Name: _____

Working as a Physicist

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

Q1.

Question Number	Acceptable Answer		Additional Guidance	Mark
	• Measured diameter in multiple places / orientations **and** calculate a mean • Calculating a mean reduces the effect of random error	(1) (1)	Treat references to resolution of instrument and thickness of wire as neutral	2

Q2.

Question Number			Additional Guidance	Mark
	• An error is the difference between the (measured) result and the true value • An uncertainty is the interval/range in which the (true) value can be considered to lie	(1) (1)	Accept calculated/their for measured result/value Accept theoretical/actual value for true value	2

Q3.

Question Number			Additional Guidance	Mark
	Any **two** valid reasons that relate to • the instrument being used to make the measurement • the way in which the measurement is made • the quantity measured not being constant	 (1) (1)	Examples: resolution of instrument, zero error, parallax error, reaction time Vague statements that there will be random errors or there might be systematic errors not acceptable.	2

Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	Any two from: • Cost of treatment reduced in the long-term (1) • Better chances of success compared with previous treatment (1) • Fewer side effects compared to previous **Or** patient recover more quickly (1)		2

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• Data not recorded to the same sf/dp **(1)** • Positions of mass holder not recorded **(1)**		2

Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • The time interval is very short **(1)** • the idea of a high sample rate (with the datalogger) **(1)** **Or** (Percentage) uncertainty in measurement would be small (when using the datalogger).	MP2 examples: time interval between measurements is small Many recordings/sec	2

Q7.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	**Either** • The GM-tube has a low efficiency for γ-ray detection (1) **Or** there is an increased area exposed to γ-rays • (So) placing the tube side on to the radiation would increase the count rate (1) **Or** • The γ-radiation could be detected anywhere inside the GM-tube (1) • So placing the tube side on to the radiation would reduce the uncertainty in the distance measurement (1)	For low efficiency, accept GM tube poor at detecting γ-rays.	2

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• Record the count (at least) twice and then determine an average count rate **Or** record the count for a much longer time (1) • This reduces the effect of (random) errors in the measurement of the count rate (1)		2

Q8.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• The measurement of resistance has an uncertainty of 0.6 % (1) • The measurement of the length has an uncertainty of 4 % (1) • The measurement of the diameter has an uncertainty of 4 % (1) • The % uncertainty in diameter is doubled giving the greatest amount of uncertainty into the value for the resistivity (1)	MP1 accept use of 0.05 giving 0.3 % Example of calculation: Uncertainty in $R = \frac{0.1\Omega}{18.2\Omega} \times 100\% = 0.55\%$ Uncertainty in $L = \frac{0.05\,\text{m}}{1.25\,\text{m}} \times 100\% = 4.0\%$ Uncertainty in $d = \frac{0.01\,\text{m}}{0.27\,\text{m}} \times 100\% = 3.7\%$	4

Q9.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Mean straight line with positive intercept on the y-axis **(1)**		1

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• $C = \frac{K}{4\pi d^2}$ used to show $\frac{1}{\sqrt{C}} \propto d$ **(1)** **Or** identifies gradient as $\sqrt{\frac{4\pi}{K}}$ which is constant • Since graph is a straight line, data is consistent with this **(1)** • However, line doesn't pass through the origin **(1)** • This indicates a <u>systematic</u> error in measuring the distance **(1)**		4

Q10.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	• Use a micrometer to measure y and/or z **(1)** • Use Vernier/digital calipers to measure x and/or **(1)** • Mass of slide(s) measured using (top pan) balance/scales **(1)** • Repeat and determine mean for at least one measurement **(1)**	**(Part (a) and (b) to be marked holistically** **MP1** accept <u>digital</u> calipers for a single slide Accept Vernier calipers if it is clear that the thickness of a number of slides is being measured. To award both MP1 & 2, *x*, *y* & *z* must all be referred to. MP4 can be awarded for a reference to averaging any of the measurements.	4

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	Check zero error on micrometer/callipers/balance **Or** measure *x*/*y*/*z* of slide in different places **Or** measure thickness/mass of multiple slides **(1)**	Accept 'tare' for zero error check on balance	1

Q11.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	• Use of $T = 2\pi\sqrt{\frac{L}{g}}$ (1) • $L = 0.994\,\text{m}$ (1)	Example of calculation: $L = \frac{(2.00\,\text{s})^2 \times 9.81\,\text{m s}^{-2}}{4\pi^2} = 0.994\,\text{m}$	2

