Resistivity and Potential Difference Answers

1. Resistivity = $\frac{\text{Resistance} \times \text{Area}}{\text{Length}}$ 1

$\frac{750}{2} = 375\ \Omega$ 1

A resistance reading which is significantly larger than others in the survey **(1)** 1

Mosaic (stone) floor is a poor conductor of electricity
or floor will probably contain less water than surrounding soil **(1)** 1

Feature containing water-logged soil e.g. ditch **(1)**

Water contains ions/conducts current/reduces resistivity **(1)** 2

$R = \frac{\rho l}{A}$ **(1)**

$= \frac{2(1.7 \times 10^{-8}\,\Omega\,\text{m})(5.0\,\text{m})}{2.0 \times 10^{-6}\,\text{m}^2}$ **(1)**

$= 8.5 \times 10^{-2}\ \Omega$ **(1)** 3

Error = $\frac{(8.5 \times 10^{-8})}{(750\Omega)} \times 100 = 1.1 \times 10^{-2}\ \%$ **(1)**

This is likely to be insignificant compared to random uncertainties due to
varying resistivity of ground **(1)** 2

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2. <u>Device</u>

Potential divider or potentiometer 1

Voltmeter reading

A 9.0 V **(1)**

B 0 V **(1)** 2

Diagram

Label X two thirds of the way down from A [Allow e.c.f.] 1

Explanation

Any 3 points from the following:

- lamp in parallel with lowest 1/3 of AB
- when resistors in parallel, resistance decreases
- p.d. across lamp reduced to below 3 V
- current divides
- no longer enough current to light lamp 3

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3. Equation to define resistivity

$\rho = \frac{RA}{l}$ **(1)**

All symbols defined (resistivity, resistance, length, cross-sectional area) **(1) (1)**

[3 symbols only defined **(1)**] 3

Resistance meter

Any two from:

- the resistance between the two probes is measured, not the resistivity
- because you cannot measure the cross-sectional area of skin between the probes
- *A* and *1* both vary; cannot calculate resistivity **(1) (1)** 2

Whether results support claims

Yes **(1)**

Any two from:

- resistance chances with programme content
- least resistance with political programme
- sweat reduces resistance / is a better conductor **(1) (1)** 3

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4. Type of scale

Logarithmic / powers of 10 **(1)**

Reason: e.g. values of resistivity cover a very large range or stretches out low values / so values fit on the graph **(1)** 2

Resistor

(i) $A = \pi r^2 = \pi \times (4.0 \times 10^{-4})^2$ **(1)**

$= 5.03 \times 10^{-7}$ m^2 (no u.e) **(1)** 2

(ii) Recall of $R = \rho l/A$ **(1)**

Length $l = RA/\rho$

$= 0.12 \times 5.0 \times 10^{-7} / 1.8 \times 10^{-8}$ [substitutions]

$= 3.3$ m **(1)** 3

Advantage of using iron wire of same diameter

Shorter piece of wire needed (if iron chosen) **(1)** 1

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5. Measurement needed

Any three from:

- Resistance
- Distance between probes
- Effective area/cross sectional area
- $R = \rho \frac{L}{A}$ **(1) (1) (1)** 3

Equation of line A

Intercept = –3.5 (Ω m) (+/– 0.3) **(1)**

Gradient = 1.5 (Ω mm^{-1}) (+/– 0.05) **(1)**

So equation is $\rho = 1.5\ d - 3.5$ [Or equivalent, e.c.f. allowed] **(1)** 3

Addition of line

Points correctly plotted (–1 for each error, allow ½ square tolerance) **(1) (1)**

Line of best fit drawn **(1)** 3

Best distance

Between 1.90 and 1.99 km **(1)** 1

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