

IGCSE Physics - Section 4– Energy – Mark scheme - teacher.

Q	Content	Marks
1	Convection currents –mine	5
2	Nuclear power – advantages and disadvantages	6
3	GPE, energy transfers, electricity generation	10
4	Forces on a golf ball, KE	12
5	$W=Fd$, GPE, Moments – suitcase	10
6	GPE, KE, forces – flying squirrel	10
7	IR radiation – emission – black & white HD	4
8	GPE and KE springs	6
9	Rollercoaster – GPE, momentum and KE	9
	Total	84

Question 1.

Question number	Answer	Notes	Marks
5	Any five of: MP1. the air (molecules are/is) warmed / heated (by the coal fire); MP2. air expands / molecules move apart; MP3. air becomes less dense; MP4. hot air or less dense air rises; MP5. cooler air (from outside the furnace) displaces warm air; MP6. (above the chimney) air cools / contracts / becomes more dense; MP7. cooled air falls; MP8. Process (of convection) is repeated / continuous;	NB 'convection' is in the stem allow another gas for air -1 for explanations which include the idea that the air particles become less dense/air particles expand/eq	5

Total 5 marks

Question 2.

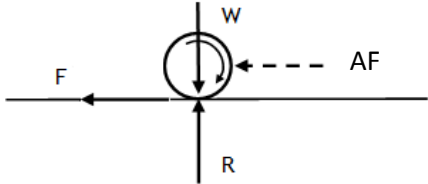
Question number	Answer	Notes	Marks
7	<p>6 marks from with a MAX of 2 from any one area</p> <p>benefits of nuclear fuel MP1. no CO₂ emitted / no smoke emitted; MP2. does not contribute to global warming; MP3. reliable/not weather dependant; MP4. small volume of waste; MP5. concentrated energy source/ not much transport costs to bring fuel; MP6. power stations are relatively small;</p> <p>disadvantages of nuclear fuel MP7. difficult to dispose of waste; MP8. accidents can spread radiation widely / risk of radiation leak; MP9. nuclear fuel is toxic / harmful / radioactive / difficult to handle / long half-life; MP10. decommissioning costs are very high; MP11. increased security risk/ terrorist attack;</p> <p>benefits of biomass MP12. abundant sources / uses waste products from farms /houses/renewable; MP13. uses materials which would produce CO₂ anyway, so no net emission; MP14. can be used to create different products (e.g. manure) as well as energy; MP15. reduces landfill; MP16. (source is) relatively cheap;</p> <p>disadvantages of biomass MP17. relatively inefficient; MP18. can increase methane in atmosphere/can increase green-house gases; MP19. may require more land; MP20. high transport costs to collect raw material; MP21. can be smelly; MP22. often seasonal power source /variable output source; MP23. can be storage costs for biogas;</p>	<p>allow other sensible points</p> <p>no green-house effect</p> <p>Allow waste</p> <p>causes acid rain</p>	6
		total = 6 marks	

Question 3.

Question number	Answer	Notes	Marks
8 (a) (i)	gravitational potential energy = mass x g x height	Allow symbols and rearrangements, e.g. GPE = m x g x h	1
(ii)	Substitution into correct equation; Calculation; e.g. GPE = 2.75 x 10 x 0.61 = 17 (J)	16.8, 16.775, 16.78 (J) allow calculation with g = 9.81 =16.46 (J)	2
(iii)	Any two of- MP1. idea that system is inefficient OR not 100% efficient; MP2. idea that energy is lost / wasted / dissipated ; MP3. explanation /detail of fate of energy; e.g. used when working against {friction / drag / air resistance} as thermal energy to parts of the apparatus or surroundings transferred to surroundings by sound converted into KE as mass fell	condone used / transferred elsewhere Need mention of 'object' Ignore light allow to overcome friction allow heat for thermal energy	2
(iv)	Substitution into correct equation; Calculation; e.g. Energy transferred = 0.46 x 12.7 x 1.3 7.6 (J)	allow answer without working or equation seen (7.5946)	2
(b)	three of the following ideas- MP1. water has (initial) GPE; MP2. KE of (moving) water; MP3. Work done on turbine / generator; MP4. Work done against magnetic force; MP5. Electrical energy/power/current/voltage (produced);	allow KE in turbine / generator	3

Total 10 marks

Question 4.

