Projectiles Past Paper Answers A Level Physics WJEC

1.

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
(a)	(i)	$ut + ½ (v - u)t$ / area of trapezium i.e. $½ (u + v)t$ (1) Displacement [in time t] (1)	1	1		2	2	
	(ii)	Use of light gates (1) Measure time for a fixed distance (1)	1 1			2		2
(b)	(i)	**Height of cliff:** Use of $x = ut + ½ at^2$ (1) $ut = 0$ **and** $a = 9.8$ [m s^{-2}] (1) $x = 122.5$ [m] (1) **Vertical velocity:** Use of $v = u + at$ (1) $v = 49$ [m s^{-1}] (1) **Initial horizontal velocity:** $u = 2$ [m s^{-1}]	1 1	 1 1 1 1		6	4	
	(ii)	Straight diagonal line (1) Starting at (0,0) finishing at (5,49) (1) Horizontal line starting at (0,2) (1)		1 1 1		3	3	
(c)		Increase time of flight (1) Reduce final velocity (1)			1 1	2		
		Question 2 total	**5**	**8**	**2**	**15**	**9**	**2**

2.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(a)		Horizontal remains constant (1) vertical decreases to zero then increases / downward component increases (1)	2			2		
	(b)	(i)	$u_y = u\sin 20$ and $u_x = u\cos 20$ (1) $t = 0.035u$ or $t = \frac{21}{u\cos 20}$ (1) Horizontally $x = u\cos 20\, t$ (1) $v = 25.3$ [m s^{-1}] (1)			4		4	4	
		(ii)	Use of $v^2 = u^2 + 2ax$ (1) Use $v^2 = 0$ and manipulation (1) $x = 3.82$ [m] ball is above the bar (1)			3	3	3	
		(iii)	Ball wouldn't go as high / horizontal velocity decreases (1) [Vertical] velocity falls to $v = 0$ quicker / ball on the way down by the time it crosses the line (1)			2	2		
			Question 7 total	**2**	**4**	**5**	**11**	**7**	**0**

3.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*		$3 \times 10^{-3} \times 85 = 2.6v$ **or** $0 = 3 \times 10^{-3} \times 85 - 2.6v$ (1) $v = 0.10$ [m s^{-1}] / 0.098 [m s^{-1}] (1)		2		2	2	
	(b)	(i)	Time = $\frac{40}{85} = 0.47$ [s] (1) Use of $s = ut + \frac{1}{2}at^2$ (1) $s = 1.08$ [m] (1)	1	1 1		3	3	
		(ii)	Vertical $v = 4.6$ [m s^{-1}] (1) Tan $\theta = \left(\frac{4.6}{85}\right)$ **ecf** for vertical velocity (1) $\theta = 3.1$[°] (1)		3		3	3	
	(c)	(i)	Greater (1) Horizontal velocity reduced (1)			2	2		
		(ii)	KE before = 10.84 J / KE after = 1.35 J (1) Difference in KE = 9.49 J (1) $F = \frac{9.49}{40} = 0.24$ [N] (1) **Alternative:** $F = 0.5 \times 3 \times 10^{-3} \times \frac{85(^2 1) - 30^2}{40}$ 1) $F = 0.24$ [N] (1) **Alternative:** Using $v^2 = u^2 + 2as$, $a = 79$ m s^{-2} (1) Using $F = ma$ (1) $F = 0.24$ [N] (1)		3		3	3	
			Question 3 total	**1**	**10**	**2**	**13**	**11**	**0**

4.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
(a)	(i)		Constant horizontal velocity if/because no horizontal force [1] That is if air resistance ignored **or** air resistance would/will make horizontal velocity decrease [1]	2			2		
	(ii)		From horiz motion, e.g. $t = \frac{6.0}{9.0} = 0.667$ [s] [1] So from vertical motion, $y = \frac{1}{2}9.81 \times \left(\frac{6.0}{9.0}\right)^2 = 2.18$ [m] **ecf on *t*** [1] Conclusion consistent [1] **Alternative:** From vertical motion, e.g. $t = \sqrt{\frac{2 \times 2.2}{9.81}} = 0.67$[0] [s] **ecf on *t*** [1] From horiz motion, $v_h = \frac{6.0}{0.67} = 8.96$ [m s^{-1}] **ecf on *t*** **or** $x = 9.0 \times 0.67 = 6.03$ [m] [1] Conclusion consistent [1] **Alternative**: Time from horiz motion = 0.67 [s] [1] Time from vertical motion = 0.67 [s] [1] Conclusion consistent [1]			3	3	2	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
(b)			Vertical velocity component, v_v = 6.5 [m s^{-1}] or 6.6 [m s^{-1}] [1] Diagram showing v_v, v_h and v_{res} **or by implication if correct answer** [1] Angle to horiz = 36° or angle to vertical = 54° [1] **ecf** on v_v Magnitude of velocity = 11 [m s^{-1}] [1] **ecf** on v_v		4		4	3	
			Question 1 total	**2**	**4**	**3**	**9**	**5**	**0**

