AS Physics - Experiment Questions for Unit 2 Mark Scheme

1. Polarisation

The (wave) oscillations **(1)**
occur only in one plane **(1)** 2
[OR shown with a suitable diagram]

How to measure angle of rotation

Any four points from:

- Polaroid filter at one/both ends
- with no sugar solution, crossed Polaroids (top and bottom of tube) block out light
- sugar solution introduced between Polaroids
- one Polaroid rotated to give new dark view
- difference in angle between two positions read from scale **(1) (1) (1) (1)** Max 4

Graph

Points plotted correctly [–1 for each incorrect; minimum mark 0] **(1) (1)**

Good best fit line to enable concentration at 38° to be found **(1)** 3

Concentration

0.57 (± 0.01) kg l^{-1} 1

The terms viscous and brittle

Viscous: a high resistance to flow **(1)**

Brittle: breaks/cracks/snaps without plastic deformation (when a load is applied) **(1)** 2

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2. Explanation of standing waves

Waves reflected (at the end) **(1)**

Superposition/interference of waves travelling in opposite directions **(1)**

Where in phase, constructive interference/superposition
OR where antiphase, destructive interference/superposition
OR causes points of constructive and destructive
interference/superposition [Do not penalise here if node/antinode mixed up] **(1)** 3

Mark node and antinode

Both marked correctly on diagram **(1)** 1

Label wavelength

Wavelength shown and labelled correctly on diagram **(1)** 1

Explain appearance of string

Any two from:

- light flashes twice during each oscillation / strobe frequency twice that of string [accept light or strobe]
- string seen twice during a cycle
- idea of persistence of vision **(2)** max 2

Calculate speed of waves

Use of $v = \sqrt{T/\mu}$ **(1)**

☐ Correct answer [57 m s^{-1}] **(1)** 2

Example of calculation:

$v = \sqrt{T/\mu}$

$= \sqrt{(1.96\ N / 6.0 \times 10^{-4}\ kg\ m^{-1})}$

$= 57.2\ m\ s^{-1}$

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3. Area of wire:

Use of $A = \pi r^2$ **(1)**
Correct answer [1.9×10^{-7} (m^2). Allow 1.9×10^{-7} and 2.0×10^{-7} (m^2)]**(1)** 2
[No u.e.]

e.g.
$A = \pi r^2 = \pi \times (2.5 \times 10^{-4})^2$
$= 1.96 \times 10^{-7}\ m^2$

Table + graph:

Length / Area / $\times 10^6\ m^{-1}$
0.0
0.5
1.0
1.5
2.0
2.5
3.1
3.6
4.0 – 4.1

(1)

First 2 points plotted correctly to within 1 mm **(1)**
Rest of points in straight line with origin by eye **(1)** 3

Resistivity calculation:

Drawn through the origin, ignoring first 2 points **(1)**
Recall $\rho = R/(L/A)$ [in any form] **(1)**
Large triangle drawn on graph OR accept the use of a pair of values **(1)**
read from the line
[$x > 3 \times 10^{-6}\ m^{-1}$ is required in **both** cases]
[x-axis allowed as bottom of triangle]
Correct answer [$1.2 \times 10^{-7}\ \Omega$ m)] **(1)**
[allow $1.1 – 1.3 \times 10^{-7}$ (Ω m)] [no u.e.] 4

e.g.
$0.4 / 3.4 \times 10^6 = 1.2 \times 10^{-7}\ \Omega$ m

Anomalous results:

Any two of the following:

- Higher current/lower resistance for shorter lengths/at these points
- At shorter lengths/at these points wire gets hotter
- Non-uniform area/diameter
- Cable / contact resistance
- Sensitivity of meters
- Effect on resistance of any of the above **(2)** max 2

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4. Device

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

[7]

5. 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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6. Explain zeroing of meter

No resistance when leads touched together/short circuit/calibration for zero error **(1)** 1

Show that resistance is about 70 Ω

$R = V \div I$ **(1)**

= 0.54 V ÷ 0.0081 A

= 67 Ω [no ue] **(1)** 2

Explain section from passage

Other currents/voltages/resistances present **(1)**

change in current changes reading for resistance **(1)** 2

Explain changes in meter reading with temperature increase

Increased lattice vibrations/vibration of atoms/molecules **(1)**

scattering flowing electrons/more collisions **(1)**

increased resistance/increase meter reading **(1)** 3

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7. Description:

Either	*Or*	
Two connected dippers just touching/above the water	Dipping beam or single source reaches two slits	**(1)** **(1)**

Vibrated electrically **(1)**
Level tank/shallow water/sloping sides **(1)**

-

Either	*Or*	
Illuminate project on to screen	Use stroboscope to freeze the pattern	**(1)** **(1)**

Max 5

Diagram:

(i) Correct line A - centre line **(1)**
(ii) Correct line B (above or below A) **(1)**
(iii) Correct line C (between A and B) **(1)**
both B and C correct **(1)** **4**

If only the separation of the sources were increased, the angle between lines A and B would *decrease* **(1)**

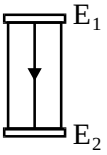
If only the wavelength of the waves were increased, the angle between lines A and B would *increase* **(1)**

If only the depth of the water in the ripple tank were increased, the angle between lines A and B would *increase* **(1)** **3**

[Total 12 marks]

8. (a) (i) Centre line with <u>arrow</u> down **(1)**

More lines on either side **(1)**



Either showing bulges at edges

(ii) E = 6.0 V ÷ 0.15 m **(1)**

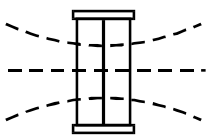
= 40 V m^{-1} [0.40 V cm^{-1}] OR 40 N C^{-1} **(1)**

[e.c.f. ÷ 0.075 m/7.5 cm] **(1)**

(iii) Centre line horizontal **(1)**

Two more lines (accept horizontal) **(1)**

OR showing correct curvature/perpendicular to field lines



(1)

(b) (i) V_X = 3.0 V/3 V **(1)**

because potential at *Y* is 3.0 V/3 V **(1)**

so p.d. across mA is zero OR mA is connected to points at the same potential [an independent mark] **(1)**

(ii) *Either*

Any reference to Y/change the resistors/change one of the resistors/use a rheostat

Or

V for mA move probe over paper **(1)**

Locate points where mA reads zero, add 3 V to V OR move Y to 0 V **(1)**

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(c) (i) (Use of) R = ρl/A **(1)**

Substitute $l = x$ and $A = xt$ **(1)**

(ii) R = ρ/t $\Rightarrow$ ρ = Rt **(1)**

ρ = (1000 Ω) (0.14 × 10^{-3}m) = 0.14 Ω m [no e.c.f.] **(1)**

4

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9. Definition of e.m.f. of a cell

Work/energy (conversion) per unit charge 1

for the whole circuit / refer to total (energy) 1

OR

Work/energy per unit charge 1
converted from chemical to electrical (energy) 1

OR

$E = \frac{W}{Q}$ for whole circuit 1

All symbols defined 1

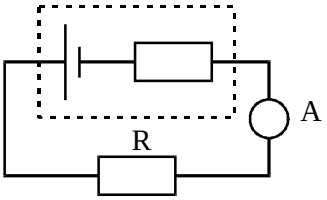
OR

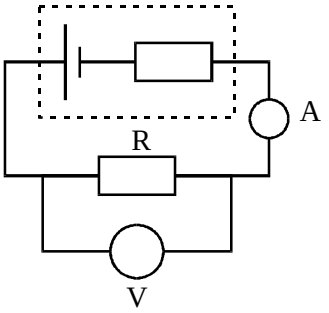
$E = \frac{P}{I}$ for whole circuit 1

All symbols defined 1

[Terminal p.d. when no current drawn scores 1 mark only]

Circuit diagram

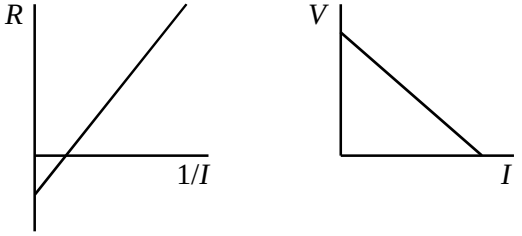




R	1	R (can be variable)	1	2
A in series	1	A and V correct V as shown Or across R + A Or across battery	1	

[2nd mark is consequent on R(fixed, variable) or lamp]

Sketch graph



Graph correctly drawn with axes appropriately labelled and consistent with circuit drawn 1

Intercept on *R* axes ≡ (–)*r* Gradient ≡ (–)*r* [Gradient mark consequent on graph mark] 1

[Gradient may be indicated on graph]

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10. Number of electrons

$(-64 \times 10^{-9}\ \text{C}) / (-1.6 \times 10^{-19}\ \text{C}) = 4.0 \times 10^{11}$ electrons
Use of $n = Q/e$ **(1)**
Seeing 1.6×10^{-19} C **(1)**
Answer of 4.0×10^{11} (electrons) **(1)** 3

[Use of a unit is a ue]

[–ve answer: 2/3]

Rate of flow

$(6.4 \times 10^{-8}$ C)/3.8 s = 16.8/17 [nC s^{-1}] OR $16.8/17 \times 10^{-9}$ [C s^{-1}]

(6.4) / 3.8 s i.e. use of $I = Q/t$ [Ignore powers of 10] **(1)**

Correct answer [No e.c.f.] [1.7 or 1.68 x 10^{-8} or 1.6×10^{-8}] **(1)** 2

Unit

Amp(ere)/A **(1)** 1

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