A-level
PHYSICS
7408/3A

Paper 3 Section A

Mark scheme

June 2020

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206A7408/3A/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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Physics - Mark scheme instructions to examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.
2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.
2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (often prefaced by 'Ignore' in the mark scheme) are not penalised.

3.2 Marking procedure for calculations

Full marks can usually be given for a correct numerical answer without working shown unless the question states 'Show your working'. However, if a correct numerical answer can be evaluated from incorrect physics then working will be required. The mark scheme will indicate both this and the credit (if any) that can be allowed for the incorrect approach.

However, if the answer is incorrect, mark(s) can usually be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

A calculation must be followed through to answer in decimal form. An answer in surd form is never acceptable for the final (evaluation) mark in a calculation and will therefore generally be denied one mark.

3.3 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.4 Errors carried forward, consequential marking and arithmetic errors

Allowances for errors carried forward are likely to be restricted to calculation questions and should be shown by the abbreviation ECF or *conseq* in the marking scheme.

An arithmetic error should be penalised for one mark only unless otherwise amplified in the marking scheme. Arithmetic errors may arise from a slip in a calculation or from an incorrect transfer of a numerical value from data given in a question.

3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited (eg fizix) **unless** there is a possible confusion (eg defraction/refraction) with another technical term.

3.6 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.7 Ignore / Insufficient / Do <u>not</u> allow

'Ignore' or 'insufficient' is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

'Do **not** allow' means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

3.8 Significant figure penalties

Answers to questions in the practical sections (7407/2 – Section A and 7408/3A) should display an appropriate number of significant figures. For non-practical sections, an A-level paper may contain up to 2 marks (1 mark for AS) that are contingent on the candidate quoting the **final** answer in a calculation to a specified number of significant figures (sf). This will generally be assessed to be the number of sf of the datum with the least number of sf from which the answer is determined. The mark scheme will give the range of sf that are acceptable but this will normally be the sf of the datum (or this sf -1).

An answer in surd form cannot gain the sf mark. An incorrect calculation **following some working** can gain the sf mark. For a question beginning with the command word 'Show that…', the answer should be quoted to **one more** sf than the sf quoted in the question eg 'Show that X is equal to about 2.1 cm' –

answer should be quoted to 3 sf. An answer to 1 sf will not normally be acceptable, unless the answer is an integer eg a number of objects. In non-practical sections, the need for a consideration will be indicated in the question by the use of 'Give your answer to an appropriate number of significant figures'.

3.9 Unit penalties

An A-level paper may contain up to 2 marks (1 mark for AS) that are contingent on the candidate quoting the correct unit for the answer to a calculation. The need for a unit to be quoted will be indicated in the question by the use of 'State an appropriate SI unit for your answer'. Unit answers will be expected to appear in the most commonly agreed form for the calculation concerned; strings of fundamental (base) units would not. For example, 1 tesla and 1 Wb m^{-2} would both be acceptable units for magnetic flux density but 1 kg m^2 s^{-2} A^{-1} would not.

3.10 Level of response marking instructions

Level of response mark schemes are broken down into three levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are two marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Determining a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

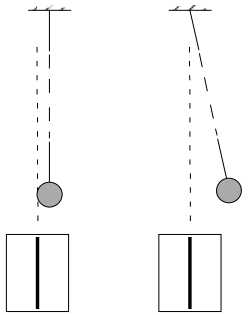
When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level. i.e. if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2.

