WJEC Physics GCSE Topic 2.3: Work and energy
Mark Schemes for Questions by topic

1.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		2	800×10 (1) 8 000 [kg m/s] (1) If multiple calculations shown can only award 2 marks if 8 000 on the answer line			
	(ii)		2	$\dfrac{40\,000}{2\,500}$ (1) 16 [m] (1)			
	(iii)		1	0 [kg m/s]	zero		
	(iv)		2	Its kinetic energy (1) Its momentum (1) Lose 1 mark for any additional phrase underlined			
(b)	(i)		2	23 (1) 18 (1)			
	(ii)		2	Doubles (1) Quadruples (1)	Twice as big or $\times$ 2 (1) 4 times bigger or $\times$ 4 (1)		Increases
Total			11				

2.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		2	$GPE = m\,g\,\Delta h$ $= 90 \times 10 \times 15$ (1 - subs) $= 13\,500$ [J] (1 - ans)	Award 1 mark only if 13 500 is developed further		
	(ii)	I	2	Equating 13 500 (**ecf**) to KE or $\frac{1}{2}\,m\,v^2$ (1) $v = 17.3$ [m/s] answer (1)			
		II	2	Some energy is lost / changed to heat or sound / not all the PE is converted to KE (1) [doing work against] friction/drag/ air resistance (1)		Reference to weight or mass	Wind
(b)	(i)		1	Work done = Fs = $200 \times 500 = 100\,000$ [J] (1-ans)			
	(ii)		2	$GPE = m\,g\,\Delta h = 60 \times 10 \times 120 = 72\,000$ [J] (1-ans) $\dfrac{72\,000}{100\,000}$ **ecf** $\times 100\% = 72$ [%] (1-ans)	Answer of 0.72 award 1 mark only		13 500 used in final calculation – no marks
Total			9				

3.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(b)	ii	3	Work = force × distance moved (written or implied) (1) $F = \dfrac{7.5}{2}$ (1-manip or sub) F = 3.75 [N] (1) **Alternative 1:** Mean speed = 0.25 [m/s] **ecf** Then time = $\dfrac{2}{0.25}$ = 8 [s] (1) Δp = 60 × 0.5 **ecf** = 30 (1) Force = $\dfrac{\Delta p}{t} = \dfrac{30\ \textbf{ecf}}{8\ \textbf{ecf}}$ = 3.75 [N] (1) **Alternative 2:** Mean speed = 0.25 [m/s] **ecf** Then time = $\dfrac{2}{0.25}$ = 8 [s] (1) $a = \dfrac{(v-u)}{t} = \dfrac{0.5\ \textbf{ecf}}{8\ \textbf{ecf}}$ = [-]0.0625 [m/s²] (1) using $F = ma$ F = 60 × [-]0.0625 F = [-]3.75 [N](1)	$F \times d$ =7.5 for the first mark $F = \dfrac{7.5}{2}$ for the first 2 marks		
Total		12				

4.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **two** from: • bungee rope may snap • rope may extend too much • student may land in the river		2	AO2/1 4.1.1 WS1
02.2	gravitational potential kinetic elastic potential	correct order only	1 1 1	AO1/1 4.1.1.1
02.3	½ × 40 × 35² 24 500 (J)	accept 25 000 (J) (2 significant figures) allow 24 500 (J) with no working shown for **2 marks**	1 1	AO2/2 4.1.1.2
Total			7	

5.

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	D the spring has more elastic potential energy than the weight has kinetic energy		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	A description including three from	care should be taken not to award marks for contradictory examples Starting point for description does not matter Ignore sound energy	
	MP1 Elastic potential energy /EPE (in stretched spring) (1)		
	MP2 (EPE is) transferred to KE (initially) (1)	EPE becomes/goes to KE (initially)	
	MP3 change from KE to GPE or vice versa(1)		
	MP4 (correct idea of) energy changes continuing		
	MP5 {total mechanical energy /kinetic +potential energy} decreases (continuously) (1)		
	MP6 (Eventually all is transferred to) {thermal/heat} (energy) (1)	condone amplitude decreases to zero KE or PE 'lost' to surroundings	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	B increase the efficiency of the motorcycle		(1)

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	MP1 (bump produces) relative motion (1) MP2 (motion between magnet and coil) {induces / generates} voltage (1)	coil moves round magnet/magnet moves {into/out of} coil / coil {cuts / moves across} magnetic field ignore magnets slide inside a coil (see stem) electromagnetic induction condone {induces / generates } {current/electricity} ignore (see stem) electrical energy provides / produces	(2)

Question Number	Answer	Acceptable answers	Mark
3(b)(iii)	An explanation linking MP1 {more/frequent} bumps (1) (idea of shorter time / increased frequency) MP2 (bigger bumps produce) bigger amplitude / move more up and down (idea of bigger size) (1) MP3 (so) {induced voltage /voltage generated} is larger (1)	idea of up and down for bump (coil / magnets) move up and down {faster / more often} (coil/magnets) move {further/higher/bigger distance} (up and down) {induced current/current generated} is larger electromagnetic induction gives more voltage/current condone more electricity/electrical energy is {induced / generated} allow once for MP1 (if MP1 or MP2 is not scored): 'bumpier' 'go in and out more'	(3)

6.

Question			Answer	Marks	Guidance
3			**[Level 3]** Detailed explanation of cause of collision injury **AND** explains actions of seat belts and air bags. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Simple explanation of cause of collision injury **AND** explains action of **either** seat belts or of air bags. Detailed explanation of cause of collision injury without action of either seat belt or air bag max 3 marks. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Description of collision **OR** explains action of seat belts **OR** explains action of air bags. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A*** Indicative scientific points may include: **Detailed explanations of cause of collision injury** • Use of work done = force x distance • Use of change of momentum = force x time • Longer time causes smaller force, related to change in momentum **Simple explanation of cause of collision injury** • passenger has momentum in moving car • force from car reduces passenger momentum • passenger injured by force if big enough • Longer time causes smaller force **Description of collision** • passenger stopped/injured by car dashboard/windscreen • car stops suddenly **Seatbelt** • provides force to stop passenger • stretches during collision • increasing time for slowing down passenger • reducing force on passenger • because force = momentum change/time **Airbag** • expands suddenly at collision • provides force to stop passenger • collapses slowly / cushioning • increasing time for slowing down passenger • reducing force on passenger • because force = momentum change/time **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
			Total	6	

7.

Question number			Answer	Notes	Marks
7	(a)		Any 2 from air bags; side impact beams/bars; crumple zones /collapsible bumpers; collapsible steering column /wheel;	Allow references to strong / laminated / safety glass ignore unqualified bumpers	2
	(b)	(i)	Any four from MP1. same momentum change (with or without a seatbelt); MP2. (but) time of impact increases; MP3. (which) reduces rate of momentum change; MP4. (therefore) reducing the (average) force; MP5. the seat belt stretches (during collision); MP6. (which) increases the area over which the force acts; MP7. (hence) pressure on body reduces;	Ignore • references to momentum reducing • word equation	4
	(b)	(ii)	A sensible suggestion; e.g. there is a higher momentum (transfer in collision) there is a larger force during impact straps have a greater area over which force acts larger area of straps reduces the pressure		1

| (c) | Momentum (of car and dummy) reduces to <u>zero</u>;
OR
All momentum is absorbed by the Earth; | | | 1 |