substitution) unless specifically allowed for in the marking scheme.

(h) In certain situations, a wrong answer to a part of a question can be carried forward within that part of the question. This would incur no further penalty provided that it is used correctly. Such situations are indicated by a horizontal dotted line in the marking instructions.

Wrong answers can always be carried forward to the next part of a question, over a solid line without penalty.

(i) ½ mark should be awarded for selecting a formula.

(j) Where a triangle type "relationship" is written down and then not used or used incorrectly then any partial ½ mark for a formula should not be awarded.

(k) In numerical calculations, if the correct answer is given then converted wrongly in the last line to another multiple/submultiple of the correct unit then deduct ½ mark.

(l) Significant figures.
Data in question is given to 3 significant figures.
Correct final answer is 8·16J.
Final answer 8·2J <u>or</u> 8·158J <u>or</u> 8·1576J – No penalty.
Final answer 8J <u>or</u> 8·15761J – Deduct ½ mark.
Candidates should be penalised for a final answer that includes

- three or more figures too many
  or
- two or more figures too few.
  ie accept two higher and one lower

(m) Squaring Error

$E_K = ½ mv^2 = ½ \times 4 \times 2^2 = 4J$ (-½, ARITH)

$E_K = ½ mv^2 = ½ \times 4 \times 2 = 4J$ (½, formula) Incorrect substitution.

The General Marking Instructions booklet should be brought to the markers' meeting.

Physics − Marking Issues

The current in a resistor is 1·5 amperes when the potential difference across it is 7·5 volts. Calculate the resistance of the resistor.

	Answers	Mark +comment	Issue
1.	V=IR 7·5=1·5R R=5·0Ω	(½) (½) (1)	Ideal Answer
2.	5·0Ω	(2) Correct Answer	GMI 1
3.	5·0	(1½) Unit missing	GMI 2(a)
4.	4·0Ω	(0) No evidence/Wrong Answer	GMI 1
5.	_____Ω	(0) No final answer	GMI 1
6.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0\Omega$	(1½) Arithmetic error	GMI 7
7.	$R=\frac{V}{I}=4{\cdot}0\Omega$	(½) Formula only	GMI 4 and 1
8.	$R=\frac{V}{I}=$_____Ω	(½) Formula only	GMI 4 and 1
9.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=$_____Ω	(1) Formula + subs/No final answer	GMI 4 and 1
10.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0$	(1) Formula + substitution	GMI 2(a) and 7
11.	$R=\frac{V}{I}=\frac{1{\cdot}5}{7{\cdot}5}=5{\cdot}0\Omega$	(½) Formula but wrong substitution	GMI 5
12.	$R=\frac{V}{I}=\frac{75}{1{\cdot}5}=5{\cdot}0\Omega$	(½) Formula but wrong substitution	GMI 5
13.	$R=\frac{I}{V}=\frac{7{\cdot}5}{1{\cdot}5}=5{\cdot}0\Omega$	(0) Wrong formula	GMI 5
14.	V=IR 7·5=1·5 x R R=0·2Ω	(1½) Arithmetic error	GMI 7
15.	V=IR $R=\frac{I}{V}=\frac{1{\cdot}5}{7{\cdot}5}=0{\cdot}2\Omega$	(½) Formula only	GMI 20

Data Sheet

Common physical Quantities

Quantity	*Symbol*	*Value*	*Quantity*	*Symbol*	*Value*
Gravitational acceleration on Earth	g	9·8 Ms^2	Mass of electron	M_e	9·11 x 10^{-31}kg
Radius of Earth	R_E	6·4 x 10^6m	Charge on electron	e	-1·60 x 10^{-19}C
Mass of Earth	M_E	6·0 x 10^{24}kg	Mass of neutron	m_n	1·675 x 10^{-27}kg
Mass of Moon	M_M	7·3 x 10^{22}kg	Mass of proton	m_p	1·673 x 10^{-27}kg
Mean of Radius of Moon Orbit		3·84 x 10^8m	Mass of alpha particle	m_a	1·645 x 10^{-27}kg
Universal constant of gravitation	G	6·67 x $10^{-11}m^3kg^{-1}s^{-2}$	Charge on alpha particles		3·20 x 10^{-19}C
Speed of light in vacuum	c	3·0 x 10^8ms^{-1}	Planck's constant	h	6·63 x 10^{-34}Js
Speed of sound in air	v	3·4 x 10^2ms^{-1}	Permittivity of free space	ε_0	8·85 x $10^{-12}Hm^{-1}$
			Permeability of free space	μ_0	4π x $10^{-7}Hm^{-1}$

Refractive Indices

The refractive indices refer to sodium light of wavelength 589 nm and to substances at a temperature of 173 K.

