1 **(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) $I \times t$ or 2×12 or $2 \times 12 \times 60 \times 60$ or amps $\times$ 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 $\times$ any time or $16 \times 60 \times 60$ or IVt or $8 \times 60 \times 60$ C1
57 600 J or 0.016 kWh or 28 800 J or 0.008 kWh [10]

2 **(a** connections such that all lamps will light B1

ammeter in correct position B1

variable resistor in correct position (condone poor symbol) B1

switch in appropriate position (could be 2 switches) B1 [4]

(b) **(i)** 3 A **B1** [1

(ii) 4Ω OR 12/his**(i)** correctly evaluated B1 [1]

(iii) 2Ω OR ½ × his**(ii)** correctly evaluated B1 [1]

(iv) 1080 J e.c.f. from **(i)** & **(ii)** if working shown B1 [1]

(c) lamps in series M1

less current/less p.d. (across 1 lamp)/voltage shared/higher resistance A1 [2]
NOT current shared

[Total: 10]

3 **(a** circuit 1 series AND circuit 2 parallel B1

(b) switch off each one separately)
one fails, other works)
both get full current/voltage/same voltage) any 2 B1+B1
other good point e.g. more heat in parallel)
lower resistance)

(c) (total R =) 10 (Ω) C1
(V =) 12V A1

(d) 1/R = 1/4 + 1/6 (= 5/12) OR $1/R = 1/R_1 + 1/R_2$ C1
2.4 (Ω) A1

(e) **(i)** 3(A) B1

(ii) 24W B1

(iii) 7200J e.c.f. **(ii)** B1

[Total: 10]

4 **(a** I = W/V or 9/6 C1
I = 1.5 A A1 **2**

(b) **(i)** 8 ohm A1

(ii) 6 V A1 **2**

(c) **(i)** brightness decreases/dimmer B1

(ii) resistance of circuit greater B1
current through lamp falls B1 **3**

(d) **(i)** 4 ohm A1

(ii) 4 ohm A1 **2**
[9]