Question number	Answer	Notes	Marks
13 (a) (i)	<p>Any two of -</p> <p>MP1. arrow downwards, labelled weight;</p> <p>MP2. arrow upwards, labelled reaction/contact force;</p> <p>MP3. arrow to the left, labelled air friction / air resistance / drag;</p> <p>MP4. arrow along the surface, labelled friction;</p> <p>e.g.</p> 	<p>In MP1, 2 & 3, position of arrows unimportant, but direction must match label Allow initial letters as shown in example ignore</p> <ul style="list-style-type: none"> • gravity <p>allow</p> <ul style="list-style-type: none"> • mg • force of gravity <ul style="list-style-type: none"> • arrow drawn on left or right <p>Accept arrow in either direction for MP4</p> <p>N = normal contact force</p>	2
(ii)	<p>Any three of -</p> <p>MP1. friction/resistance /drag (acts);</p> <p>MP2. (there is an) unbalanced force;</p> <p>MP3. (hence) ball decelerates;</p> <p>MP4. reference to $f_{(R)} = ma$;</p> <p>MP5. (kinetic) energy dissipates / fate of energy discussed;</p>	<p>ignore stem</p> <p>allow</p> <ul style="list-style-type: none"> • resistive forces > {forward/driving} force • there is a resultant force • its momentum changes • accelerates 	3
(b) (i)	<p>idea that friction is (much) less in the air;</p>	<p>allow</p> <ul style="list-style-type: none"> • RA • no contact / ground friction • less energy lost 	1

Question number	Answer	Notes	Marks
13 (c) (i)	KE = $\frac{1}{2} mv^2$;	Words or symbols	1
(ii)	Conversion to kg; Substitution into correct equation; Rearrangement; Evaluation; e.g. 45 g = 0.045 kg (or 1 kg = 1000 g etc) $36 = \frac{1}{2} \times 0.045 \times v^2$ $v^2 = \frac{2 \times 36}{0.045}$ (= 1600) 40 (m/s)	allow <ul style="list-style-type: none"> • 1000 seen • steps in any order • correct answer with no working for full marks • up to 3 marks for use of 45 kg \rightarrow 1.26 (m/s)- working must be seen 	4
(iii)	Any one of- <ul style="list-style-type: none"> • (Hit the ball transferring) more energy; • (Hit the ball with) more velocity; • (Hit the ball with) more speed; • (Hit the ball with) more force; 	Ignore <ul style="list-style-type: none"> • harder • power Allow <ul style="list-style-type: none"> • momentum • keep contact for a larger part of the swing • go to a place where g is less (e.g. on the moon) • hit ball at a steeper angle / vertically (e.g. use a more lofted club) 	1

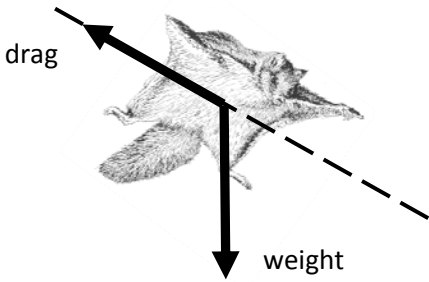
Total 12 marks

Question 5.

Question number	Answer	Notes	Marks
6 (a) (i)	Work done = force x distance moved;	Allow $W = F \times d$ and rearrangements	1
(ii)	Substitution into correct equation; Calculation; e.g. 13×110 1430 (J)	Correct answer without working scores 2 marks	2
(iii)	Same response as for 3(a)(ii)	1430 (J) or ecf	1
(b)	Any two of - MP1 Idea that GPE depends on height OR Statement that $GPE = mgh$; MP2 Idea that h is reduced; MP3 Idea that centre of gravity (is now) lower;	Allow centre of mass for centre of gravity	2
(c) (i)	Moment = force x (perpendicular) distance (from the pivot);	Allow moment = $F \times d$ and rearrangements	1
(ii)	Calculate given moment; Equate moments; Calculation; e.g. $(150 \times 0.32) = 48$ for one mark $150 \times 0.32 = F \times 0.87$ for two marks $F (= 150 \times 0.32 / 0.87) = 55$ (N) for three marks	If no other mark gained, allow a statement that "clockwise moment = anticlockwise moment" for one mark 55.172 (N)	3

Total 10 marks

Question 6.