Substance	*Refractive index*	*Substance*	*Refractive index*
Diamond	2·42	Glycerol	1·47
Glass	1·51	Water	1·33
Ice	1·31	Air	1·00
Perspex	1·49	Magnesium Fluoride	1·38

Spectral Lines

Element	*Wavelength/nm*	*Colour*	*Element*	*Wavelength/nm*	*Colour*
Hydrogen	656	Red	Cadmium	644	Red
	486	Blue-green		509	Green
	434	Blue-violet		480	Blue
	410	Violet	*Lasers*		
	397	Ultraviolet	*Element*	*Wavelength/nm*	*Colour*
	389	Ultraviolet			
Sodium	589	Yellow	Carbon-dioxide	9550 10590	Infrared
			Helium-neon	633	Red

Properties of selected Materials

Substance	*Density/ Kg m^{-3}*	*Melting Point/K*	*Boiling Point/K*	*Specific Heat Capacity/ Jkg^{-1} K^{-1}*	*Specific Latent Heat of Fusion/ Jkg^{-1}*	*Specific latent Heat of Vaporisation/ Jkg^{1}*
Aluminium	$2{\cdot}701 \times 10^3$	933	2623	$9{\cdot}02 \times 10^2$	$3{\cdot}95 \times 10^5$	….
Copper	$8{\cdot}96 \times 10^3$	1357	2853	$3{\cdot}86 \times 10^2$	$2{\cdot}05 \times 10^5$	….
Glass	$2{\cdot}60 \times 10^3$	1400	….	$6{\cdot}70 \times 10^2$	….	….
Ice	$9{\cdot}20 \times 10^2$	273	….	$2{\cdot}10 \times 10^3$	$3{\cdot}34 \times 10^5$	….
Gylcerol	$1{\cdot}26 \times 10^3$	291	563	$2{\cdot}43 \times 10^3$	$1{\cdot}81 \times 10^5$	$8{\cdot}30 \times 10^5$
Methanol	$7{\cdot}91 \times 10^2$	175	338	$2{\cdot}52 \times 10^3$	$9{\cdot}9 \times 10^4$	$1{\cdot}12 \times 10^6$
Sea Water	$1{\cdot}02 \times 10^3$	264	377	$3{\cdot}93 \times 10^3$	….	….
Water	$1{\cdot}00 \times 10^2$	273	373	$4{\cdot}19 \times 10^3$	$3{\cdot}34 \times 10^5$	$2{\cdot}26 \times 10^6$
Air	$1{\cdot}29$	….	….	….	....	….
Hydrogen	$9{\cdot}0 \times 10^{-2}$	14	20	$1{\cdot}43 \times 10^4$	....	$4{\cdot}50 \times 10^5$
Nitrogen	$1{\cdot}25$	63	77	$1{\cdot}04 \times 10^3$	….	$2{\cdot}00 \times 10^5$
Oxygen	$1{\cdot}43$	55	90	$9{\cdot}18 \times 10^2$	….	$2{\cdot}40 \times 10^5$

The gas densities refer to a temperature of 273 K and pressure of $1{\cdot}01 \times 10^5$ Pa.

