<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 (a)</td><td>1 mark for each correct tick;;;

<table><tr><th>Radiation</th><th>Ionising</th><th>Non-ionising</th></tr><tr><td>alpha</td><td>✓given</td><td></td></tr><tr><td>beta</td><td>✓</td><td></td></tr><tr><td>gamma</td><td>✓</td><td></td></tr><tr><td>ultrasound</td><td></td><td>✓</td></tr></table></td><td></td><td>3</td></tr>
<tr><td>(b)</td><td>any two sensible ideas
e.g.

• keep time exposure short;

• store source in lead container;

• keep distance exposure as long as possible;

• wear protective clothing (1 MAX);</td><td>ignore
idea of ingestion

condone
short half-life for short time exposure

allow
tongs or barrier for distance

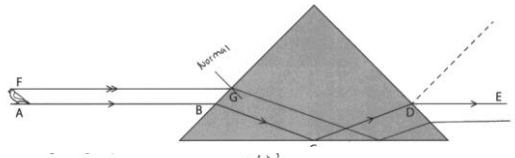
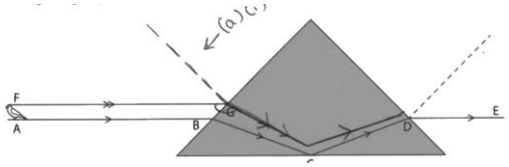
e.g.
goggles, lab coat, gloves, mask, etc</td><td>2</td></tr>
</table>

Question number		Answer	Notes	Marks
3 (a)	i	3.1 ONLY circled in the table;		1
	ii	(average) speed = distance (moved)/time (taken);	accept words or standard symbols	1
	iii	discards anomalous result; calculates mean time for B; substitution; evaluation; e.g. average time = 4.7 gets 1 marks average time = 5.5 gets 2 marks speed = 20/ 5.5 gets 3 marks =3.7 gets 4 marks	 allow 4.67 Allow 5.45 allow 20/5.45 Allow 3.67 answers which round to 4.3 get 3 marks	4
	iv	explanation including the following ideas EITHER bar chart; because woodpeckers are discrete / eq; OR mass is a continuous variable; therefore scatter-gram / eq;	 condone histogram DOP DOP allow line graph	2
b		discussion to include any 3 ideas from: MP1. there is no (discernible) pattern; MP2. supporting data quoted; MP3. discussion of why prediction is wrong/ C should be fastest; MP4. three data sets is insufficient to decide; MP5. need for further data to extend range of results;	no mark for unqualified 'yes' or 'no' results don't go in order/eq allow calculated speeds (cm/s) A= 1.8 B= 3.7 (4.3) C = 2.3 A heaviest,slowest; B middle, fastest; C lightest, middle ignore discussion of anomalies	3

Total 11 marks

Question number	Answer	Notes	Marks
8 (a) i	B a 1 kg mass would weigh more on Earth than on Uranus;		1
ii	C 4 N/kg;		1
b i	conversion into s; substitution into correct equation (no mark for equation); rearrangement; evaluation; e.g. $1350 = \frac{2 \times \pi \times r}{1820 \times 60}$ $r = \frac{1350 \times 1820 \times 60}{2 \times \pi}$ = 23 500 000 (m)	factor of 60 seen $\text{orbital speed} = \frac{2 \times \pi \times \text{orbital radius}}{\text{time period}}$ 23 462 621(m) POT error loses one mark 391 000 gains 3 marks	4
ii	A		1

Total 8 marks

Question number	Answer	Notes	Marks
11 (a) i	normal drawn at G ;	by eye	1
ii	value for G ; (45) value for D; (45)	tolerance ±2°	2
b	ray has been reflected; totally internally; because angle of incidence > critical angle;	allow 42 or 43°	3
c	correct refraction at G downwards; TIR on bottom surface; emergent ray parallel to and below DE;  =3  = MP1 only		3

Total 10 marks