WJEC Physics GCSE
Topic 2.4: Further motion concepts
Mark Schemes for Questions by topic

1.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(i)			2	momentum = 50 000 × -2 (1-subs) = -100 000 [kg m/s] (1 –ans)	100 000 to the left gets 2 marks. NB1: 50 000 × 2 = 100 000 gets 1 mark. NB2: 50 000 × -2 = 100 000 gets 1 mark NB3: 50 000 × 2 = -100 000 **gets 1 mark** NB4: 50 000 × 2 = 100 000 to the left **gets 1 mark**		50 000 + -2 = ±100 000
(ii)			1	The negative of answer in (i) i.e. 100 000 [kg m/s] **ecf**			
(iii)			2	Answer from part (ii) ÷ 80 000 (1-subs) = 1.25 [m/s] or correct answer for their substitution (1)	If no answer in part (ii) and answer from part (i) used to get a correct answer award 1 mark only		
	Total		5				

2.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	[When two or more objects interact the total] momentum remains constant <u>providing no external forces act</u>	Momentum before = momentum after <u>provided no external forces act</u>		
(b)	(i)		3	Initial momentum = 0.01v OR 10v (1) Final momentum = 0.4 × 10 = 4 OR 4 000 (1) Therefore $v = \dfrac{4}{0.01}$ or $\dfrac{4\,000}{10}$ = 400 [m/s] (1)			
	(ii)		3	Initial KE = 0.5 × 0.01 × 400^2 **ecf** = 800 [J] (1) Final KE = 0.5 × 0.4 × 10^2 = 20 [J] (1) Subtraction of their 2 values i.e. 780 [J] (1) **don't award 3rd mark if negative answer**	For final KE = 19.5 [J] based on 0.39 kg for the final momentum in (b)(i) award 2nd mark		
	TOTAL		7				

3.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			2	Equal[s] (1) Force[s] (1)	Must be Is [the same as] Stays the same as		
(b)	(i)		3	Initial momentum = 1 000 × 5 or 5 000 (1) 800 × 2 or 1 600 (1) Correct addition of 2 momenta (**ecf**) i.e. 6 600 [kg m/s] (1)			1 000 × 5 not equal to 5 000 800 × 2 not equal to 1 600
	(ii)		1	Momentum of van = 3 400 [kg m/s]			
	(iii)		1	Mom of car = 6 600 (**ecf**) – 3 400 (**ecf**) = 3 200 [kg m/s]			
	(iv)		1	$\dfrac{3\,200\textbf{ecf}}{800}$ = 4 [m/s]			
(c)			1	16 000 [N] on the van **or** to the left	Same size force on the van -16 000 [N] 16 000 [N] backwards / back / in the opposite direction		
	TOTAL		9				

4.

Question			Marking details	Mark
5.	(a)	(i)	0.15 x 20 (1 for substitution) = 3 [kg m/s] (1)	2
		(ii)	$\dfrac{3}{0.5}$ (1) allow **ecf** from (i) = 6 [N] (1)	2
		(iii)	3 [N] allow **ecf** from (i) which gives the same answer as in (i) **or** allow **ecf** from (ii) which gives half the answer to (ii)	1
	(b)	(i) (ii)	e.g. car crash / emergency stop / sudden braking / landing on ground <u>Stretchy</u> seat belt / air bag / crumple zone to achieve it/ bending legs on landing **Mark parts (i) and (ii) together.**	2
			Question total	**[7]**