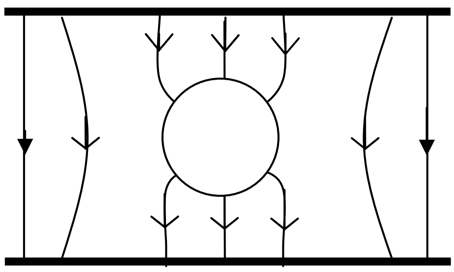
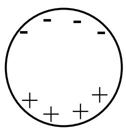
2005 AH Physics			
Sample answer and mark allocation	**Notes**	**Margin**	
1.(a) $\omega = \frac{v}{r}$ (½) $= \frac{1 \cdot 3}{23 \times 10^{-3}}$ (½) $= 56 \cdot 5$ rad s^{-1} (1)		2	9
(b) $\omega = \frac{v}{r}$ (½) $= \frac{1 \cdot 3}{58 \times 10^{-3}}$ (½) $= (22 \cdot 4$ rad $s^{-1})$	Accept $v = r\omega$	1	
(c) ωr is constant (½) r increases (½) (ω decreases)		1	
(d) (i) θ = no. of revolutions $\times 2\pi$ $= 2 \cdot 8 \times 10^4 \times 2 \times 3 \cdot 14$ (1) $= (1 \cdot 76 \times 10^5$ radians)		1	
(d) (ii) $\omega^2 = \omega_0^2 + 2\alpha\theta$ (½) $22 \cdot 4^2 = 56 \cdot 5^2 + 2 \times \alpha \times 1 \cdot 76 \times 10^5$ (½) $\alpha = \frac{22 \cdot 4^2 - 56 \cdot 5^2}{2 \times 1 \cdot 76 \times 10^5}$ $= -7 \cdot 64 \times 10^{-3}$ rad s^2 (1)	$56 \cdot 5^2 - 22 \cdot 4^2 \Rightarrow$ max (½)	2	
(d) (iii) $\alpha = \frac{\omega - \omega_o}{t}$ (½) $t = \frac{\omega - \omega_o}{\alpha}$ $= \frac{22 \cdot 4 - 56 \cdot 5}{-7 \cdot 64 \times 10^{-3}}$ (½) = 4460 s (1) (74·3 minutes)	Accept using $\theta = \omega_0 t + ½ \alpha t^2$ $\omega_0 < \omega$ - max (½) for equation	2	

2005 AH Physics			
Sample answer and mark allocation	**Notes**	**Margin**	
2 (a) $I_{child} = mr^2$ (½) $= 25 \times 2^2$ (½) $= 100$ (kg m^2) (½) $I_{total} = I_{roundabout} + I_{child}$ $= 500 + 100$ (½) for adding (= 600 kg m^2)		2	12
(b) The angular momentum before (an impact) equals the angular momentum after the impact (½) provided there are no external torques. (½)	Isolated system acceptable (½)	1	
(c)(i) $mv = 25 \times 2{\cdot}4$ $= 60$ kg m s^{-1} (1)		1	
(c)(ii) $mrv = 25 \times 2{\cdot}4 \times 2$ $= 120$ kg m^2 s^{-1} (1)	or $\omega = v/r = 2{\cdot}4/2 = 1{\cdot}2$ (rad s^{-1}) $I\omega = 100 \times 1{\cdot}2 = 120$ kg m^2 s^{-1} (1)	1	
(d) $I_1\omega_1 = I_2\omega_2$ (½) $120 = 600 \times \omega_2$ (½) $\omega_2 = \frac{120}{600}$ $= 0{\cdot}2$ rad s^{-1} (1)		2	
(e) E_k before $= ½ I \omega^2$ $= 0{\cdot}5 \times 100 \times 1{\cdot}2^2$ $= 72$ (J) (½) E_k after $= ½ I \omega^2$ (½) (formula) $= 0{\cdot}5 \times 600 \times 0{\cdot}2^2$ $= 12$ (J) (½) E_k lost $= 72 - 12$ $= 60$ J (½)	or $½ mv^2 = 0{\cdot}5 \times 25 \times 2{\cdot}4^2$ $= 72$ (J) (½)	2	
(f) $\omega^2 = \omega_0^2 + 2\alpha\theta$ (½) $0 = 0{\cdot}2^2 + 2 \times \alpha \times (0{\cdot}5 \times 2\pi)$ (½) $\alpha = - 6{\cdot}4 \times 10^{-3}$ (rad s^{-2}) (½) $T = I\alpha$ (½) $= 600 \times (-)6{\cdot}4 \times 10^{-3}$ $= (-)\ 3{\cdot}8$ N m (1)	Or $\Delta E_K = T\theta$ (1) (½) $12 = T\pi$ (½) $T = \frac{12}{\pi} = 3.8$Nm (1)	3	