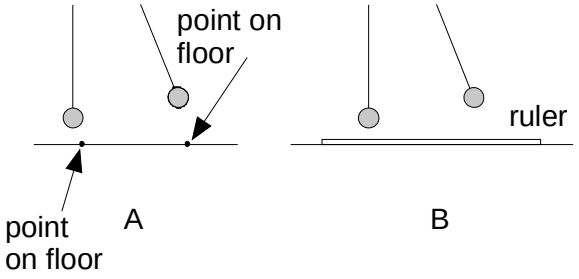
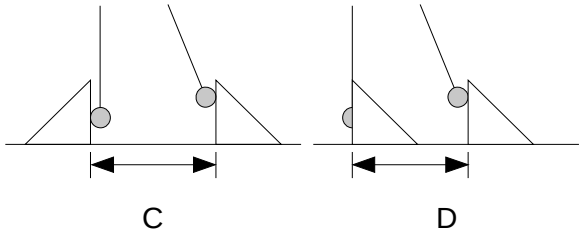
The exemplar materials used during standardisation will help you to determine the appropriate level. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

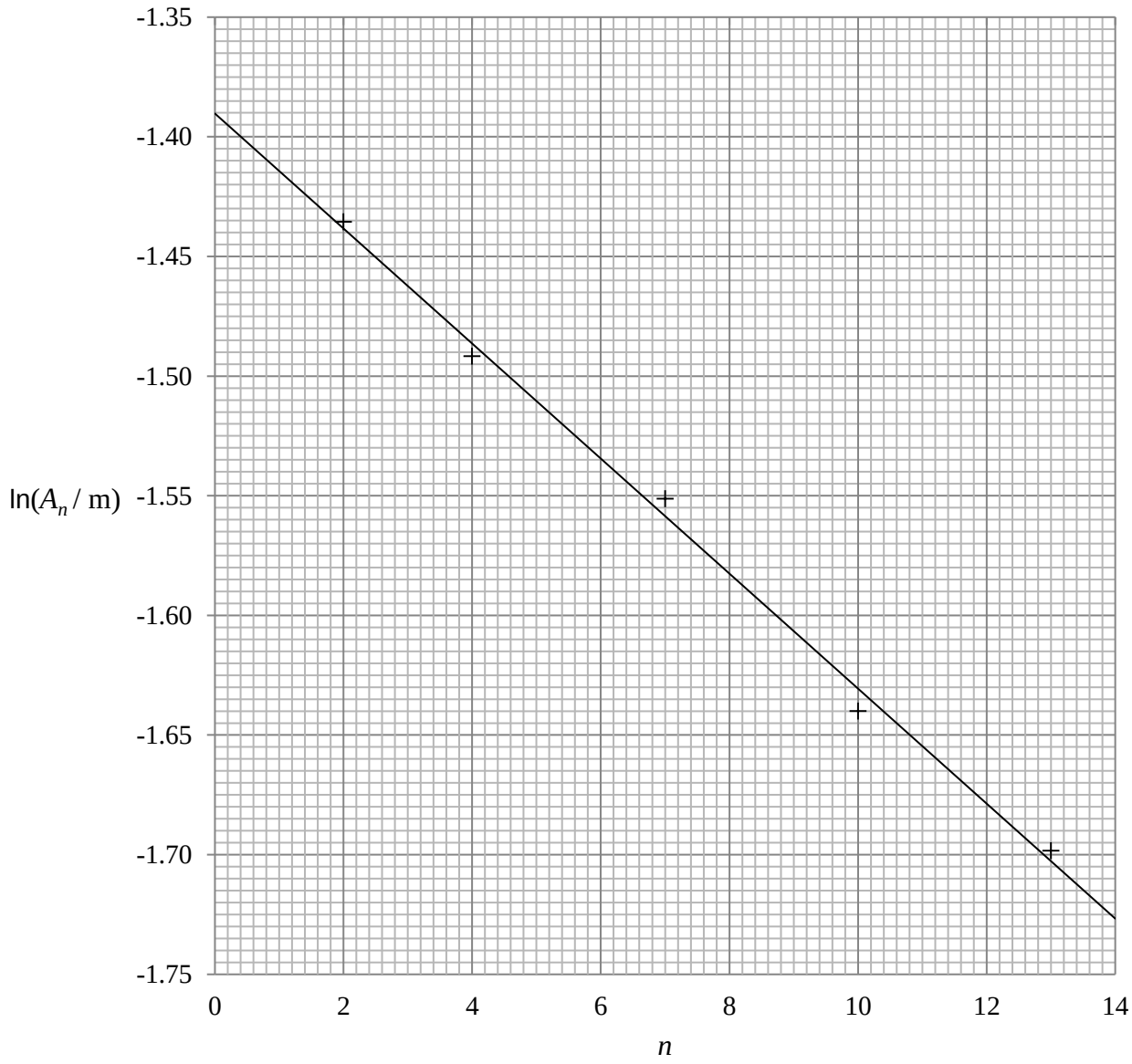
An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Additional comments/Guidelines	Mark	AO
01.1	<u>annotates</u> **Figure 1** to identify equilibrium position; some (or all) of the mark should be below the bob **or** (bottom of mark) should be level with bottom of bob $_1$✓ this is where (the pendulum / bob) is moving fastest / (pendulum has) maximum kinetic energy **or** this is where the transit time is least $_2$✓	for $_1$✓ condone a poorly-annotated sketch if intention is clarified in $_2$✓; do not allow talkout do not insist on seeing the outline of the card as long as the <u>vertical</u> line is seen; condone arrows ↑ ↕ etc; blobs ●✚✖ are neutral allow <u>vertical</u> line of the mark to be aligned with either edge of the bob in the left-hand view or marked directly below point of suspension (within one-quarter of bob radius) in the right-hand view, eg  if marks are shown on each view of the pendulum, then each separately must satisfy the criteria for $_1$✓ **$_2$✓ is contingent on award of $_1$✓** for $_2$✓comments about why the mark is not aligned with bob in right-hand view are neutral (at equilibrium) 'acceleration is zero' is neutral	2	AO1-1b