Question number	Answer	Notes	Marks
7 (a) (i)	gravitational potential energy = mass × g × height	Allow abbreviations e.g. g.p.e. = mgh for g/gravitational field strength reject 'gravity'	1
(ii)	Substitution into correct equation; Evaluation; e.g. g.p.e. = 0.19 × 10 × 17 = 32 (J)	32.3 (J) (or 31.6 J when g = 9.8 ms ⁻²) allow 32300 for 1 mark	2
(iii)	Value same as for (a)(ii)	Allow "the same"	1
(b) (i)	Judge by eye Weight shown acting downwards; Drag shown acting against motion; 	NB NO label = no mark Allow abbreviations for labels e.g W, mg ignore gravity	2
(ii)	k.e. = ½ × mass × velocity ²	Allow abbreviations e.g. k.e. = ½mv ²	1
(iii)	Substitution into correct equation; Evaluation; e.g. k.e. = ½ × 0.19 × 13 ² = 16 (J)	(16.055) 16055 gets 1 mark	2
(iv)	A an unbalanced force acts on the squirrel		1

Total 10 marks

Question 7.

Question number	Answer	Notes	Marks
9	<p>Any four of -</p> <p>MP1. either transfer between the two is by conduction; or same SA either way up.</p> <p>MP2. Infrared (radiation) mentioned;</p> <p>MP3. Idea of emission of thermal energy;</p> <p>MP4. a correct effect of (surface) colour on emission;</p> <p>MP5. Comparative of surfaces;</p> <p>MP6. correct statement about thermal energy flow at equilibrium temperature;</p>	<p>- ignore other comments about conduction, convection, absorption and reflection</p> <p>for thermal energy accept heat or radiation e.g. black emits heat e.g.</p> <ul style="list-style-type: none"> • black is a good emitter • white is a poor emitter <p>e.g. the black loses more heat than the white</p>	4

Total 4 marks

Question 8.

Question number	Answer	Notes	Marks
11	<p>any six points from the following 2 groups:</p> <p><u>Relating to energy and position</u> MP1 statement re KE values e.g. KE is zero at top and bottom OR KE is greatest/4J in the middle;</p> <p>MP2 statement re GPE values e.g. GPE is greatest/25J at the top OR GPE is least/5J at the bottom;</p> <p>MP3 statement re EPE values e.g. EPE is greatest/21J at the bottom OR EPE is least/1J at the top;</p> <p>MP4 the change in GPE/EPE is 20J OR the change in KE is 4J;</p> <p>MP5 change in GPE/EPE > change in KE;</p> <p>MP6 total energy is constant (in all three charts)/eq;</p> <p><u>Relating to speed and position</u> MP7 in the middle speed is greatest;</p> <p>MP8 in the middle $v = 2.8$ (m/s);</p> <p>MP9 ball is stationary at the top/bottom;</p>	<p>allow GPE decreases as the ball moves down</p> <p>allow EPE increases as the ball moves down</p> <p>allow ball moves through height of 2 metres</p>	6

Total 6 marks

Question 9.

Question number		Answer	Notes	Marks	
1	a	B;		1	
		E;		1	
	b	i	$p = m.v$	in words or accepted symbols do not accept 'M' for momentum	1
		ii	substitution; evaluation; e.g. 900×15 14 000 unit = kg m/s OR N s;	13 500 Independent Allow kg ms^{-1}	3
		iii	$\text{KE} = \frac{1}{2} m.v^2;$	in words or accepted symbols allow speed for velocity	1
		iv	substitution; evaluation; e.g. $0.5 \times 900 \times 15^2$ 100 000(J)	101 250 Allow 101 000	2
				total = 9 marks	