1 **(a** $W = mg$ in any form OR $(m =)\ W \div g$ OR $80\,000 \div 10$ C1
8000 kg A1

(b) $\rho = m \div V$ in any form OR $(V =)\ m \div \rho$ OR $8000 \div 1000$ C1
$= 8.0\,m^3$ ecf **(a)** A1

(c) mgh OR weight $\times$ h OR $8000 \times 10 \times 4$ C1
$= 320\,000$ J OR 320 kJ ecf **(a)** A1

(d) (efficiency =) output (energy) ÷ input (energy) ($\times$ 100)
OR 96 ÷ 320 ($\times$ 100) C1

= 0.30 OR 30% ecf **(c)** A1

[Total: 8]

2 **(a** velocity has direction/is a vector AND speed doesn't/isn't/is a scalar B1

(b) horizontal arrow to right AND touching parachutist (when extended) B1
arrow/line horizontal AND arrow / line vertical AND making two sides of triangle OR rectangle

(ii) correct diagonal (i.e. top left to bottom right) B1
10.4 – 10.5 m / s B
51–55° to horizontal OR 35 – 39° to vertical (NOT more than 2 sig.figs.) B1

(iii) $\frac{1}{2}mv^2$ OR $0.5 \times 85 \times 10.5^2$ (e.c.f. from **(b)(ii)**) C
$0.5 \times 85 \times 10.5^2$ (e.c.f. from **(b)(ii)**) C
$4.7/4.69/4.685625 \times 10^3$ J (e.c.f. from **(b)(ii)**) A [9]

3 **(a** (mass flow rate =) 1030 (kg/s)
use of *mgh* C1
loss of GPE = 1030 × 10 × 3 = 30 900 J or Nm ecf from 1st line A1 [3]

(b) output power = (26 × 400 =) 10 400 (W)
efficiency = output (power)/input (power) with/without 100
OR= output/input with/without 100 OR any numbers
that clearly show relationship the correct way up is intended C1
efficiency = (100 × 10 400/30 900 =) 33.7% at least 2 s.f. A1 [3]
allow ecf from **(a)** and 1st line of **(b)**

(c) **(i)** from basin/to sea/from right/to left B1

(ii) turbine design allows rotation in both directions
OR meaningful comment on change of pitch
OR generator works when rotating in either direction B1 [2]

[Total: 8]

4 **(a** (The point in the body) where (all) the mass / weight / gravity acts / appears to act (owtte) B1

(b) h is the height through which the centre of mass/rises
OR centre of mass/rises (much) less than 2.0 m

OR centre of mass/of athlete is above the ground level
OR centre of mass/gravity passes under bar B1

Allow centre of gravity in place of centre of mass

(c) Standing: has chemical energy B1
Run-up: kinetic energy gained B1
Pole bent: has strain / elastic energy B1
Rise: potential energy gained B1
Fall: kinetic energy gained B1
On mat: has thermal / heat / sound / strain / elastic energy B1 **[8]**

5 **(a** $Q = mc\Delta T$ in any form or $mc\Delta T$ C1
$\Delta T = 50$ C1
$Q = 798\,000$ J A1 [3]

(b) use of E = Pt OR 170×8 OR see 1 360 OR $\times 60$) C1
energy = $(170 \times 8 \times 3\,600) = 4\,896\,000$ J A1 [2]

(c) efficiency = output(energy)/input (energy) OR his **(a)** ÷ his **(b)**
accept power for energy but not wrong/mixed quantities. Accept useful for output, ignore total for input C1
efficiency = 0.16 or 16% ecf from **6(a)** and **6(b)** A1 [2]

(d) source not finite/will not run out ignore can be re-used/replaced
Give for right idea e.g. accept sun always shines B1 [1]

(e) one point from:
doesn't work at night/cloud cover/no sun/variable output
high (initial) cost (of panels)
do not accept too low unless appropriate for a clearly stated context B1 [1]