Question	Answers	Additional comments/Guidelines	Mark	AO
01.2	use of appropriate <u>horizontal</u> scale or wtte 1✓ use of set-square with edge made vertical or other suitable equipment to eliminate parallax error in A_R 2✓ measures A_R from (either) edge of displaced bob 3✓	any of 1✓2✓or 3✓can be earned by suitable annotation to **Figure 2** for 1✓ruler or 'mm scale' only; 'measuring with a ruler between points marked on the floor' is acceptable (see A below) or use of a 'ruler placed on floor' (see B)  for 2✓allow use of plumb line, spirit level, video or photographic equipment; reject clamp stand any use of the fiducial mark or the idea that the supporting beam is horizontal are neutral withhold 3✓unless candidates explains that allowance is being made for radius / diameter of bob (see C and D below) 	MAX 2	AO3.2b

Question	Answers	Additional comments/Guidelines	Mark	AO
01.3	extrapolation of curve to (at least) $x = 0.70$ m 1✓ consistently-recorded min 3 dp values for $T_{0.35}$ and $T_{0.70}$ 2✓ evidence of valid calculation (check denominator correct); percentage increase in range $1.4(0)$ % to $1.8(0)$ % 3✓	for 1✓extrapolation must be continuous and smooth; allow (ruled) straight line; reject hairy, thick or dashed lines for 2✓allow values seen in working; $T_{0.35}$ must round to 2.322; condone $T_{0.70}$ by eye don't insist on horizontal or vertical lines between curve and vertical axis on **Figure 3** for 3✓expected answer is 1.51%	1 2	AO3.1a AO2.1h
01.4	rejects anomalous 0.247; average $A_5 \geq$ 3 sf (that rounds to) $0.22\underline{1}$ (s) 1✓ correct uncertainty calculation or $0.004(0)$ (s) seen 2✓ **or** does not reject 0.247; average A_5 = (rounds to) $0.22\underline{6}$ (s); correct uncertainty calculation or $0.01\underline{5}$ (s) seen 12✓ correct % uncertainty from $\frac{their\ half\ \ range}{their\ average} \times 100 \geq$ 2 sf 3✓	0.221 and 1.8 % on answer lines earn 123✓✓✓ 1✓ (0.247 rejected) full answer 0.2214 (s) 2✓ from half range; can be inferred from working 3✓ if 12✓✓full answer 1.81 %; allow 1.8 % or 1 sf 2 % when 0.247 is not rejected 12✓full answer 0.2257 (s) 3✓ full answer 6.647 %; allow $6.6\underline{4}$ / $6.6\underline{5}$ % or 2 sf 6.6 / 6.7 % for 3✓ allow ECF only if uncertainty is from half range	3	AO2.1h

