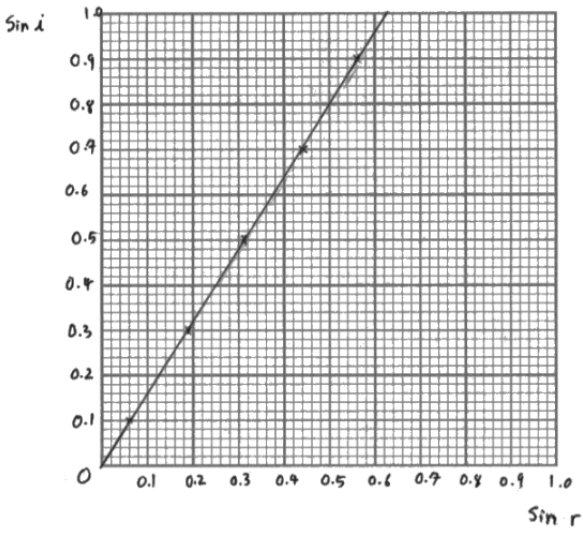
Question number	Answer	Notes	Marks
4	MP1 nebula/gas cloud; MP2 protostar; MP3 main sequence (then red supergiant); MP4 supernova; MP5 neutron star/ black hole;	1 mark penalty for any incorrect sequence	5

Total for Question 4 = 5 marks

Question number	Answer	Notes	Marks
6 (a)	correct symbol for voltmeter in parallel with any component; voltmeter drawn in parallel with the LDR;		2
(b) (i)	$V = I \times R$;	allow any re-arrangement allow word equation condone 'i' for current reject 'c' or 'C' for current	1
(ii)	substitution; evaluation; e.g. $V = 7.8 \times 10^{-3} \times 73$ $V = 0.57$ (V)	POT error gives 1 mark penalty allow 0.5694 (V) for both marks '0.6 (V)' scores 1 mark	2
(iii)	idea that voltages of two resistors in series adds up to supply voltage; calculation of correct voltage; e.g. $V_{cell} = 1.5 = V_{LDR} + V_{resistor}$ $V_{LDR} = 1.5 - 0.56(94)$ $V_{LDR} = 0.93$ (V)	 allow ecf from 6(c)(ii) allow 0.9306 (V) for both marks	2
(c) (i)	resistance decreases (with increasing L.I); non-linear/decreasing rate/curve;		2
(ii)	increases;		1
(iii)	larger current means larger voltage across fixed resistor; total voltage remains constant;		2

Total for Question 6 = 12 marks

(b)	(i)	any FOUR from: MP1 any method of recording an incident ray; MP2 any method of recording a refracted ray; MP3 range of angle of incidences; MP4 normal lines drawn; MP5 angles measured using a protractor;	accept marks on a clear, labelled diagram	4
	(ii)	axes labelled; appropriate scale with data enclosed by 3 x 3 grid or larger; points plotted correctly within ½ a square;		3
	(iii)	best fit straight line drawn with ruler;	judge by eye	1
	(iv)	evidence of gradient triangle used; evaluation of 1.6;  	accept markings on graph or evidence of a gradient calculation. accept answer in range 1.55 – 1.65 consistent with candidate's LoBF allow ecf from candidate's LoBF	2

Total for Question 10 = 16 marks

Question number	Answer	Notes	Marks
11 (a)	any THREE from: MP1 walls further apart; MP2 fewer collisions between particles and walls per second/lower frequency of collisions; MP3 means (average) force on walls lower; MP4 lower force means lower pressure for same wall surface area;	 reject unqualified 'fewer collisions' accept idea that force per collision is the same ignore references to particles colliding with each other accept	3
(b)	substitution into given equation "$p_1 \times V_1 = p_2 \times V_2$"; rearrangement to give p_2; evaluation of p_2; e.g. $101 \times 110 = p_2 \times 140$ $p_2 = 101 \times 110 / 140$ $p_2 = 79\,000$ (Pa)	 allow 79357.1... (Pa), 79(.4) kPa , standard form	3
(c)	any THREE from: MP1 pressure outside balloon is lower than inside balloon; MP2 pressure difference causes a force; MP3 force is outwards on balloon; MP4 force causes extension of balloon;	 accept 'stretching'	3

Total for Question 11 = 9 marks