

- 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  
 $1.2 \times 10^n$  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  $0.5 \times 5.3$  OR  $500 \times 5.3$  C1  
 $2.6\text{W}$  OR  $2600\text{mW}$
- (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  
 $14000\text{J}$  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  $11520 \times 10$  (OR  $\times 60$  OR  $\times 10 \times 60$ ) C1  
 $6.9 \times 10^6\text{J}$  A1
- (iii)  $96 \times 120$  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  
 $12 \Omega$  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  $5.4 \times 10^5$  C1  
 $3.2 \times 10^7$  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]