Question	Answers	Additional comments/Guidelines	Mark	AO
01.5	$\ln(A_4 / \text{m}) = -1.492$ ✓	CAO 3 dp only	1	AO1.1b
01.6	vertical scale with one major (cm) grid square = 0.02 **or** 0.025; maximum spacing of values marked on the scale = 5 cm 1✓ points plotted for n = 2, 4, 7, 10 and 13; suitable continuous ruled line of negative gradient from n = 2 to (at least) n = 13; line must pass above n = 4 **and** n = 10 points **and** must pass below n = 7 point 2✓	withhold both marks for false plot for 1✓scale might go (down page) from −1.40 to −1.72 (1 square = 0.02) or from −1.30 to −1.70 (1 square = 0.025); scale must cover range of plotted points; do not insist on use of broken scale convention no credit for reversed values leading to graph with 'positive' gradient; no credit for missing / inconsistent minus signs or for inconsistent dp in labelled values for 2✓allow ECF acceptable line based on accurate plot of incorrect n = 4 point allow ECF for graph with 'positive' gradient due to reversed scale, eg line must pass **below** n = 4 **and** n = 10 points **and** must pass **above** n = 7 point accept only 4 points if n = 4 is not tabulated; line must pass **between** n = 7 and n = 10 ignore any plot of $\ln(A_5 / \text{m})$ based on 01.4 data; withhold mark for poor points eg blobs or for thick / faint / non-continuous line	2	AO2.1h


-1.35
-1.40
-1.45
-1.50
-1.55
-1.60
-1.65
-1.70
-1.75
ln(A_n / m)
0
2
4
6
8
10
12
14
n

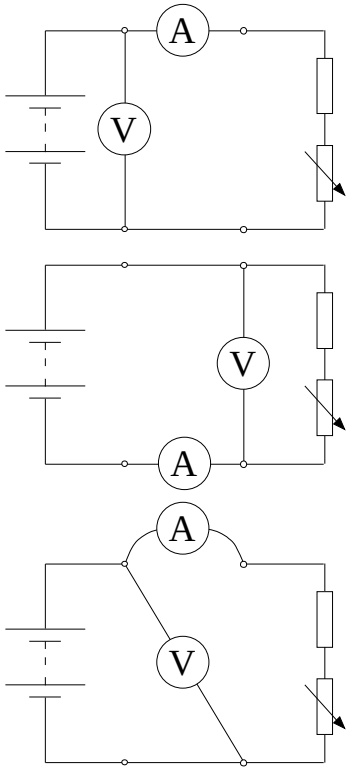
Question	Answers	Additional comments/Guidelines	Mark	AO
01.7	(any) correct expression with ln A_n as subject $_1$✓ $\delta = e^{-gradient}$ or wtte $_2$✓	for $_1$✓ $y = mx + c$ idea is required **either** ln A_n = – n ln δ + ln A_0 ($y = mx + c$) **or** ln A_n = ln A_0 – n ln δ ($y = c + mx$) **not** ln A_n = ln A_0 – ln δ^n treat 'lg A' as a slip allow use of 'log A' for $_1$✓ but no ECF in $_2$✓ for $_2$✓ δ must be the subject, reject ln δ = – gradient etc allow ECF if $_1$✓ is withheld for missing – sign; if gradient is evaluated accept $\delta = e^{(+)0.024}$ or $\delta = 1.02(4)$ etc an explanation that δ can be found using $A_n = A_0 \delta^{-n}$ must rely on values of A_n, A_0 and n that are determined using <u>the line</u> in **Figure 4**	2	AO3.2a
Total			**15**	

