

1)

<b>(a)</b>	$V/E = R/R_{\text{tot}}$	or	$0.5 = I \times 3900$	C1	
	$1.0/1.5 = R/(R + 3900)$	or	$1.0 = 0.5R/3900$	M1	
	$R = 7800\Omega$ .	or	$R = 7800\Omega$	A0	[2]
<b>(b)</b>	$V = 1.5 \times (7800/(7800 + 1250))$	or	$I = 1.5/(7800 + 1250)$	C1	
	$= 1.29 \text{ V}..$	or	$V = IR = 1.29 \text{ V}$	A1	[2]
<b>(c)</b>	Combined resistance of R and voltmeter is 3900 $\Omega$			C1	
	reading at 0 °C is 0.75 V			A1	[2]
<b>Total</b>					<b>[6]</b>

2)

<b>(a)</b>	<i>either</i> $V = E R_1 / (R_1 + R_2)$		<i>or</i> $I = E / (R_1 + R_2)$	C1	
	$= \frac{1800}{3000} \times 4.50$		$V = \frac{1800}{3000} \times 4.50$	M1	
	$= 2.70 \text{ V}$		$= 2.70 \text{ V}$	A0	[2]
<b>(b)</b>	<b>(i)</b>	for a wire, $V = I \times (\rho L/A)$		M1	
		$I, \rho$ and $A$ are constant so $V \propto L$		A1	
				A0	[2]
	<b>(ii)</b>	<b>1</b> 2.70 V		A1	[1]
		<b>2</b> $\frac{L}{100} = \frac{2.70}{4.50}$		C1	
		$L = 60.0 \text{ cm}$		A1	[2]
	<b>(iii)</b>	thermistor resistance decreases as temperature rises so QM is shorter		M1	
				A1	[2]

3)

<b>(a)</b>	<i>either</i> $V = IP$		B1	
	current in circuit = $E / (P + Q)$		B1	
	hence $V = EP / (P + Q)$		A0	[2]
	<i>or</i> current is the same throughout the circuit	(M1)		
	$V/P = E / (P + Q)$	(A1)		
	hence $V = EP / (P + Q)$	(A0)		

- (b) (i) (as temperature rises), resistance of (thermistor) decreases M1  
*either* resistance of parallel combination decreases M1  
*or* p.d. across 5 k $\Omega$  resistor / thermistor decreases M1  
p.d. across 2000  $\Omega$  resistor / voltmeter reading increases A1 [3]
- (ii) if  $R$  is the resistance of the parallel combination,  
*either*  $3.6 = (2 \times 6) / (2 + R)$  *or* current in 2 k $\Omega$  resistor = 1.8 mA C1  
 $R = 1.33 \text{ k}\Omega$  current in 5 k $\Omega$  resistor = 0.48 mA C1  
 $\frac{1}{1.33} = \frac{1}{5} + \frac{1}{T}$  current in thermistor = 1.32 mA C1  
 $T = 1.82 \text{ k}\Omega$   $T = 2.4 / 1.32 = 1.82 \text{ k}\Omega$  A1 [4]