1 **(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]

2 **(a (i)** total R = 320 (Ω) or V per lamp = 6 (V)
I = (240/320 or 6/8 =) 0.75 A ecf from previous line A1 [2]

(ii) use of $P = VI$ OR I^2R OR V^2/R C1
4.5 W ecf from **(a)(i)** A1 [2]

(b) resistance of each lamp = 8 × 1.05 = 8.4 (Ω)
total R = 240/0.9 = 266.7 (Ω) OR V per lamp = 8.4 x 0.9 = 7.56 (V) B1
no. of lamps (= 266.7/8.4) = 31.7 OR (= 240/7.56) = 31.7 B1
max. no. of failed lamps = 8 B1
accept reverse logic [4]

[Total: 8]

3 **(a** any three from:
use a strong(er) magnet
increase the number of coils in the solenoid / turns of solenoid closer together
move the magnet fast(er).
place iron core in the solenoid
use thick(er) wire / low(er) resistance wire for solenoid max B3

(b) (i) $N_P/N_S = V_P/V_S$ OR $200/800 = V_P/24$ OR $V_P = N_P V_S/N_S$
OR $V_P = 200 \times 24/800$ C1
6.0 V A1

(ii) $I_p V_p = I_s V_s$ OR $I_p N_p = I_s N_s$ OR $I_P = I_S V_S/V_P$ OR $I_P = I_S N_S/N_P$
OR $I_P = (0.5 \times 24)/6$ OR $I_P = (0.5 \times 800)/200$ C1
2(.0) A
allow ecf from **(b)(i)** A1 [7]

4 **(a) (i)** 0 (A) / zero Unit penalty if wrong unit B1

(ii) 12 V B1

(b) (i) V / R OR $V = IR$ in any form, letters, words or numbers C1
0.5 A A1

(ii) 8 × candidate's **(i)** OR 8/24 × 12 C1
4 V OR 4.0 V e.c.f. A1

(c) $1/R_1 + 1/R_2 = 1/R$ OR $R = R_1R_2 / (R_1 + R_2)$ in any form B1
5.3 (Ω) OR 5⅓ (Ω) OR 16/3 (Ω) C
12 / candidate's R C1
2.25 A c.a.o. A1

Alternatively: 12/16 (= 0.75) OR 12/8 (= 1.5) C1
12/16 (= 0.75) AND 12/8 (= 1.5) C1
Currents added C1
2.25 A c.a.o. A1 [10]

5 (a) all 4 lights in parallel with supply and none in series B1
master switch in a place where it will work (cannot score if no supply or if short circuit) B1

one switch for 2 lights in living room AND one for bathroom
AND one for bedroom B1

(b) (i) W = V × I or 100 = 200 × I in any form C1
0.5 A or 0.5 a A1

(ii) I × t or 0.5 × 60 e.c.f. C1
30 C or 30 c e.c.f. A1

(c) (i) 135 W B1

(ii) any power × any time (words or symbols or numbers) C1
NOTE: 280 (W) is the total power of lamps in house, so counts as "power"

486 000 J or 486 kJ or 0.135 kWh accept lower case units A1
NOTE: 45 × 3600 = 162000 J gets e.c.f. from (i)

[10]

6 **(a)** changes a.c. to d.c. OR rectifies a/c OR allows current to flow one way only
OR prevents current flowing backward B1

(b) I × t or 2 × 12 or 2 × 12 × 60 × 60 or amps × seconds C1
24 Ah or 86 400 C or 86 000 C A

(c) emf = J/C OR energy converted/work done per unit charge/coulomb
OR W/A OR volts/p.d. when no current in circuit C1
12 J of energy are delivered/needed for every coulomb of charge
OR 12 W is the power to drive a current of 1 A A

(d) **(i)** series connection shown, any recognisable symbols B1

(ii) total power = 16 W OR 8/6 C1
1.33 A accept fraction c.a.o. A1

(iii) any power × any time or 16 × 60 × 60 or IVt or 8 × 60 × 60 C1
57 600 J or 0.016 kWh or 28 800 J or 0.008 kWh

[10]

7	**(a**	switch in correct position		B1	[1]
	(b)	**(i)**	rheostat/variable resistance symbol drawn	B1	
		(ii)	dot and R in line to 12 W lamp	B1	[2]
	(c)	Question deleted			
	(d)	R = V/I or 12/.3 = 4Ω		C1 A1	[2]
	(e)	**(i)**	parallel circuit/all lamps connected separately across the 12V	B1	
		(ii)	4 A	A1	[2]
				[Total: 7]	