2005 AH Physics Sample answer and mark allocation	Notes	Margin	
3(a)(i) $m\omega^2 R = \frac{GMm}{R^2}$ (1) $\omega^2 = \frac{GM}{R^3}$ (½) $(2\pi/T)^2 = \frac{GM}{R^2}$ (½) $T^2 = \frac{4\pi^2 R^3}{GM}$	(½) cancelling m (½) for $\omega = 2\pi/T$	2	8
(a)(ii) $T^2 = \frac{4\pi^2 R^3}{GM}$ $= \frac{4 \times 3{\cdot}14^2 \times (3{\cdot}84 \times 10^8)^3}{6{\cdot}67\times10^{-11} \times 6{\cdot}0 \times 10^{24}}$ (½) data (½) data $T = \sqrt{5.58\times10^{12}}$ $= 2{\cdot}4 \times 10^6$ s (1)		2	
(b)(i) $E_p = \frac{-GM}{R} \times m$ (½) $= \frac{-6{\cdot}67 \times 10^{-11} \times 6 \times 10^{24} \times 900}{(6{\cdot}4 \times 10^6 + 400 \times 10^3)}$ (½) substitution (1) for adding ($= -5{\cdot}3 \times 10^{10}$ J)		2	
(b)(ii) $E_k = \frac{1}{2}mv^2$ $= 0{\cdot}5 \times 900 \times (7{\cdot}7 \times 10^3)^2$ $= 2{\cdot}67 \times 10^{10}$ J (½) $E_{total} = E_p + E_k$ (½) $= -5{\cdot}3 \times 10^{10} + 2{\cdot}67 \times 10^{10}$ $= -2{\cdot}6 \times 10^{10}$ J (1)	$E_T = \frac{-GMm}{2R}$ (½) $= \frac{-6{\cdot}67\times10^{-11}\times6\times10^{24}\times900}{2\times(6{\cdot}4\times10^6 + 400\times10^3)}$ (½) $= -2{\cdot}6 \times 10^{10}$ J (1)	2	

2005 AH Physics			
Sample answer and mark allocation	**Notes**	**Margin**	
4(a) Acceleration is proportional to displacement (from a fixed point) (½) and is always directed to (that) fixed point. (½) **or** The unbalanced force is proportional to the displacement (from a fixed point) (½) and is always directed to (that) fixed point (½)	Accept $F = - k x$ or $a = - k x$ (½) (½)	1	7
(b)(i) ($x = A\sin\omega t$) $v = -\omega A\cos\omega t$ $\omega = 625$ (rad s^{-1}) (½) $f = \frac{\omega}{2\pi}$ (½) $= \frac{625}{2 \times 3{\cdot}14}$ $= 99{\cdot}5$ Hz (1) (100 Hz)		2	
(b)(ii) $\omega A = 0{\cdot}5$ (½) $A = \frac{0{\cdot}5}{625}$ (½) $= 8 \times 10^{-4}$ m (1)		2	
(c) (maximum) acceleration = $9{\cdot}8$ m s^{-2} (1) (contact lost) when cap accelerates downwards greater (or equal to) g or similar (1)	Must have $9{\cdot}8$ ms^{-2} to gain 2nd mark 1 or 0 cone's acceleration (or speed) greater than g or greater than bead's acceleration (or bead)	2	

2005 AH Physics

Sample answer and mark allocation	Notes	Margin	
5(a) $E = \frac{Q_1 (½)}{4\pi\varepsilon_0 r_1^2} + \frac{Q_2}{4\pi\varepsilon_0 r_1^2}$ $= \frac{4 \cdot 0 \times 10^{-6}}{4\pi 8 \cdot 85 \times 10^{-12} \times (3 \times 10^{-3})^2} + \frac{6 \times 10^{-6}}{4\pi 8 \cdot 85 \times 10^{-12} \times (2 \times 10^{-3})^2}$ (½) $= 4 \cdot 0 \times 10^{9} + 1 \cdot 4 \times 10^{10}$ $= 1 \cdot 8 \times 10^{10}$ N C^{-1} (1)	formula (½) for E substitution (½) must have "+"	2	7
(a)(ii) to the right (1)		1	
(b)(i)(A) 	(1) correct shape of lines to cylinder essential for the other (½) marks (½) direction (½) outside lines straight or bulging	2	
(b)(i)(B)  (1)	1 or 0	1	
(b)(ii) (external) electric fields (interference) cannot reach the central wire (1)	idea of shielding E inside of mesh = 0	1	