Question	Answers	Additional comments/Guidelines	Mark	AO
02.1	37.8 ✓	CAO	1	AO2.1h
02.2	random (error) condone 'statistical' ✓	the following are neutral: 'parallax' / 'human (error)' / '(some) results are anomalous'	1	AO1.1b
02.3	advantage (of using thinner beam): (same load produces) larger (values of) s or wtte 1✓ so the percentage uncertainty / error (in s) is reduced 2✓	for 1✓accept 'beam bends / deflects more' 'beam extends more' / 'easier to bend' are neutral for 2✓the following are neutral: 'easier to make readings' / 'values (of s) are more accurate' / 'more precise' / 'less mass needed' / 'wider range of readings'	MAX 3	AO3.2a
	disadvantage (of beam bending more): idea that beam may undergo plastic deformation 3✓ so the graph will be non-linear / curve or wtte 4✓ **or** beam 'may break' / 'slip off knife edges' **and** relevant comment about safety / health / hazard / 'cannot get unload data' **or** reduces range of m or wtte **and** relevant comment about the effect on the graph, eg increase scatter 34✓= 1 MAX	for 3✓accept / 'beam may become permanently deformed' or wtte / 'necking may occur' / 'hysteresis may occur' / 'beam can reach (go past) elastic limit' the following are neutral: 'causes systematic error' / 'beam may go past limit of proportionality' / 'need to increase height of supports' / 'beam may bend under own weight'		

Question	Answers	Additional comments/Guidelines	Mark	AO
02.4	$E \approx 10^9$	for 1✓ accept 10^9 seen in working	1	AO1.1b
	or		2	AO2.1d
	1.14×10^9 seen 1✓	for 2✓ **either**	1	AO2.1f
	correct manipulation seen in **body of answer** of $s = \frac{\eta m}{E}$ 2✓	substitution of their E and data from **Figure 8** leaving η as only unknown: allow POT in s but not in m eg $\eta = \frac{\text{their } E \times 25.5\left(\times 10^{-3}\right)}{0.25}$ **or**		
	correct raw result (allow POT in E) 3✓	substitution of their E and result of a gradient calculation: allow POT in Δs but not in Δm eg $\eta = 1.14 \times 10^9 \times 1.02\ (\times 10^{-1})$ **or**		
	(on answer line) order of magnitude consistent with their raw result 4✓	calculation involving orders of magnitude (expect 10^{-1} but allow 10^2 for gradient) eg $\eta \approx 10^9 \times 10^{-1}$		
		for 3✓ expect 1.16×10^8 but allow 1 sf gradient eg leading to 1.14×10^8		
		for 4✓ $\eta = 10^8$ or 8 only; allow use of their E		
		award 34✓= 1 MAX for use of gradient ≈ 100 leading to order of magnitude = 10^{11} or 11 only		

Question	Answers	Additional comments/Guidelines	Mark	AO
02.5	identifies that s and L are linked by a power law ✓	accept any correct expression (unless there is talk-out) with s or log s as the subject; treat any quantities other than s and L as constant except E and η possible answers are: $s \propto L^n$ allow $s \propto L^m$ if m identified as constant $s \propto L^3$ $s = kL^n$ log s = n log L + (log) k log s = 3 log L + (log) k log s = log L^3 + (log) k	1	AO3.1b
		reject $s = L^n$ log s = n log L log $s \propto n$ log L $10^s \propto 10^L$'s and L are linked logarithmically' 's is directly proportional to L'		