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	A description that makes reference to the following points: • Record nT (where n is at least 5) **and** divide by n (to find T) (1) • Time oscillations from equilibrium position of bob using a (fiducial) marker **Or** repeats timings for multiple oscillations and calculate mean (1)		2

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)	• Using the stopwatch there would be reaction time (1) • The uncertainty in the measurement of the time is larger with the stopwatch than with the data logger. (1) • Timing multiple swings (with stopwatch) reduces %U (1) • Light gates are difficult to use with a pendulum bob. (1)	MP2 dependent on MP1	4

Q12.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>(a)(i)</td><td>Max 2
Inconsistent number of significant figures or decimal places
Or results recorded to different precision /resolution (1)
No repeat readings (1)
More readings needed up to <u>1.5</u> cm (1)</td><td>2</td></tr>
<tr><td>(a)(ii)(1)</td><td>Attempt to use Vr= constant (1)
Correctly finds two values of Vr from values in table and makes comment
Or uses Vr value with another r or V to confirm corresponding value and makes comment (1)

<u>Example of calculation</u>

<table>
<tr><th>r/cm</th><th>V/V</th><th>rV/ cmV</th></tr>
<tr><td>1.0</td><td>0.725</td><td>0.725</td></tr>
<tr><td>1.5</td><td>0.483</td><td>0.725</td></tr>
<tr><td>2.0</td><td>0.363</td><td>0.726</td></tr>
<tr><td>2.5</td><td>0.29</td><td>0.725</td></tr>
<tr><td>3.0</td><td>0.242</td><td>0.726</td></tr>
<tr><td>3.5</td><td>0.21</td><td>0.735</td></tr>
</table></td><td>2</td></tr>
<tr><td>(a)(ii)(2)</td><td>The graph would be a straight line graph through the origin. (1)
(accept a sketch of a straight line graph going through the origin graph)</td><td>1</td></tr>
<tr><td>(b)(i)</td><td>An e.m.f. is (induced) when there is a changing (magnetic) field/flux. (1)

Because the <u>current</u> is constant there is a constant magnetic field. Or Because the <u>current</u> is constant there isn't a changing magnetic field. (1)</td><td>2</td></tr>
<tr><td>(b)(ii)</td><td>
Movement of either the coil or the wire (1)
Use an alternating current/signal/supply/AC (1)
Switch the current on/off Or change current e.g. use of variable resistor (1)</td><td>3</td></tr>
<tr><td></td><td>Total for question</td><td>10</td></tr>
</table>

Q13.

Question Number	Acceptable answers		Additional guidance	Mark
(a)	• V at top/start = 0V **Or** recognition "potential divider" **Or** V increases (by implication) **Or** V at bottom = 1.5V	(1)	**Alternative MS** Constant Current (I) in wire (1) p.d. across section of wire = Ir between A and loop (1) Increases from 0V to 1.5V linearly (1)	3
	• Two sections of wire act as series resistors **Or** $R=\rho l/A$ **Or** comment about R proportional to length **Or** $\frac{V}{1.5}=\frac{R}{R_T}$	(1)		
	• potential difference proportional to length of wire	(1)		

Question Number	Acceptable answers		Additional guidance	Mark
(b)	• Tangent drawn at 1.5 s	(1)	Example of calculation Gradient $=\frac{1.1\text{V}-0.2\text{V}}{1.0\text{s}}=0.9\text{Vs}^{-1}$ As 1.5 V represents 2.00 m $v=0.9\ \text{Vs}^{-1}\times\frac{2.00\text{m}}{1.5\text{V}}=1.2\ \text{ms}^{-1}$	4
	• Scales p.d. to give distance	(1)		
	• Gradient determined using a base of triangle of at least 1.0 s **Or** use of $s=\frac{(u+v)}{2}t$ **and** correct V read from graph	(1) (1)		
	• velocity = 1.0 m s^{-1} – 1.3 m s^{-1}			

Question Number	Acceptable answers		Additional guidance	Mark
(c)	• Use of $v=u+at$	(1)	Example of calculation $1.5\,\text{ms}^{-1}=1.2\,\text{m s}^{-1}+\text{a}\times0.5\,\text{s}$ $a=\frac{0.3\,\text{m s}^{-1}}{0.5}=0.6\,\text{m s}^{-2}$ $0.6\,\text{m s}^{-2}=9.81\,\text{m s}^{-2}\sin\theta$ $\theta=3.6°$	4
	• Use of $a=g\sin\theta$	(1)		
	• Calculates a value for a, θ or v (using a SUVAT AND $a=g\sin\theta$)	(1)		
	• Valid comparison of their calculated quantity and the stated quoted uncertainty.	(1)		