

- 1 (a) more negatives in top half than bottom half M1
 roughly same no of positives as negatives A1
- (b) clearly more negatives than positives, anywhere in/on block B1
- (c) wire removed first M1
 charges kept in block OR so no charge can flow to or from block
 NOT any mention of positive charges moving
 accept reverse argument A1
- (d) (charging by) induction NOT e.m. induction OR earthing B1
- [Total: 6]**

- 2 (a) at least **three** vertical lines between the plates B1
 equally spaced **OR** some curvature at the ends B1
 at least one correct (upwards) arrow **AND** none wrong B1
- (b) (i) ($I=$) Q/t **OR** 0.000 000 042/0.000 000 035 **OR** $4.2 \times 10^{-8}/3.5 \times 10^{-8}$ C1
 1.2×10^n for any n C1
 1.2 A A1
- (ii) contains electrons C1
 electrons are free to move A1
- [Total: 8]**

- 3 (a) (i) rectifier/diode
- (ii) frequency (of A.C. supply) B1
- (b) $(P =) IV$ OR 0.5×5.3 OR 500×5.3 C1
 2.6W OR 2600mW
- (ii) $(E =) Pt$ OR IVt OR $2.65 \times 1.5 \times 3600$ OR $0.5 \times 5.3 \times 1.5 \times 3600$ C1
 14000J A1
- (c) energy only underlined B1
- [Total: 7]**

- 4 (a) mark (i) and (ii) together:
- mention of free electrons B1
- (current is) flow/movement of free electrons B1
- insulators contain no free electrons / metals contain many free electrons B1
- (b) (i) chemical (energy) to electrical (energy) IGNORE heat)
- (ii) (energy =) VI OR $120 \times 96 \times 10$ (OR $\times 60$ OR $\times 10 \times 60$)
OR 11520×10 (OR $\times 60$ OR $\times 10 \times 60$) C1
 $6.9 \times 10^6\text{J}$ A1
- (iii) 96×120 OR $1.2/1.15(2) \times 10^4$ OR $12000/11500/11520$
 $1.0 \times 10^4\text{W}$ A1
- [Total: 8]**

- 5 (a) ($P_i = 260 \times 2 \times \text{length} \times \text{breadth} (= 260 \times 0.1)$), words, symbols or numbers C1
 note: gets this mark if omits factor of 2
 $(P_i = 2 \times 260 \times 0.25 \times 0.2 =) 26 \text{ W}$ A [2]
- (b) ($P_o = 0.95 \times 20 =) 19 \text{ (W)}$ B1
 efficiency = output (energy) / input (energy)
 accept power for energy
 $E = \text{candidate's } P_o / \text{candidate's } P_i \text{ evaluated} (= 0.73 \text{ or } 73\%)$, accept fraction (19/26) C1
 0.73% or bald 73 gets unit penalty A1 [3]
- (c) A OR B in series with C connected across 20 V M
 parallel combination of A and B only A1 [2]
- (d) $1 / R = 1 / R_1 + 1 / R_2$ OR $R = R_1 R_2 / (R_1 + R_2)$ in any form OR $R_1 R_2 / (R_1 + R_2)$ C1
 words, symbols or numbers
 12Ω A1 [2]
- [Total: 9]**

- 6 (a) in copper/metals/conductors, electrons (free to move) B1
 in nylon/insulators electrons fixed/not free (to move) B1
- (b) (negatively charged nylon) rod near to sphere B1
 earth/touch (with hand) the sphere B1
 remove earth/hand (and remove rod) B1
- (c) at least four equally spaced, radial lines from surface M1
at least one outward arrow AND none wrong A1 [7]

7 (a) (i) $(I = \frac{P}{V})$ OR 18 000/120 OR 18/120 C1
150 A A1

(ii) $(E =)Pt$ OR $18\,000 \times 30 \times 60$ OR $18\,000 \times 1800$ OR $18\,000 \times 30$ OR 5.4×10^5 C1
 3.2×10^7 J OR 9.0 kWh A

(b) any three of:
(high voltage means) low(er) current
for given supply power
(low(er) current means) less heat/thermal energy (generated in cables) OR $P = I^2R$
for given resistance (of cables)
cables heated by current

B3 [7]