Question	Answers	Additional comments/Guidelines	Mark	AO
02.6	(log L =) -0.097 seen **or** working on **Figure 9** confirming a value of log L between -0.095 and -0.100 1✓ uses **Figure 9** to obtain s in range 2.9 to 3.1×10^{-2} (m) 2✓	for 1✓accept any log L rounding to -0.097; working can be suitable ruled line or mark on the best-fit line / on graph axes for 2✓ accept 29, 30 or 31 mm etc reject 1sf 3×10^{-2} (m)	1 1	AO2.1b AO3.1a
	use of wrong base ln $L = -0.22(3)$; uses **Figure 9** to obtain s in range 1.49 to 1.51×10^{-1} or 1.5×10^{-1} (m) 12✓	accept 15 cm etc		
02.7	use of **Figure 8** to determine M ✓	their (final answer to) **02.6** × gradient of **Figure 8** ($9.8 \pm 2.5\%$) minimum 2sf condone use of 1sf s	1	AO3.1a
Total			**13**	

Question	Answers	Additional comments/Guidelines	Mark	AO
03.1	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 **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	AO1.1b

Question	Answers	Additional comments/Guidelines	Mark	AO
03.2	(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✓ plot V (against) I 2✓ ε = (vertical / y-axis) intercept 3✓ r = –gradient 4✓ 2✓3✓and 4✓ can be awarded for a suitable sketch graph	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 condone 'use the (variable) resistor to vary current and read I, V' idea that R can be read from Q is neutral mark 2✓ independently of 1✓ 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 $r = \frac{-1}{\text{gradient}}$ and 3✓ intercept = $\frac{\varepsilon}{r}$ for 3✓open circuit methods involving ε read directly using voltmeter are neutral for 4✓ any subject but minus sign essential	2 2	AO1.1a AO1.1b
	variation	1✓as above; 3✓find R from V divided by I ; disconnect external circuit and measure ε directly; 4✓plot $\frac{\varepsilon}{V}$ against $\frac{1}{R}$; 2✓gradient = r		

Question	Answers	Additional comments/Guidelines	Mark	AO
03.3	gradient calculation seen with Δn^{-1} divided by ΔI^{-1}; ε from $22 \times$ gradient $_1$✓ ε minimum 3 sf; in range 1.58 to 1.61 (V) $_2$✓	for $_1$✓ do not penalise one read off error, (allow use of 0, 0) or for small steps expect gradient ≈ $7.2(5) \times 10^{-2}$ leading to $\varepsilon = 1.594$ (V) do not allow reverse working based on answer to 03.5 **$_2$✓ is contingent on award of $_1$✓**	1 1	AO3.1a AO2.1h
03.4	use of **Figure 12** 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 12** expect $I^{-1} = 4.2 \pm 0.1$ (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 03.5	1	AO3.1b

Question	Answers	Additional comments/Guidelines	Mark	AO
03.5	circuit resistance $R = 5.5$ (Ω) seen **in 03.5** working 1✓ minimum 2sf V from their $I \times 5.5$ **or** V from their $\varepsilon -$ their $I \times r$ 2✓	for 1✓ allow $R = \frac{22}{4}$ or $\frac{11}{2}$; allow $R^{-1} = \frac{4}{22}$ 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	4	AO3.1a
	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 12**; 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 12**; full substitution of their valid data eg their vertical intercept $\times -22$ **or** their horizontal intercept $\times \varepsilon$ 3✓	use of 'show that' or 2 sf data: $r = \frac{\varepsilon - V}{I}$ with $\varepsilon = 1.6$ V, $V = 1.4$ V and $I =$ 0.25 A gives $r = 0.80$ Ω $\frac{22}{n} = \frac{\varepsilon}{I} - r$ with $\varepsilon = 1.6$ 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: $r = -1 \times -0.053 \times 22 = 1.17$(Ω) horizontal intercept = 0.73: $r = 1.6 \times 0.73 = 1.18$(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		

Question	Answers	Additional comments/Guidelines	Mark	AO
03.6	$n = 2$ **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	AO3.2b
03.7	both points move (by ≥ half a grid square) to the <u>right</u> 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 14** 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	AO3.1b
Total			**17**	