9. Electricity

9.1 Electric current

Paper 2

Marking Scheme

Q1.

(a)	$Q = It$	**C1**
	$= 3.3 \times 10^4 \times 2.6 \times 10^{-5}$ $= 0.86\,\text{C}$	**A1**

Q2.

(a)	(number density =) $2.3 \times 10^{23} / (1.5 \times 10^{-6} \times 1.8) = 8.5 \times 10^{28}\ (\text{m}^{-3})$	**A1**
(b)	$I = Q / t$ **or** $I = 172 / 2.5 \times 60$ **or** $I = 1.1(5)$	**C1**
	$I = nAvq$ $172 / (2.5 \times 60) = 1.5 \times 10^{-6} \times 8.5 \times 10^{28} \times v \times 1.6 \times 10^{-19}$	**C1**
	$v = 5.6 \times 10^{-5}\ \text{m s}^{-1}$	**A1**

Q3.

(b)(ii)	$I = Anvq$ $n = N / V$ **or** $n = N / AL$	**C1**
	$v = (V / R) / [(V / L)\,(N / V)\,e]$ **or** $(V / R) / [A\,(N / AL)\,e]$ $= VL / RNe$	**A1**
	or	
	$v = L / t$ $= L / (Q / I)$	**(C1)**
	$= LI / Q$ $= L(V / R) / Ne$ $= VL / RNe$	**(A1)**
(b)(iii)	time = distance / speed **or** Q / I $= L / (VL / RNe)$ **or** $Ne / (V / R)$ time = RNe / V	**A1**

Q4.

(b)(ii)	charge $= 4.0 \times 10^{-3} \times 3.2 \times 60$ $(= 0.768\ \text{C})$	**C1**
	number $= 0.768 / 1.6 \times 10^{-19}$ $= 4.8 \times 10^{18}$	**A1**

Q5.

(c)(i)	$I = Q / t$	**C1**
	$= 650 / 540$ $= 1.2\,\text{A}$	**A1**

Q6.

(b)(ii)	$Q = It$	**C1**
	number $= (2.0 \times 45) / 1.60 \times 10^{-19}$ $= 5.6 \times 10^{20}$	**A1**

Q7.

(c)	(Q =) $6.9 \times 10^{-9} \times 60$	**C1**
	number = $(6.9 \times 10^{-9} \times 60) / (2 \times 1.60 \times 10^{-19})$	**C1**
	= 1.3×10^{12}	**A1**

Q8.

(a)	$Q = It$	**C1**
	= $0.80 \times 7.5 \times 60$ = 360 C	**A1**
(c)(i)	$n = 3.2 \times 10^{22} / (1.3 \times 10^{-7} \times 3.0)$ = 8.2×10^{28} m^{-3}	**A1**
(c)(ii)	$I = Anvq$ $v = 0.80 / (1.3 \times 10^{-7} \times 8.2 \times 10^{28} \times 1.60 \times 10^{-19})$	**C1**
	= 4.7×10^{-4} m s^{-1}	**A1**
(d)	(wire Y has) larger resistance / resistance increases	**M1**
	(wire Y has) smaller current / current decreases	**M1**
	(average drift) speed is less (in wire Y)	**A1**

Q9.

(a)(iii)	$I = Anvq$ $v = 0.53 / (4.5 \times 10^{-7} \times 6.1 \times 10^{28} \times 1.60 \times 10^{-19})$	**C1**
	= 1.2×10^{-4} m s^{-1}	**A1**
(b)(i)	(cross-sectional) area/A is less	**M1**
	(I, n, e the same so) average drift speed is greater	**A1**

Q10.

(c)	$I = Anvq$ $v = (0.45 / 0.49) \times 2.1 \times 10^{-4}$	**C1**
	= 1.9×10^{-4} m s^{-1}	**A1**

Q11.

(a)(ii)	minimum charge (on drop) is 1.6×10^{-19} C	**B1**

Q12.

(d)(ii)	number = $0.50 / 1.60 \times 10^{-19}$ = 3.1×10^{18}	**A1**

Q13.

(a)	A: (cross-sectional) area (of wire)	**B1**
	n: number of free electrons per unit volume **or** number density of free electrons	**B1**
(b)	line drawn between (X, v_x) and (Y, $4v_x$)	**M1**
	line has increasing gradient	**A1**