UNIT 2: FORCES, SPACE and RADIOACTIVITY
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

<u>Extended response question</u>

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

<u>Marking abbreviations</u>

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao   = correct answer only
ecf   = error carried forward
bod   = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			<table><tr><td>Statement</td><td></td></tr><tr><td>Atoms of all of these isotopes have the same number of protons in their nuclei.</td><td></td></tr><tr><td>An atom of uranium has 92 neutrons in its nucleus.</td><td></td></tr><tr><td>An atom of californium has the greatest number of protons in its nucleus.</td><td>✓</td></tr><tr><td>An atom of californium has the smallest number of neutrons in its nucleus.</td><td>✓</td></tr><tr><td>Uranium is not a naturally occurring element.</td><td></td></tr><tr><td>An atom of uranium has 92 protons in its nucleus.</td><td>✓</td></tr></table> 1 mark for each correct answer		3		3		
	(b)			234 (1) 90 (1)		2		2		
	(c)			$^{232}_{92}U$ (1) and $^{235}_{92}U$ (1)	2			2		
				Question 1 total	**2**	**5**	**0**	**7**	**0**	**0**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	The distance travelled by light in one year	1			1		
		(ii)	Distance = 300 000 × 500 (1) = 15 000 000 [km] (1)	1	1		2	2	
		(iii)	9 × 15 000 000 [km] (1) = 135 000 000 [km] (1)	1	1		2	2	
	(b)		supernova red giant neutron star white dwarf 1 mark for each correct answer in the correct position (4)	4			4		
			Question 2 total	**7**	**2**	**0**	**9**	**4**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Lead, aluminium, beta, gamma. All four correct – 3 marks 2 or 3 correct - 2 marks 1 correct – 1 mark			3	3		
	(b)	(i)		Radioactive decay is a random process.	1			1		
		(ii)		Mean = 20 (1) $\dfrac{20}{60}$ = 0.33 [counts/s] (1)		2		2	2	
		(iii)		Rocks / cosmic / radon / food	1			1		
				Question 3 total	**2**	**2**	**3**	**7**	**2**	**0**

Question			Marking details	Marks Available					
				AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
4	(a)	(i)	450 [N]		1		1	1	
		(ii)	Substitution: $\dfrac{450}{60}$ (1) Acceleration = 7.5 [m/s^2] (1)	1	1		2	2	
	(b)		**Indicative content:** Initially, the only force acting on the skydiver is her weight. This makes her accelerate at 10 m/s^2. However, as her speed increases, the air resistance acting upwards on her increases and this reduces the resultant downward force on her. Her downward acceleration thus decreases until she reaches a situation in which her weight and the upward force of air resistance are balanced. She no longer accelerates and travels at a constant speed called her terminal velocity. **5 – 6 marks** Detailed description of the forces involved relating them to her motion without omission. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks** A description of the forces involved, identifying them by name and relating them in part to changes in her motion. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** A basic description of the forces is given in which one force is identified and some attempt is made to identify changes in motion. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.*	6			6		

				0 marks *No attempt made or no response worthy of credit.*						
				Question 4 total	**7**	**2**	**0**	**9**	**3**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		$W \times 20 = 5 \times d$	1			1	1	
		(ii)		All 6 points correctly plotted within ±½ small square division (2) 5 points correctly plotted within ±½ small square division (1) 1-4 points correctly plotted within ±½ small square division (0) Correct straight line of best fit within ± ½ small square division of all points (1) Don't accept thick, double, whispy lines		3		3	3	3
		(iii)		2.5 [N]		1		1	1	1
		(iv)		24 [cm]		1		1	1	1
		(v)		As d increases, W increases (1) in proportion / doubling each time d doubles (or similar)(1)		2		2		2
		(vi)		Repeat readings would not have been necessary (1) as all of the results are perfectly along a straight line (1)			2	2		2
	(b)			Anticlockwise moment = $40 \times 7 = 280$ [N cm] (1) Clockwise moment = $(10 \times 20) + (8 \times 10)$ = 280 [N cm] (1) Claim is correct because moments are the same (1)			3	3	2	3
				Question 5 total	**1**	**7**	**5**	**13**	**8**	**12**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		Slow down the neutrons	1			1		
		(ii)		Absorb neutrons	1			1		
		(iii)		Absorb radiation	1			1		
	(b)	(i)		[Nuclear] fission	1			1		
		(ii)		Barium OR krypton	1			1		
	(c)			1. The waste is very radioactive (1) 2. The waste has a long half-life (1)	2			2		
				Question 6 total	**7**	**0**	**0**	**7**	**0**	**0**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)	14 [m/s]		1		1	1	
		(ii)	26.5 [m]		1		1	1	
	(b)	(i)	Substitution: $\dfrac{18.7}{25}$ (1) Time = 0.748 [s] (1)	1	1		2	2	
		(ii)	70.7 – 18.7 (1) Distance = 52.0 [m] (1)			2	2	2	
	(c)	(i)	Ice / wet / oil on road / poor brakes / bigger speed / worn tyres	1			1		
		(ii)	Line over-drawn along the inner spiral on the diagram		1		1		
			Question 7 total	**2**	**4**	**2**	**8**	**6**	**0**

Question			Marking details	Marks Available					
				AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
8	(a)		0.16 [s]		1		1	1	
	(b)		Selection and substitution: $\dfrac{100}{9.58}$ (1) Speed = 10.44 (1) Unit = m/s (1)	1 1	 1		 3	 2	
	(c)		They need strong leg muscles / big muscle mass relative to body weight (1) which are needed to exert a large force on the ground (1)		2		2		
	(d)		Continuous line from (0,0) to (60,12.4) (1) Line has decreasing gradient (1) Any line showing small decrease in speed beyond (80,12.4) (1)			3	3	3	
			Question 8 total	**2**	**4**	**3**	**9**	**6**	**0**

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
9	(a)		The ball decelerates as it rises until it comes to a stop vertically (1) then it accelerates as it falls (1) because gravity pulls down on it (1)		3		3		
	(b)	(i)	Change in momentum = 0.16 × (0 – 40) (1) = [-]6.4 [kg m/s] (1)	1	1		2	2	
		(ii)	Selection and substitution: $\dfrac{6.4}{0.4}$ (1) **ecf** = 16 [N] (1)	1	1		2	2	
		(iii)	32 [N] **ecf**		1		1	1	
	(c)		Bend knees on landing (1) Increases time to stop (1) which decreases the force on legs (1)			3	3		
			Question 9 total	**2**	**6**	**3**	**11**	**5**	**0**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	5	0	7	0	0
2	7	2	0	9	4	0
3	2	2	3	7	2	0
4	7	2	0	9	3	0
5	1	7	5	13	8	12
6	7	0	0	7	0	0
7	2	4	2	8	6	0
8	2	4	3	9	6	0
9	2	6	3	11	5	0
TOTAL	32	32	16	80	34	12