1 **(a (i)** (GPE =) mgh **or** 0.40 × 10 × 8.5 (accept 9.8 for 10) C1
34 J A1 [2]

(ii) KE = GPE in any form **or** $\frac{1}{2}mv^2$ **or** $2gh$
or 2 × 10 × 8.5 (e.c.f. from **4(a)(i)**) C1
(v^2 =) 170 **or** (v =)√170
(e.c.f. from **4(a)(i)**) C1
13 m / s e.c.f. from **4(a)(i)** A1 [3]

(b) drag **or** air resistance **or** friction with air (ignore wind for air) B1
WD **or** energy lost as heat **or** more KE needed to overcome drag etc. B1 [2]

(c) transformed to thermal energy/heat **or** friction/air resistance slows parachutist down **or** lost to air particles
(**not** KE (accept KE of air), **not** GPE → KE → heat; ignore sound) B1 [1]

[Total: 8]

2 **(a** (nuclear) fusion B1 [1]

(b) (i) smaller (surface) area
(accept thinner, narrower(at top), ignore reference to lid) B1 [1]

(ii) apparatus: black object, white object, thermometer(s)/ball-bearing with wax/level of water in vessel B1

source of heat e.g. Sun/radiant heater (condone light bulb/Bunsen burner) B1

action: (fill cans with water and) measure temperature rise **or** wax melts **or** compare volumes of water B1

observation: water in black can (better absorber) has greater temperature increase / wax melts first / less water
note: emission experiment gains max. 2 B1 [4]

[Total: 6]

3 **(a** Example: e.g. battery: (chemical to) electrical
engine: (chemical to) kinetic / mechanical
fire: (chemical to) thermal / heat
(human) body: (chemical to) heat / kinetic B1

(b) (i) (P =) IV OR in words OR 0.27 × 17 C1
= 4.59 W at least 2 s.f. A1

(ii) (K.E. =) efficiency × input OR 0.35 × 4.59 C1
= 1.61 J or Nm at least 2 s.f. A1

(iii) 1. $d = m/V$ OR (m =) $V \times d$ OR in words OR 0.00014 × 1000 C1
= 0.14 kg

2. P.E. gained = K.E. lost OR $mgh = ½ mv^2$
OR 0.14 × 10 × h = 1.61 OR 1.6 C1
h = 1.15 m OR 1.14 m at least 2 s.f. A1

OR
$½ mv^2 = 1.61$ OR
$v^2 = 2 \times 1.61 / 0.14 = 23$ OR $v^2 = 2 \times 1.6 / 0.14 = 22.86$ (C1)
(h =) $v^2/2g = 23/20 = 1.15$ m OR (h =) 22.86/20 = 1.14 m (A1)

[Total: 9]

4 **(a** $½ mv^2$ C1
correct rearrangement to find v/v^2 C1
23 m/s A1 [3]
bald 0.73 scores first two marks

(b) use of mgh (= 160 000 – 40 000 = 120 000 J) C1
h = 20 m A1 [2]

(c) any three points from:
KE of <u>water</u>
PE of <u>water</u>
sound
heat/friction
Award one mark for each correct point B3 [3]

5 **(a)** distance/height AND tape measure/(metre) rule(r) B1
weight OR load OR force
AND balance/scale(s) OR newton-meter/spring balance/force meter B1
time AND watch/clock/timer B1

(b) power = work/time OR energy/time in any form
OR *Pt* words or numbers seen anywhere e.g. 528 x 5 C1
(work =) force × distance in any form C1
11 A1

(c) efficiency = E_{out}/E_{in} OR P_{out}/P_{in} seen anywhere, clearly identified
OR 520 × (20/11) × 5
OR (work done =) 800 × 20 × 0.3 OR 800 × 20 × 30 OR 4800 (J) OR 720 (J) C1
(energy used =) 32,000 J A1 [8]

6 **(a** kinetic energy (of the package / belt / motor)
heat / thermal / internal energy / work done <u>against friction</u>
sound energy B2

(b) *mgh* OR 36 × 10 × 2.4 C1
= 864 J OR N m A

(c) *P* = *E*/*t* in any form: words, symbols or numbers
OR *E*/*t* OR 864 / 4.4 C1
= 196 W OR J/s A

(d) *P* = *E*/*t* in any form, words or symbols
OR mass is increased AND power is constant B1

increase in <u>potential</u> energy of mass is greater
OR work done / energy used (to raise mass) is greater B1

speed reduced / time taken is longer B1 [9]