5.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		2	Substitution into $x = ut + \frac{1}{2}at^2$ i.e. $x = [0 +]$ ($\frac{1}{2} \times 10 \times 2.8^2$) (1) Answer = 39.2 [m] (1)	Combinations of equations of motion – find the mean speed (14 m/s) (1) and use of distance = speed × time = 39.2 [m] (1)		2.8 × 28 = 78.4 [m]
(b)		3	Substitution into $v = u + at$ i.e. $v = [0] + 10 \times 2.8$ (1) $v = 28$ [m/s] (1) Momentum = mv = 0.3×28 (**ecf**) = 8.4 [kg m/s] (1)	Use of energy argument to get value for v i.e. PE = 117.6 J (**ecf**) (1) use KE to find $v = 28$ [m/s] (1) Substitution into $v^2 = u^2 + 2ax$ **ecf** on x (1) $v = 28$ [m/s] (1)		
(c)	(i)	2	Substitution into KE = $\frac{1}{2}mv^2$ i.e. KE = $\frac{1}{2} \times 0.3 \times 14^2$ (1) Answer = 29.4 [J] (1)			KE = $\frac{1}{2} \times 0.3 \times 14$
	(ii)	2	Momentum after bounce = [-] 4.2 (1) Change in momentum = - 4.2 - 8.4 **ecf** = [-]12.6 [kg m/s] (1)	Change in momentum = 8.4 **ecf** + answer for momentum after bounce – award 2 marks		
	(iii)	2	Change in momentum of the ball (1) is equal [and opposite] to the change in momentum of the Earth (1) The **2nd** mark can only be awarded if it is linked to the **1st** mark.			Statement of principle of conservation of momentum
(d)		2	Force on Earth / ground from the ball (1) <u>equal and opposite</u> force on ball from Earth / ground (1)	Force on Earth from the ball = force on ball from Earth (1)		Statement of N3rd Law
Total		13				

6.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		3	Use of $v = u + at$ (1) by implication $= 0 + (12 \times 10)$ (1) $= 120$ [m/s] (1)	$65 + (12 \times 10) = \underline{185}$ award 2 marks $65 + (12 \times 10) = \underline{\text{not equal to } 185}$ award 1 mark Statement that $u = 0$ only award 1 mark		
(b)		3	Use of $x = \frac{1}{2}(u+v) \times t$ (1) by implication $= \frac{1}{2}(0 + 120$ [ecf]$) \times 12$ (1) $60 \times 12 = 720$ [m] (1)	If u identified as 65 in (a) then apply **ecf** in (b) for: $\frac{1}{2}(65 + 185) \times 12 = 1\,500$ [m] award 3 marks The following may be seen by candidates taught HT Use of $x = ut + \frac{1}{2}at^2$ $= 0 + (5 \times 144) = 720$ [m] Use of $v^2 = u^2 + 2ax$ $120^2 = 0 + 2 \times 10 \times x = 720$ [m]		
(c)		2	Dist $= 65 \times 12$ (1) $= 780$ [m] (1)			
TOTAL		8				

7.

Question			Marking details	Marks
3.	(a)	(i)	15 [m/s] (1)	1
		(ii)	900 [kg m/s] (1) **ecf**	1
		(iii)	$\dfrac{900(\text{ecf})}{6} = 150$ (1) N **or** kg m/s² **or** Newtons (1)	2
	(b)		The same change in momentum happens in a shor<u>ter</u> time / change in momentum per second is gr<u>eater</u> / increased deceleration (1) so force increases / is gr<u>eater</u> (1) **The 2nd mark must be linked to the 1st mark.**	2
	(c)		**Any 2 × (1) from:** Air bag, crumple zone, head rest, passenger cage, ABS (anti-locking) brakes, <u>laminated</u> windscreen, collapsible steering-wheel / side impact bars / child safety seat **Do not accept** flexible bumper / crumble zone / crash zone / head support	2
			Question total	**[8]**

8.

(a)   product of the force and the **perpendicular distance (1)**
reference to a point/pivot **(1)**

2

(b)   (i)   since *W* is at a greater distance from A **(1)**
then *W* must be less than *P* if moments are to be equal **(1)**

(ii)   *P* must increase **(1)**
since moment of girl's weight increases as she moves from A to B **(1)**
correct statement about how P changes
(e.g. P minimum at A, maximum at B, or P increases in a
linear fashion) **(1)**

max 4

9.   [6]

(a)   (sum of) clockwise moment**s** (about a point) =(sum of) anticlockwise
moment**s (1)**

(for a system) in equilibrium **(1)**
accept balanced not stationary

2

(b) $(780 \times 0.35 =)$ 270 (Nm) **(1)** (273)

Nm (1) or newton metre(s) accept Newton metre(s)
(not J, nm or nM, Nms, etc)

2

(c)   (b) + (1100×0.60) **(1)**

$(=) F_A \times 1.3$ **(1)** ($F_A = 660 + 273/1.3$ gets both marks)

$(= 933/1.3) = 720$ (N) **(1)** (717.7 or 715 for use of 930)
ecf (b)

2 sf only (1)
independent mark

4

(d)   (780 + 1100 – (c)) = 1200 **(1)** (1162 N)
ecf (c)

1