1 **(a (i)** Straight line through origin B1

(ii) Strain (energy) OR elastic (energy) B1

(b) Use of $1/2mv^2$ C1
$0.5 \times 2.5 \times v^2 = 0.48$ C1
$v^2 = 0.48/(0.5 \times 2.5)$ OR $v^2 = 0.384$ C1
$v = 0.62\,m/s$ A1

[Total: 6]

2 **(a** *mgh* OR $36 \times 10 \times 2.4$ [1]
864 J OR N m (2 or 3 sig. figs.) [1]

(b) (*P* =) *E*/*t* in any form, words, symbols or numbers OR 864 / 4.4 [1]
196 W OR J/s (2 or 3 sig. figs.) [1]

(c) evidence that candidate understands the principle of energy conservation, expressed in words or as an equation (e.g. total energy is constant OR initial energy = final energy) or implied by statement accounting for difference [1]

some energy is dissipated into the surroundings OR difference due to increase in internal energy/heating/thermal energy (of belt, motor, surroundings) owtte
note: do not accept kinetic energy / sound / friction if no mention of heating [1]

(d) increase in potential energy of mass is greater
OR work done/energy used (to raise mass) is greater [1]
t = *E*/*P* OR *P* = *E*/*t* in any form, words or symbols AND power is constant [1]
speed reduced / time taken is longer [1]

[Total: 9**]**

3 **(a** strain / elastic (potential) (energy) B1

(b) **(i)** (KE =) ½ m v^2 in any form C1

1200 J A1

(ii) (G)PE (gained) = KE (lost) in any form C1

(G)PE = mgh OR h = PE ÷ mg in any form C1

1.8 m e.c.f. from **(b)(i)** A1

(iii) friction with air OR air resistance OR thermal energy / heat produced/lost B1

(c) **(i)** limit of proportionality B1

(ii) Hooke's law B1

4 **(a** kinetic (energy) B1

(b) **(i)** (work done =) $F \times x$ in any form: words, symbols, numbers C1
1.4×10^9 J A1

(ii) work done = kinetic energy OR ½ mv^2 seen C1
(v^2 =) $2WD \div m$ OR $2 \times 1.4\,(4) \times 10^9 \div 4.5 \times 10^5$ OR 6400 C1
80 m / s ecf **(i)** A1

(iii) (work done against) friction / (air) resistance / drag B1
ACCEPT energy converted to thermal energy

(c) perpendicular (to curved path) OR centripetal OR towards centre (of circle) B1

[Total: 8]

5 **(a** lines from solar energy to boxes 1 AND 4 only B1

lines from natural gas to boxes 2 AND 3 only B1

(b) (relatively) cheap OR widely available OR can be used on a large scale OR always available B1

(c) (i) 2.05×10^9 N B1

(ii) use of *mgh* OR weight × *h* C1
1.03×10^{12} J NOT ecf from **(i)** A1

(iii) output energy ÷ input energy OR $6.2 \times 10^{11} \div 1.2 \times 10^{12}$ C1
0.52 OR 52 % A

[Total: 8]

6 **(a** (g.p.e.=) mgh OR $75 \times 10 \times 880$ C1
$= 6.6 \times 10^5$ J / Nm OR 660 kJ / kNm

(b) (work =) Fs / Fd OR 220×2800 C1
$= 6.2 \times 10^5$ J / Nm OR 620 kJ / kNm

(ii) answer to **(a)** – answer to **(b)(i)** C1
e.g. (k.e.=) $6.6 \times 10^5 - 6.2 \times 10^5 = 4.0 \times 10^4$ J OR 44 kJ
OR $6.6 \times 10^5 - 6.16 \times 10^5 = 4.0 \times 10^4$ J OR 44 kJ

(c) (to go faster by) reduced air resistance / drag / resistive force OR to lower centre of mass OR increase stability / balance

[Total: 7]