Question	Answer	Marks	AO Element	Notes	Guidance
1(a)	240 W	**1**			
1(b)(i)	P = VI in any form **OR** 11 × 2 (1) 22 W (1)	**2**			
1(b)(ii)	(efficiency =) P_o / P_i **OR** (efficiency =) (11 × 2 / 240) × 100 (1) {efficiency = (11 × 2 / 240) × 100 =} 9.2 (%) (1)	**2**			
2	(P_i =1.2 × 2.8 × 260 =) 870 (W) (1) (P_o = 2.5 × 86 =) 220 (W) (1) (efficiency =){P_o/P_i } × 100 in any form **OR** {P_o/P_i } × 100 (1) (efficiency = {220/870} × 100 =) 25 (%) (1)	**4**			
3(a)	(E =) m × g × h **OR** 32 × 10 × 2.5 (1) 800 J (1)	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
3(b)	output power = E ÷ t **OR** 800 ÷ 5.4 **OR** 148.148 (W) (1) efficiency = output (power) ÷ input (power) **OR** P_{out} ÷ P_{in} **OR** E_{out} ÷ E_{in} **OR** output power ÷ 0.65 **OR** 148.148 ÷ 0.65 **OR** 800 ÷ 0.65 (1) = 230 W (1)	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
4(a)	if hydroelectric described: hydroelectric named **OR** water from behind dam K.E. of (falling) water used / P.E. of stored water turbine / waterwheel / paddle wheel operated (Turbine) turns / drives a generator (that produces electricity) **OR** if tidal flow described: tides / tidal flow named K.E. of water used turbine / waterwheel / paddle wheel operated (turbine) turns / drives a generator (that produces electricity) **OR** if waves described: waves on surface of sea K.E. of water used to oscillate a floating mechanism turbine / waterwheel / paddle wheel operated (turbine) turns / drives a generator (that produces electricity)	**4**			

Question	Answer	Marks	AO Element	Notes	Guidance
4(b)	if hydroelectric described: rain (fills lakes in high places) cause of rain is the Sun, so renewable **OR** if tidal flow described: moon (and Sun) causes tides moon (and Sun) permanently in place, so renewable **OR** if waves described: wind causes waves Sun causes wind, so renewable	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
4(c)	if hydroelectric described: Sun evaporates water from sea etc. to fall (later) as rain Sun is the source of energy **OR** if tidal flow described: attraction due to Moon's (and Sun's) gravity causes tides Sun is a source of (part of) the energy **OR** Sun is not the primary source of energy **OR** if waves described: wind are air currents caused by thermal energy / heat from the Sun Sun is the source of energy	**2**			
5	(G) **D** (C) **A** (F) **B E**	**3**		all four correct = 3 marks three correct = 2 marks two correct = 1 mark	

Question	Answer	Marks	AO Element	Notes	Guidance
6	any **two** from: produces CO_2 **OR** contributes to global warming / greenhouse effect mining damages landscape produces atmospheric pollution produces SO_2 / NO_x / acid rain soot / particulates / smoke (produced) pollution caused by transporting coal (from mine)	**2**			
7	renewable **OR** no air pollution **OR** low running costs **OR** no named polluting gas **OR** no greenhouse effect (1) explanation that follows from advantage stated (1) expensive to install **OR** not available at night **OR** visual pollution **OR** needs a suitable (roof) space (1) explanation that follows from disadvantage stated (1)	**4**			
8	any **three** from: kinetic energy (of wind / air) turns / drives turbine (blades) (turbine blades) turn generator coil turns in magnetic field	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
9	water is heated / **changed to steam** as it passes through (fractures in) rocks (1) steam turns a turbine (1) the turbine drives a generator (1) generator produces electricity (1)	**4**			
10(a)	1. 100 (W) (1) 2. 500 (W) (1)	**2**			
10(b)	less power **OR** energy used (by LED) (1) less CO_2 **OR** greenhouse gases **OR** global warming (1)	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
11	**advantages** - any **two** from: easy to store less atmospheric pollution than other fossil fuels cheaper than other fossil fuels concentrated energy source large reserves can respond to demand **disadvantages** - any **two** from: (produces / releases) carbon dioxide (waste gases produce) acid rain (waste gases produced) contribute to global warming non-renewable danger of explosion danger of carbon monoxide poisoning long pipelines needed (from some gas fields)	**4**			

Question	Answer	Marks	AO Element	Notes	Guidance
12(a)	any **two** from: solar wind water hydroelectric waves tidal geothermal	**2**			
12(b)	any **one** from: energy from wind / waves / Sun is not always available cost of building wind turbines or tidal barrages or hydroelectric dams wind turbines affect the scenery of some areas solar (farms) use (agricultural) land / takes up a lot of space AVP	**1**		answer must relate to a correct answer from **(a)**	
13	yes/renewable **AND** nothing used up o.w.t.t.e.	**1**			

