M1.(a) A combination of resistors in series connected across a voltage source (to produce a required pd) ✓

Reference to splitting (not dividing) pd

1

(b) When R increases, pd across R increases ✓

Pd across R + pd across T = supply pd ✓

So pd across T / voltmeter reading decreases ✓

Alternative:

Use of $V = \frac{R_1 \times V_{tot}}{R_1 + R_2}$ ✓

V_{tot} and R_2 remain constant ✓

So V increases when R_1 increases ✓

3

(c) At higher temp, resistance of T is lower ✓

1

So circuit resistance is lower, so current / ammeter reading increases ✓

1

(d) Resistance of T = 2500 Ω

Current through T = V / R = 3 / 2500 = 1.2×10^{-3} A ✓

(Allow alternative using $V_1/R_1 = V_2/R_2$)

pd across R = 12 − 3 = 9 V

The first mark is working out the current

1

Resistance of R = V / I = 9 / 1.2×10^{-3} = 7500 Ω✓

The second mark is for the final answer

1

(e) Connect the alarm across R instead of across T ✓

allow: use a thermistor with a ptc instead of ntc.

1

[9]

M2.B

[1]

M3.(a) (i) *(use of $I = V / R$)*

first mark for adding resistance values 90 k Ω

I = 6.0 / (50 000 + 35 000 + 5000) ✓ = 6.7×10^{-5}A ✓

accept 7×10^{-5} or dotted 6×10^{-5}

but not 7.0×10^{-5} and not 6.6×10^{-5}

2

(ii) V = $6.7 \times 10^{-5} \times 5000$ ✓= 0.33 (0.33 − 0.35) V ✓

OR

V = 5 / 90 × 6 ✓ = 0.33(V) ✓

CE from (i)

BALD answer full credit

0.3 OK and dotted 0.3

2

(b) resistance of LDR decreases ✓

need first mark before can qualify for second

reading increase because greater <u>proportion / share</u> of the voltage across R OR higher current ✓

2

(c) I = 0.75 / 5000 = 1.5×10^{-4} (A) ✓

(pd across LDR = 0.75 (V))

pd across variable resistor = 6.0 − 0.75 − 0.75 = 4.5 (V) ✓

R = 4.5 / 1.5×10^{-4} = 30 000 Ω ✓

or

I = 0.75 / 5000 = 1.5×10^{-4} (A) ✓

R_{total} = 6.0 / 1.5 × 10^{-4} = 40 000 Ω ✓
R = 40 000 − 5000 − 5000 = 30 000 Ω ✓

3

[9]

M4.(a) (i) **$1/R_{total}$ = 1/(40)** ✓+1/(10+5) ✓= 0.09167
R_{total} = 10.9 kΩ ✓

3

(ii) I = 12 / 10.9 k = 1.1 mA ✓

1

(b)

position	pd / V
AC	6.0 ✓
DF	4.0 ✓
CD	2.0 ✓

C.E. for CD

3

(c) (i) AC: no change ✓
constant pd across resistors / parallel branches(AE) ✓
no CE from first mark

2

(ii) DF: decreases ✓
as greater proportion of voltage across fixed / 10 k Ω resistor ✓
no CE from first mark

2

[11]

M5.(a) 1 joule per coulomb (or equivalent)

B1

allow watt per amp

1

(b) (i) Use of potential divider formula

C1

allow 1 for 4.05 (V) or current of 2.25 (mA)

4.95 (V)

A1

2

(ii) reduced current

B1

1

(iii) use of parallel resistor formula

C1

leading to 1.72 (kΩ)

C1

pd = 4.4 (V)

A1

3

(iv) potential divider can provides sensitive control of current (from 0 - 1.1 mA)

B1

allow pot div can provide zero current ***and*** *variable resistor gives larger current*

variable resistor can provide larger current but cannot get near 0 A owtte

B1

2

[9]

M6. (a) (i) *(use of $V = IR$)*

I = (12-8) / 60 ✓ = 0.067 Or 0.066(A) ✓

2

(ii) *(use of $V = IR$)*

R = 8/0.067 = 120 (Ω) ✓

1

(iii) *(use of $Q = It$)*

Q = *0.067* × *120* = 8.0 ✓ C ✓

2

(b) reading will increase ✓

resistance (of thermistor) decreases (as temperature increases) ✓

current in circuit increase (so pd across R_1 increases) OR correct potential divider argument ✓

3

[8]