2005 AH Physics

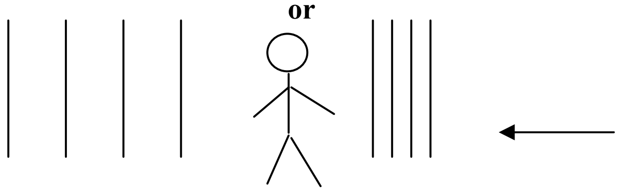
Sample answer and mark allocation	Notes	Margin	
6(a) (½) $QV = ½mv^2$ (½) (½) $1·6 \times 10^{-19} \times 1500 = 0·5 \times 9·11 \times 10^{-31} \times v^2$ (½) $v^2 = 5·27 \times 10^{14}$ ($v = 2·3 \times 10^7$ m s^{-1})		2	14
(b) $t = \frac{d}{v}$ (½) $= \frac{90 \times 10^{-3}}{2·3 \times 10^7}$ (½) $= 3·9 \times 10^{-9}$ s (1)		2	
(c)(i) $E = \frac{V}{d}$ (½) $= \frac{600}{50 \times 10^{-3}}$ = 12000 (N C^{-1}) (½) $F = EQ$ (½) $= 12000 \times 1·6 \times 10^{-19}$ (½) (= $1·9 \times 10^{-15}$ N)		2	
(c)(ii) $a = \frac{F}{m}$ (½) $= \frac{1·9 \times 10^{-15}}{9·11 \times 10^{-31}}$ $= 2·1 \times 10^{15}$ (m s^{-2}) (½) - - - - - - - - - - $s = ut + ½ at^2$ (½) $= 0 + 0·5 \times 2·1 \times 10^{15} \times (3·9 \times 10^{-9})^2$ (½) $= 1·6 \times 10^{-2}$ m (1)		3	

2005 AH Physics			
Sample answer and mark allocation	**Notes**	**Margin**	
6 (d)(i) There is an unbalanced force (on the electron) (1) in the vertical direction (1)	Accept vertical acceleration or Electrons attracted to positive plate	2	
(d) (ii) No (unbalanced) forces act (on the electron) (1)		1	
(e) s increases (1) since v decreases (½) t decreases (½)		2	

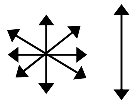
2005 AH Physics			
Sample answer and mark allocation	**Notes**	**Margin**	
7(a)(i) positive (1)		1	10
(a)(ii) (½) $Bqv = (½)\ \frac{mv^2}{R}$ (½) $= \frac{2 \times 10^6}{1{\cdot}5 \times 13{\cdot}9 \times 10^{-3}}$ (½) $= 9{\cdot}6 \times 10^7$ C kg^{-1} (1)	Accept $\frac{m}{q} = 1{\cdot}04 \times 10^{-8}$ kg c^{-1} $q = 9{\cdot}6 \times 10^7 m$ (2½) no unit	3	
(a)(iii) proton (1) $\frac{q}{m} = \frac{1{\cdot}6 \times 10^{-19}}{1{\cdot}67 \times 10^{-27}}$ (1) $= 9{\cdot}6 \times 10^7$ (C kg^{-1}) (same)		2	
(b) the component of the electron's velocity perpendicular to the magnetic field causes circular motion (1) (or equivalent) the component of the electron's velocity parallel to the magnetic field is unchanged (1) (**or** no force on electron parallel to B)	Good answer – (2) Some valid physics in description – (1)	2	
(c) Enter toward the poles (1) move in circles/spirals (1) <u>or</u> never reach atmosphere above equator (1)		2	

2005 AH Physics Sample answer and mark allocation	Notes	Margin	
8(a) 2 volts is induced in the coil when the current changes at (a rate of) 1 A s^{-1}. (1)		1	9
(b) $E = -L\frac{dI}{dt}$ (½) $-12 = -2 \times \frac{dI}{dt}$ $\frac{dI}{dt} = \frac{12}{2}$ (½) $= 6$ A s^{-1} (1)	minus sign missing ⇒ 0 marks (E is back emf across L) $12 = -2 \times \frac{dI}{dt}$ ⇒ (½) max (formula)	2	
(c)(i) I_{max} is less (½) due to V_s less (½) [calculation evidence $I_{max} = \frac{10}{4}$ $= 2{\cdot}5$ (A) (½)] (initial) $\frac{dI}{dt}$ is greater (½) since L is smaller (½) [calculation evidence $\frac{dI}{dt} = \frac{10}{1{\cdot}5}$ $= 6{\cdot}7$ (A s^{-1}) (½)]	Allow justification with no calculations	2	
(c)(ii) $E = ½LI^2$ (½) $= 0{\cdot}5 \times 1{\cdot}5 \times 2{\cdot}5^2$ (½) $= 4{\cdot}7$ J (1)		2	

