Name of the Student:_____

Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

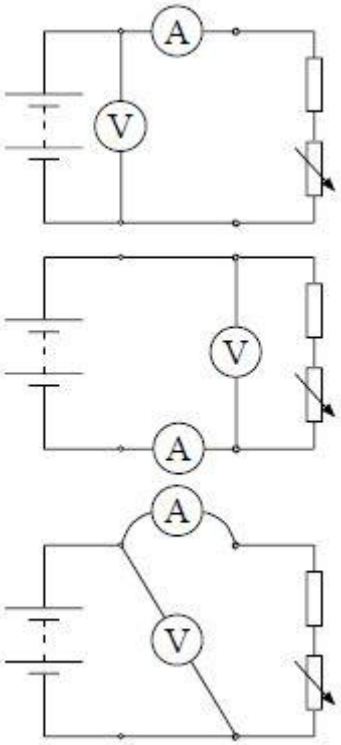
Q1.

(a) valid continuous series circuit that includes ammeter, and one wire link (condone diagonal connections)

and

voltmeter between any two sockets that enable the terminal pd to be measured ✔

all of the following are acceptable:



links and connections

reject broken / dashed lines

tolerate diagrams with diagonal or non-straight connections between sockets if these will produce a valid circuit

don't insist on connection blobs

circuit must be continuous unless a switch is included: otherwise no gaps wider than the thickness of their links

inclusion of a switch is neutral but the length of the open switch must be ≥ length of the gap where the switch is connected: condone the whole gap between terminals vertically opposite the ammeter to be marked as an open switch

Downloaded from www.merit-minds.com

meters

correct ASE symbol for ammeter and correct ASE symbol for voltmeter are essential

one voltmeter and one ammeter only

meters must not be 'transparent'

positions of meters assume that the ammeter has negligible resistance and voltmeter has infinite resistance

1

(b) (with any switch closed) read ammeter and voltmeter

or

record / measure I and V;

adjust / vary / change resistance / (setting of) variable resistor / Q

and repeat (readings) 1✔

for 1✔ must produce a range of I, V values (>2 sets) and identify how this is achieved; it is not necessary to suggest range or number of sets

plot V (against) I 2✔

mark 2✔ independently of 1✔

2

ε = (vertical / y-axis) intercept 3✔

r = −gradient 4✔

2✔ 3✔ and 4✔ can be awarded for a suitable sketch graph

condone 'use the (variable) resistor to vary current and read I, V'

idea that R can be read from Q is neutral

for 2✔ (and further credit in 3✔ and 4✔) the ordinate and the abscissa must be identified;

allow 'plot V over I ' or 'plot V/I'

allow 2✔ for reverse plot 'I (against) V'

then 4✔ for $r = \dfrac{-1}{\text{gradient}}$ *and 3✔ intercept =* $\dfrac{\varepsilon}{r}$

for 3✔ open circuit methods involving ε read directly using voltmeter are neutral

for 4✔ any subject but minus sign essential

2

variation

1✔ as above;

3✔ find R from V divided by I ; disconnect external circuit and measure ε directly;

4✔ plot $\dfrac{\varepsilon}{V}$ *against* $\dfrac{1}{R}$

2✔ gradient = r

(c) gradient calculation seen with Δn^{-1} divided by ΔI^{-1};

Downloaded from www.merit-minds.com

ε from 22 × gradient 1✔

for 1✔ do not penalise one read off error, (allow use of 0, 0) or for small steps

expect gradient ≈ 7.2(5) × 10^{-2} leading to ε = 1.594 (V)

do not allow reverse working based on answer to part (e)

1

ε minimum 3 sf; in range 1.58 to 1.61 (V) 2✔

2✔ is contingent on award of 1✔

1

(d) use of **Figure 3** to read off I^{-1} corresponding to n^{-1} = 0.25;

calculates I in range 0.23(2) to 0.24(4) (A) ✔

*do not insist on seeing evidence of working on **Figure 3***

expect I^{-1} = 4.2 ± 0.1 (A^{-1}) leading to I = 0.238 (A)

(should expect 1 more sf than in 0.25 for 'show that' but condone 0.23 and 0.24 since result based on 2 sf data)

do not allow reverse working based on answer to (e)

1

(e) circuit resistance R = 5.5 (Ω) seen in (e) working 1✔

minimum 2sf V from their I × 5.5

or

V from their ε − their I × r 2✔

for 1✔ allow R = $R = \frac{22}{4}$ or $\frac{11}{2}$; allow R^{-1} = $R^{-1} = \frac{4}{22}$ etc

for 2✔ correct R only; expect V = 1.3(1) V; use of I = 0.25 A gives V = 1.38 V

do not allow $V \geq$ their ε

r using lost volts divided by current; full substitution of their valid data

eg $r = \frac{1.58 - 1.31}{0.238}$ 3✓

or

r using formula for **Figure 3**; full substitution of their valid data

eg $r = \frac{\varepsilon}{I} - \frac{22}{4} = \frac{1.58}{0.238} - 5.5$ 3✓

or

r using either intercept on **Figure 3**; full substitution of their valid data

eg their vertical intercept ×−22 **or**

their horizontal intercept × ε 3✔

use of 'show that' or 2 sf data:

Downloaded from www.merit-minds.com

$r = \frac{\varepsilon - V}{I}$ *with* ε *= 1.6 V,* V *= 1.4 V and* I *= 0.25 A gives r = 0.80 Ω*

$\frac{22}{n} = \frac{\varepsilon}{I} - r$ *with* ε *= 1.6 V,* I *= 0.25 A and n = 4 gives r = 0.90 Ω;*

(can find r first, then V *using* $\varepsilon - Ir$*)*

a vertical intercept must be calculated; result is negative, eg vertical intercept = −0.053:

r = −1 × −0.053 × 22 = 1.17(Ω)

horizontal intercept = 0.73:

r = 1.6 × 0.73 = 1.18(Ω)

minimum 2 sf result in range 0.80 and 1.3(0) (Ω) 4✔

allow 4✔ only if there is clear evidence of a valid method leading to a result in range

4

(f) $n = 2$ **and** $n = 3$ 1✔

$n = 5$ **or** $n = 6$ **or** $n = 7$ 2✔

to improve distribution of points (along the line) or wtte 3✔

for 1✔ and 2✔ if suggesting more than three values for n accept only the last three

for 3✔ allow:

'spread out' / 'avoid concentrating' points'

where current / n is smaller' or wtte 'reduce distance between points (data)' / (add) detail

'most uniform distribution' / 'most equally spread out' / 'roughly evenly spaced'

reject:

'making points (data) 'equally' / 'evenly-spaced' / 'even spread' (without qualification)

'easier to plot / draw line' / 'line more accurate' / 'easier to see trend' are neutral

3

(h) both points move (by ≥ half a grid square) to the right 1✔

both points move (by ≥ half a grid square) causing the gradient of a straight line between them to be reduced 2✔

allow badly-marked points / use of arrows

ignore any best-fit line added to ***Figure 5***

for 1✔ rightwards motion of each point must be parallel to gridlines ± half small square

award of 2✔ mark is independent of 1✔ mark

for 2✔ the points do not need to move in the same direction

2

[17]

Downloaded from www.merit-minds.com