5.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
(a)			$v = at$ and $v^2 = 2ax$ seen (i.e. consequence of $u = 0$ on equations) (1) $a^2t^2 = 2ax$ seen (1) [implies first mark]	1	1		2	2	
(b)			Graph 3 (1) Vertical: constant acceleration due to [force of] gravity (1) Horizontal: **no** acceleration (accept constant speed or constant velocity) because no forces act (1)	1	1 1		3	1	
(c)	(i)		$t = \frac{1.8}{3.4}$ [= 0.53 s] (1) Height = ½ × 9.81 × 0.53^2 (1) substitution and $u = 0$ **(ecf on *t*)** Height = 1.37 [m] (1)	1	1 1		3	3	
	(ii)		Vertical velocity = 9.81 × 0.53 = 5.2 [m s^{-1}] (1) **(ecf on *t*)** [Alternative: vertical velocity = ((2 × 9.81 × 1.37)$^{1/2}$) **(ecf on *h*)** Pythagoras: $V_R^2 = 5.2^2 + 3.4^2$(1) **(ecf on vertical velocity)** V_R = 6.2 [m s^{-1}] (1) At 57° to the horizontal (1) (apply **ecf** if incorrect vertical or resultant velocity used to calculate angle)	1	1 1 1		4	4	
(d)			Untrue **and** link to ... Flight time depends on **(two** × (1) **from):** • drop height • acceleration [due to gravity] • [initial] vertical velocity [Award 1 mark only for untrue because horizontal and vertical motions are independent of each other]			2	2		
			Question 5 total	**4**	**8**	**2**	**14**	**10**	**0**

6.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)		**Vertical**: Decreasing (accept deceleration), then increasing (accept acceleration) / changes at 9.81 m s^{-2} (1) **Horizontal**: Constant (1) **Reason**: Gravity acts vertically **or** no forces act horizontally (1)	3			3		
	(b)	(i)	0.15 [m s^{-1}] i.e. $\frac{(1000)}{(110 \times 60)}$ or 0.54 km/h		1		1		
		(ii)	Correct substitution into $x = ut + ½ at^2$ Ignore sign convention e.g. 1 000 = ½ × a × (55 × 60)^2 (1) At least one mathematical step shown leading to a = 0.00018 [m s^{-2}] e.g. $a = \frac{2\,000}{1.09 \times 10^7}$ (1) **Alternative:** $u_{vertical}$ calculated from $x = ½(u + v)t$ i.e. u = 0.606 m s^{-1} (1) Substitution into: $a = (v\text{-}u)/t$ to show a = 0.00018 [m s^{-2}] (1)	1	1		2	2	
		(iii)	Correct substitution into $v = u + at$ **or** $v^2 = u^2 + 2ax$ e.g. 0 = u – 0.00018 (55 × 60) **or** 0 = u^2 – 2 × 0.00018 × 1 000 (1) **ecf** [accept use of 0.0002 m s^{-2}] e.g. u = 0.61 [m s^{-1}] (1) e.g. $\frac{0.61}{0.88}$ × 100% seen (1) Accept 67% – 75% **Alternative for final mark:** 60% of 0.88 m s^{-1} = 0.53 m s^{-1} therefore: 0.61 > 0.53	1	1 1		3	3	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		For: • Job creation • Cost/year reasonable • Generate interest in science • New technologies developed e.g. renewable • Improve understanding of origin of life on earth Against: • Funding could have been used to address earth based issues. • Little impact on society • Costs outweigh discoveries • Risky mission it might have failed 3 statements given **must expand** on bullet points in question (3) No mark for agreeing or disagreeing			3	3		
			Question 6 total	**5**	**4**	**3**	**12**	**5**	**0**