Question	Answer	Marks	AO Element	Notes	Guidance
14	no air pollution/CO_2/acid rain/greenhouse gases/global warming/harmful gases **OR** no damage from mining/drilling (1) visual pollution/use of land/pollution during manufacture (1)	**2**			
15	light	**1**			
16	idea that (panel can) follow the sun as it moves across the sky **OR** will absorb more energy **OR** transfer energy / work more efficiently	**1**			
17(a)	any **two** from: uses a renewable source of energy no cost for source of energy no polluting / greenhouse gases **OR** no carbon dioxide produced easy to erect and dismantle conserves fossil fuels	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
17(b)	any **one** from: does not work at night need large area of land (for sufficient output)	**1**			
18	any **one** advantage from: (1) no fossil fuel used; no fuel costs; no pollution of air / water; no polluting gases; is a renewable energy source; does not contribute to global warming / greenhouse effect; any **one** disadvantage from: (1) wind not always blowing; causes noise pollution; causes visual pollution; is a danger to wildlife; is expensive to build;	**2**			
19	kinetic **OR** movement energy from wind **OR** moving air (1) turns turbine (1) turbine turns generator (to generate electricity) (1)	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
20	**any two advantages from:** reliable supply of electricity owtte large amount of electrical energy produced / power output plentiful supply of fuel **any two disadvantages from:** non-renewable (energy source) greenhouse gases / carbon dioxide produced / increases global warming contributes to atmospheric / air pollution / acid rain	**4**			
21	any **two** from: radioactive material/waste produced problems storing waste long half-life of waste/fission products (accidental) leak of nuclear/radioactive material	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
22	(thermal energy is used) to produce steam (1) steam turns a turbine (1) (turbine) turns a generator (1)	**3**			
23	Q S P R	**3**		all 4 correct = [3] 2-3 correct = [2] 1 correct = [1]	
24	advantage: not dependent on weather/wind blowing **OR** always available (1) disadvantage: polluting **OR** CO_2/SO_2/greenhouse gases emitted **OR** leads to global warming **OR** oil must be transported **OR** not renewable **OR** oil will run out/be used up	**2**			

Question	Answer	Marks	AO Element	Notes	Guidance
25	any **three** from: • does not contribute to atmospheric pollution / acid rain • does not contribute to greenhouse gases / global warming • renewable energy source (so will not run out) • short start-up time / can meet surges in demand owtte • conserve non-renewable reserves / fossil fuels • reduces dependence on fossil fuels (from other countries)	**3**			
26	any **three** from: water flows down (from reservoir) idea of gravitational / potential energy (transferred to kinetic (energy)) water turns turbine turbine turns generator	**3**			

Question	Answer	Marks	AO Element	Notes	Guidance
27	any **two** from: (renewable sources) are replaceable in a short time no (atmospheric) pollution conserves fossil fuels do not contribute to global warming no fuel costs	**2**			
28	B - 25%	**1**			
29	B - 4.0 W	**1**			
30(a)	suitable fuel for a power station any **three** from five: - thermal energy / heat (from fuel) - water / steam / gas heated **OR** steam produced - (steam / gas) turns / moves / drives turbine - (turbine) turns / moves / drives generator - 2 correct energy transfers	**4**			

Question	Answer	Marks	AO Element	Notes	Guidance
30(b)	Sun is energy source for plants / living matter (to grow) o.w.t.t.e plant / animal (remains compressed) into fuel **OR** carbon / chemical energy stored / trapped in plant / animal (remains)	**2**			
30(c)	not renewable (as fuel is consumed) could only be replaced over very long time period (e.g. clearly > 50 years)	**2**			
31	any three from: (cold) water is pumped into the ground warm rocks heat water / hot water turns to steam / water boils (steam) drives or turns or moves turbine (turbine) drives or turns or moves generator	**3**			
32	C - wasted output energy = useful output energy	**1**			
33(a)	(gravitational) potential (energy)/(G)PE	**1**			

Question	Answer	Marks	AO Element	Notes	Guidance
33(b)	any 3 from: water flows down **OR** water flows at constant speed water drives turbine **OR** turbine rotates owtte turbine turns generator (at constant speed) electricity generated/produced owtte	**3**			
33(c)	transferred to thermal **OR** sound dissipated to the surroundings owtte	**2**			
33(d)	shorter (travelling) distance/water in B higher than A/water from A has to be pumped (up to C) owtte	**1**			
34	B between E and C G between C and D A followed by F in last two boxes	**3**			
35	B - 15%	**1**			

Question	Answer	Marks	AO Element	Notes	Guidance
36	any **two** from: renewable source of energy no atmospheric pollution conserves fossil fuels do not contribute to global warming	**2**			
37	any **one** from: a dilute source of energy dependent on weather / intermittent supply	**1**			
38	gas **AND** oil both circled	**1**			
39	box 1 ✓ box 2 ✓ box 3 box 4 box 5 ✓	**3**			
40	energy losses as heat / sound (to surroundings)	**1**			
					[Total: 117]