1. (a) (i) . . . . direction of the force on a positive charge
   
   (ii) Straight parallel lines from upper to lower plate
        At least 3 lines drawn. All lines drawn equally spaced, approximately symmetrical with respect to plates
        Arrows downwards

(b) (i) Upward force (on drop) due to electric field/charge on plates
       = weight of drop
       Upward force on drop = downward force on drop
       OR no resultant/net force on drop
       OR forces are balanced

   (ii) Drop moves upwards
        Weight/mass of drop decreases OR downward force decreases
        OR Upward force (due to electric field) > weight of drop

   [Total: 8]

2. (a) electrons/negative charges move towards the rod/to R (ignore just “attracted”)
    ignore any mention of positive charges moving
    any mention of positive electrons = 0

(b) negative charges (are) close(r) (to the rod)
    attraction between opposite charges greater than repulsion between like charges

(c) coulomb
3  (a)  (i) at least three horizontal, parallel lines evenly spaced (ignore edge effects) arrows pointing left to right  

(b) right hand half of ball has more + signs than – signs  
   AND left hand half of ball has more – signs than + signs  
   equal numbers of + and – signs  

(c) \( Q = I \ t \) in any form  OR  \( (I =) Q + t \)  OR  \( 2.8 \times 10^8 + 0.05 \)  
   \( 5.6 \times 10^7 \) A OR C/s  

[Total: 6]

4  (a) energy transferred per coulomb/unit charge  
   OR energy supplied in driving coulomb/unit charge around a circuit  
   ACCEPT p.d./voltage across battery/power supply  

(b)  (i) \( V = IR \) in any form  OR  \( (I =) V + R \)  
   \( 2.0 \) A OR 2 A  
   (ii) electrons  
   (iii) arrow right to left by heater OR indication of clockwise  

(c) \( (E =) VIt \) OR \( V^2tIR \) OR \( I^2Rt \) in any form  
   \( 14000 \) J
5  \( (a) \ (Q =) \ I t \ OR \ 4.1 \times 10^5 \times 1.6 \times 10^7 \)
\[ = 660 \text{C} \]
\( (b) \ (R =) \ V/I \ OR \ 1.3/4.1 \times 10^5 \)
\[ = 32000 \Omega \ OR \ 32 \text{k}\Omega \]
\( (c) \ 1\text{st method: (P =) } I V \ OR \ 4.1 \times 10^5 \times 1.3 \)
\( \text{OR 2nd method: (P =) } I^2 R \ OR \ (4.1 \times 10^5)^2 \times 32000 \)
\( \text{OR 3rd method: (P =) } V^2 /R \ OR \ 1.3^2 /32000 \)
\( \text{OR 4th method: (P =) } QV/t \ OR \ 660 \times 1.3/1.6 \times 10^7 \)
\[ \text{1st and 3rd methods: } 5.3 \times 10^5 \text{W}/0.000053 \text{W} \]
\[ \text{2nd and 4th methods: } 5.4 \times 10^5 \text{W}/0.000054 \text{W} \]

[Total: 6]

6  \( (a) \ \text{coulomb} \)
\( (b) \ (i) \ \text{negative charge(s) on left AND positive charge(s) on right} \)
\[ \text{equal number of positive and negative charges AND number of each } \leq 7 \]
\( (ii) \ \text{electrons/negative charges flow from Earth/on to sphere (NOT protons/positive charges/positive electrons move)} \)
\[ \text{total charge negative OR (some) protons/positive charges cancelled} \]
\( (c) \ \text{metal contains free (delocalised) electrons OR electrons can move about} \)
\[ \text{electrons in plastic not free to move/fixed} \]

[Total: 7]
7  
(a) i) A region in which a force acts upon an (electric) charge/charged object

(ii) At least 4 radial straight lines with lines evenly spaced
      Arrows on lines pointing away from + charge

(b) Use positively charged rod

   Place rod close to surface of sphere

   Touch sphere (briefly) with finger OR Connect sphere to earth and remove earth connection OR Briefly connect sphere to earth

   Remove charged rod

[Total: 7]

8  
(a) 3rd box only indicated, reverses direction

(b) straight line up/down page

   arrow pointing down page

   (ii) to the right or left e.c.f. (b)(i)

   to the right e.c.f. (b)(i)

(c) \( F=ma \) in any form or \( F/m \) symbols, words or numbers

   OR final answer \( 6 \times 10^4 \text{ m/s}^2 \)

   \( a = 0.21/0.35 = ) 0.6 \text{ m/s}^2 \)

[Total: 7]