Eduqas Physics GCSE
Topic 1.1: Energy changes in a system
Mark Schemes for Questions by topic

1.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		2	GPE = $m\,g\,\Delta h$ = 90 × 10 × 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 × 500 = 100 000 [J] (1-ans)			
	(ii)		2	GPE = $m\,g\,\Delta h$ = 60 × 10 × 120 = 72 000 [J] (1-ans) $\frac{72\,000}{100\,000}$ ← **ecf** × 100% = 72 [%] (1-ans)	Answer of 0.72 award 1 mark only		13 500 used in final calculation – no marks
Total			**9**				

2.

Question			Marking details	Mark
6.	(a)		Indicative content: As the car is pulled to the top of the hill it gains potential energy. Since this is the highest point of its journey, this will be the maximum potential energy that the car will gain. As the car runs down the other side of the hill, potential energy will be converted to kinetic energy. As the car begins to rise at the next hill, the kinetic energy is then converted back into potential energy and so on. However due to resistive forces, some of the energy is dissipated as heat so during the ride the total energy possessed by the car decreases. This explains why each successive hill must be lower than the previous one. **5 – 6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3 – 4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1 – 2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.	6
	(b)	(i)	Calculation of PE using *mgh* or by implication (1): 1 200 x 10 x 90 (1) = [1 080 000 J] If 1 200 x 10 x 50 **or** 1 200 x 10 x 140 used this implies use of *mgh* so award 1 mark. 1 080 000 **ecf** = ½ mv^2 **or** 1 080 000 **ecf** = KE (1) = 600 v^2 v = 42.4 [m/s] **ecf** (1) **Alternatives:** If PE = KE stated anywhere award 1 mark If show ½ mv^2 = mgh anywhere award 2 marks	4
		(ii)	No (1), because ½ mv^2 = mgh **or** m cancels out (1) Actual KE at bottom = ½ 1 200 x 37^2 = 821 400 [J] (1)	2
		(iii)	Energy loss = 1 080 000 **ecf** – 821 400 **ecf** = 258 600 [J] (1) mean resistive force = WD **ecf** /distance = 2 586 [N] (1)	3
			Question total	**[15]**
			Higher Tier Paper Total	**[60]**

3.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	i		3	KE = mgh (written or implied) (1) $h = \frac{2\,940}{(60 \times 10)}$ (1-manip or sub) h = 4.9 [m] (1-ans)	mgh = 2 940 for the first mark. $h = \frac{2\,940}{600}$ for the first 2 marks Answer of 49 or 490 = 1 mark		
	ii		3	Some energy has been lost [to air resistance] / heat is produced (1) So the diver would have had more than 2 940 J of PE when on the diving board (1) So the diving board would have been higher than 4.9 [m] (**ecf**) (1) **Alternative:** The acceleration would have been smaller (1) So the acceleration would have been over a greater distance (1) So the diving board would have been higher than 4.9 [m] (**ecf**) (1) **To award full marks the first two statements must be linked.**			
(b)	i		3	$½mv^2$ = 7.5 (1) $v^2 = \frac{(2 \times 7.5)}{60}$ (1-manip and sub) v = 0.5 [m/s] (1)	$v^2 = \frac{15}{60}$ or 0.25 for the first 2 marks		

4.

Question			Marking details	Mark
5.		(i)	Substitution into $v^2 = u^2 + 2ax$ (1) $u = 0$ (1) $v = 10$ m/s (1) **Alternative method:** t calculated first **OR another alternative method:** PE = $mgh = 0.2 \times 10 \times 5 = 10$ [J] (1) ½ $mv^2 = 10$ [J] (1) then $v = 10$ [m/s] (1)	3
		(ii)	Recognition that v^2 halves i.e. to 50 (1) Therefore new $v = \sqrt{50} = 7[.07]$ [m/s] (1) **Alternative method:** Initial KE = 10 [J] **ecf** so rebound KE = 5 [J] (1) Calculation of $v = 7[.07]$ [m/s] (1)	2
		(iii)	Substitution into $x = ½ (u+v)t$ (1) rearrange so $t = \frac{2.5}{3.5(\text{ecf})}$ (1) Answer = 0.7[1] s (1) Award same format of marks if $x = ut + \ldots$. is used	3
			Question total	**[8]**

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 MP1 Elastic potential energy /EPE (in stretched spring) (1) MP2 (EPE is) transferred to KE (initially) (1) 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)	care should be taken not to award marks for contradictory examples Starting point for description does not matter Ignore sound energy EPE becomes/goes to KE (initially) condone amplitude decreases to zero KE or PE 'lost' to surroundings	**(3)**

6.

