Question number	Answer	Notes	Marks
1 (a) (i)	geothermal / geothermic;	allow nuclear	1
(ii)	any suitable resource or method; e.g. • wind (turbine) • hydro-electric • waves • tidal • solar (panels) • biofuels/biomass	ignore nuclear ignore unqualified 'water' allow photovoltaic cells, (sun)light allow wood	1
(b)	any four from: MP1. thermal energy is transferred from hot rock to cold water OR water heats up; MP2. water molecules gain KE (as they are heated); MP3. steam gains KE as it is heated by the rock; MP4. GPE of steam increases as it gains height; MP5. turbine gains KE from hot water/steam; MP6. generator (coils) transfer KE (from turbine) into electrical energy; MP7. electrical energy is transferred from pump into GPE/KE of water;	allow 'mechanical energy' for KE throughout allow 'heat' for thermal energy allow water turned into steam allow turbine transfers KE to electrical energy total marks = 6	4

Question number	Answer	Notes	Marks
2 (a) (i) (ii)	light; kinetic;		2
(b) (i)	Power = energy ÷ time	power = energy ÷ time energy = power x time time = energy ÷ power ONLY ACCEPT standard letters (P, E, t)	1
(ii)	Substitution into correct equation; Rearrangement; Calculation; **e.** 78 = energy ÷ 10 78 x 10 780 (J)	Correct final value gets all three marks irrespective of working. Substitution and rearrangement in either order. Rearrangement may be shown in (b)(i)	3
(c)	Useful energy calculated; Correct substitution in formula; **e.** 200 – 176 OR 24 (J) 24 ÷ 200 (x 100 = 12%) ALTERNATIVE METHOD energy wasted = 176 ÷ 200 OR 88(%); useful energy transfer = 100 – 88 = (12%);	Second line of working scores 2 (since the use of 24 implies first line has been correctly carried out) Second line of working scores 2 (since the use of 88 implies first line has been correctly carried out)	2

Total 8 Marks

Question number	Answer	Notes	Marks
3 (a) (i)	any three from: MP1. air becomes hot; MP2. air expands; MP3. air becomes less dense; MP4. air rises;	NOTE cannot award MP4 unless MP2 or MP3 has been given reject for 1 mark(ie MAX mark = 2) air particles expand OR air particles become less dense	(3)
(ii)	clear inward arrow above the heat absorbing materials; clear up arrow inside the tower;		(2)
(iii)	convection (current);		(1)
(b) (i)	thermal (energy); kinetic (energy);	allow heat or solar or light	(2)
(ii)	(hot) air turns turbines; turbines turn the generator/magnets inside a coil;		(2)
(c) (i)	during the day there is direct heating from the sun/eq;	allow RA	(1)
(ii)	any sensible suggestion e.g. so that convection continues beyond daylight hours; to act as heat source for night time;		(1)
(iii)	any sensible suggestion e.g. water tanks (to provide hot water at night); crops;	Allow photovoltaic cells solar panel (dull) black objects / blocks painted black	(1)

Total for Question 3 = 13 marks

Question number	Answer	Notes	Marks
4 (a) (i)	Current that passes in one direction **only**;	ignore current varies	1
(ii)	Any three of - MP1 provides a connection / current to the coil/commutator; MP2 idea of reverses the current in the coil; MP3 Every half turn; MP4 Reverses (coil) field /polarity (every half turn); MP5 So that the force is always in the same direction; MP6 So that the motor keeps turning (the same way);	allow swops the contacts/ ensures that current always flows clockwise through the coil/eq so the moment is always in the same direction	3
(iii)	Any one of - Still spins clockwise; No (overall) effect/direction remains the same; The two changes cancel out/nothing changes;	Ignore "nothing happens" unless clear that rotation continues	1
(b) (i)	power = voltage × current;	Accept symbols $P=I\times V$ Condone a mix of correct symbols and words	1
(ii)	Substitution and calculation; Conversion to megawatts; e.g. $P=I\times V$ $P= 4000 \times 600 = 2\ 400\ 000$ (W) $= 2\ 400\ 000 \div 1\ 000\ 000$ = 2.4 (MW)	division by 10^6 or 1 000 000 seen correct answer without working scores two marks	2

Continued

Question number		Answer	Notes	Marks
4 (c)	(i)	work done = force × distance (moved)	Accept symbols W=F×d W =Fd	1
	(ii)	Substitution; Calculation; e.g. Work = 400 000 × 190 76 000 000 (J)	Accept 76 MJ with correct unit 7.6×10^7 (J) 76×10^6 (J)	2
(d)	(i)	Substitution into given equation; P = W/t Rearrangement; Calculation; e.g. 1.9 = 67 ÷ t.....worth 1 t = 67 ÷ 1.9 .....worth 2 = 35 (s).....worth 3	No mark for the equation as it is given in QP Substitution and rearrangement in either order Or (in joules and watts) 67 000 000 ÷ 1 900 000 (35.26) correct answer without working =3	3
	(ii)	Any one of :- Takes longer /eq; More time needed to raise coal; Load moves more slowly;	Ignore: unqualified comments about the amount of work done	1

Total 15 marks