2005 AH Physics			
Sample answer and mark allocation	**Notes**	**Margin**	
8(d)(i) (gold bracelet) moves in magnetic field (1) (conductor)		1	
(d)(ii) moving magnetic field or changing current (½) induces current (voltage) (½)		1	

2005 AH Physics Sample answer and mark allocation	Notes	Margin	
9(a)(i) $2\pi f = 1570$ (1) $f = \dfrac{1570}{2\times3{\cdot}14}$ $= 250$ Hz (1)		2	9
(a)(ii) $y = 4\times10^{-4}\sin(1570t + 4{\cdot}6x)$ (1) for amplitude (1) for plus sign		2	
(b)(i) frequency increases approaching (½) and decreases after train passes (½)		1	
(b)(ii) The waves (wavefronts) are closer together as they approach the person (1) then they are further apart after they pass the person (1) **or**  (1) (1)	Any statement of speed of sound increasing or decreasing (0)	2	
(b)(iii) $f = f_s \dfrac{v}{v + v_s}$ (½) $760 = 800 \times \dfrac{340}{340 + v_s}$ (½) $340 + v_s = 358$ $v_s = 18$ m s^{-1} (1)	"-" used ⇒ 0 marks "±" used does not get formula (½) unless "+" is selected in the next line	2	

2005 AH Physics Sample answer and mark allocation	Notes	Margin	
10(a)(i) $\lambda = \frac{xd}{D}$ (½) $= \frac{0{\cdot}25\times10^{-3} \times 8\times10^{-3}}{3{\cdot}91}$ (½) $= 5{\cdot}1 \times 10^{-7}$ m (1)		2	9
(a)(ii) % uncertainty in x $= \frac{0{\cdot}5 \times 100}{8} = 6{\cdot}25\%$ (½) % uncertainty in d $= \frac{0{\cdot}01 \times 100}{0{\cdot}25} = 4\%$ (½) (% uncertainty in D) $= \frac{0{\cdot}01 \times 100}{3{\cdot}91} = 0{\cdot}3\%$) % uncertainty in $\lambda = \sqrt{6{\cdot}25^2 + 4^2}$ (½) $= 7{\cdot}4$ % absolute uncertainty in $\lambda = 7{\cdot}4\% \times 5{\cdot}1 \times 10^{-7}$ (½) $= 4 \times 10^{-8}$ m	Allow 6% or $\sqrt{6{\cdot}25^2 + 4^2 + 0{\cdot}3^2}$	2	
(a)(iii) An uncertainty should be quoted to one significant figure	Too many significant figures okay Too many decimal places (0)	1	
(b) (new) % uncertainty in x $= \frac{0{\cdot}5 \times 100}{64} = 0{\cdot}8\%$ (½) (new) % uncertainty in $\lambda = 4\%$ (½) new absolute uncertainty in $\lambda = 4\% \times 5{\cdot}1 \times 10^{-7}$ $= 2 \times 10^{-8}$ m (1)	or $\sqrt{4^2 + 0{\cdot}8^2 + 0{\cdot}3^2}$	2	
(c)(i) The % uncertainty in x is very small compared to the % uncertainty in d (1) **or** reducing 0·8% still further does not change the uncertainty of λ at 4%.		1	
(c)(ii) the slit separation (d) (1)		1	

2005 AH Physics			
Sample answer and mark allocation	**Notes**	**Margin**	
11(a) Unpolarised light has the (electric field) oscillating in all planes. Polarised light has the electric field oscillating in one plane only. (1)	 Accept diagrams Plus explanation In all directions (0) In one direction (0)	1	6
(b)(i) (Polarised) light cannot pass through the liquid crystal (1) and is not reflected by the mirror. (1)		2	
(b)(ii) Switch is opened. (1)		1	
(c) The numbers disappear (or cannot be seen) and then re-appear. (1) Light reflected from calculator polarised (½) Indication of polarising material blocking/allowing transmission of light depending on rotation. (½)		2	

[END OF MARKING INSTRUCTIONS]