Question number	Answer	Notes	Marks
1 (a)	B (no earth connection);		1
(b)	C (the circuit cannot overheat if there is a fault);		1
(c)	A (in parallel);		1

Total 3 marks

Question number	Answer	Notes	Marks
4 (a) (i)	6.1 (m);		1
(ii)	any two from:- MP1. (on distance-time graph,) flat line means zero speed / eq MP2. (so) count when slope is zero; MP3. 7 (times);	allow flat or horizontal for zero slope	2
(b) (i)	(average) speed = <u>(total) distance moved</u> / (total) time taken	allow defined symbols ignore 'triangles'	1
(ii)	Substitution; Calculation; Matching unit; e.g. Average speed = <u>6.1</u> / (7x 60) = 0.0145 = 0.015 m/s	allow both substitution and calculation marks for a correct value without working allow 6.1, or ecf for distance 7 for time allow alternatives with compatible unit, e.g. 1.45 cm/s OR 1.5 cm/s 14.5 mm/s OR 15 mm/s 0.87 m/minutes 87 cm/minute 870 mm/minute Allow for 1 mark 6 / 7 or 0.9	3

Total 7 marks

Question number	Answer	Notes	Marks
6 (a) (i)	only 2.65 (mm) circled;		1
(ii)	discards anomaly; performs averaging; quotes answer to 3sf / 2 d.p.; e.g. 3.60 + 3.62 + 3.63 + 3.61 ~~+ 2.65~~ + 3.62 + 3.60 + 3.61 (= 25.29) 25.29 ÷ 7 = 3.612857... = 3.61 (to 3 sf	÷ 7 or ÷ 8 sufficient even if sum is incorrect e.g. 3.61→3 marks 3.6128 →2 marks (wrong sf) 3.49→ 2 marks (includes anomaly) 3.4925→ 1 mark (includes anomaly and wrong sf)	3
(b) (i)	Bar chart/graph;	condone histogram	1
(ii)	Idea that (size) data is discontinuous; and either of - Idea that there are no values between sizes; Idea that a line graph would indicate continuity;	discrete, categoric, non continuous allow "no half sizes"	2
(iii)	Idea of inverse relationship; Idea of non-linearity;	allow a pattern sentence, condone negative correlation allow "almost" linear Ignore idea of proportionality	2

Question number	Answer	Notes	Marks
11 (a)	D;		1
(b)	Any four of - MP1. mention of ray box/pins; MP2. Use of protractor; MP3. (vary *i* to) obtain a range of values; MP4. statement of equation; $n = \frac{\sin i}{\sin r}$ MP5. plot a graph of sin *i* against sin *r*; OR calculate/work out/ find *n*; MP6. find gradient of graph; OR calculate average of n; MP7. sensible experimental precaution; OR improvement to a basic method;	ignore reference to critical angle allow Snell's Law equation in words allow correct use of A and D from diagram including – • draw lines with a ruler, • use a thinner beam/slit, • use a monochromatic beam, e.g. red, • fix block firmly in position, • set any anomalous readings aside, • use a sharp pencil, • use a more precise protractor e.g. to ½°	4

Total 5 marks

Question number	Answer	Notes	Marks
13 (c) (i)	KE = ½ mv^2;	Words or symbols	1
(ii)	Conversion to kg; Substitution into correct equation; Rearrangement; Evaluation; e.g. 45 g = 0.045 kg (or 1 kg = 1000 g etc) $36 = ½ \times 0.045 \times v^2$ $v^2 = \frac{2 \times 36}{0.045}$ (= 1600) 40 (m/s)	allow • 1000 seen • steps in any order • correct answer with no working for full marks • up to 3 marks for use of 45 kg →1.26 (m/s)- working must be seen	4
(iii)	Any one of- • (Hit the ball transferring) more energy; • (Hit the ball with) more velocity; • (Hit the ball with) more speed; • (Hit the ball with) more force;	Ignore • harder • power Allow • momentum • keep contact for a larger part of the swing • go to a place where g is less (e.g. on the moon) • hit ball at a steeper angle / vertically (e.g. use a more lofted club)	1

Total 12 marks