Question	Answers	Extra information	Mark	AO spec ref
7(a)	conduction		1	AO1 1.1.3
7(b)	35 000		1	AO2 1.1.4a
7(c)	500 J/kg°C	their 7(b) = 2 x c x 35 correctly calculated scores **2** marks allow **1** mark for correct substitution, ie 35000 = 2 x c x 35 **or** their 7(b) = 2 x c x 35	2 1	AO1 AO2
7(d)	energy lost to surroundings **or** energy needed to warm heater	accept there is no insulation (on the copper block) do **not** accept answers in terms of human error or poor results or defective equipment	1	AO3 1.1.3d
Total			**6**	

7.

7(a)	4200 J/kg°C	allow **2** marks for correct substitution ie 6930 = 0.330 x c x 5.0 answers of 1050 **or** 840 **or** correctly calculated answer from correct substitution of incorrect temperature change **or** identification of temperature change ie 5 °C gain **1** mark accept J/kg K	3 1	AO2 AO1 P1.1.4d
7(b)	(in a metal) free electrons gain kinetic energy (free electrons) transfer energy to other electrons / ions / atoms by collision	to gain full credit the answer must be in terms of free electrons accept move faster do **not** accept particles allow a maximum of **2** marks for answers in terms of atoms / ions / particles • gaining kinetic energy or vibrating faster / more • transferring energy by collisions	1 1 1 1	AO1 P1.1.3a
7(c)	(air) particles spread out (which causes the) air to become less dense / expand (so the) warm air rises	 do **not** accept particles become less dense do **not** accept heat rises particles rise is insufficient	1 1 1	AO1 P1.1.3a
7(d)	large surface area black / dark (colour)	ignore references to type of metal or external conditions	1 1	AO1 P1.1.3c

8.

(a energy/heat required to increase temperature
- of 1 kg / 1 g / unit mass (of the substance) B1
- by 1 °C / 1 K / unit temperature B1

(b) $E = mc\Delta\theta$ in any form OR $(c =)\ E \div m\Delta\theta$ C1
$E = Pt$ in any form OR 420×95 (= 39 900) C1
$\Delta\theta = [40.5 - 19.5]$ OR 21 C1
$(c = 39\,900 \div 42 =)$ 950 J/(kg °C) A1

(c) any two separate points from: max. B2
- lagging / insulation (around block) OR insulate (the block)
- raise temperature of block by a smaller amount OR heat for a shorter time OR use lower power heater <u>for same time</u> OR higher power <u>for same temperature rise / shorter time</u>
- polish the surface of the block OR wrap the block in shiny material OR paint (shiny) white
- reduce initial temperature of block (to below room temperature) OR raise temperature of room
- reduce draughts

[Total: 8]

9.

(a energy/heat needed to change state of substance/melt B1

(from solid to liquid at constant temperature / melting point) per kg / per unit mass B1

(b) **(i)** $(l_f =)\ Q \div m$ in any form: words, symbols, numbers C1

340 J/kg OR 336 J/g OR equivalent in J/kg A1

(ii) $(c =)\ Q \div [m\Delta T]$ in any form: words, symbols, numbers C1
4.1 J / (g °C) OR 4100 J/(kg °C)

(iii) <u>cold</u> water denser AND sinks B1
convection (current) OR circulation OR warmer water rises B1

[Total: 8]

10.

(a $c = Q/(m\Delta\theta)$ B1

(b) $d = m/V$ in any form OR $(m =) Vd$ OR 0.0036×1000 C1
3.6 kg A1

(ii) $(E =) Pt$ OR 8500×60 OR 510 000 J OR 5.1×10^5 J C1
$\Delta\theta = Q/mc$ OR $\Delta\theta = Pt/mc$ in any form OR $5.1 \times 10^5/(3.6 \times 4200)$ C1
$= 34\,(^\circ C)$ A1

OR $\Delta\theta = P/(\text{mass per second} \times c)$ (C1)
$= 8500/[(0.0036/60) \times 4200$ (C1)
$= 34\,(^\circ C)$ (A1)

outflow temp $= 15 + 33.73 = 49\,^\circ C$ B

[Total: 7]

11.

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	$½ \times 40 \times 35^2$ 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**	