OCR
Oxford Cambridge and RSA

…day June 20XX– Morning/Afternoon

AS Level Physics A

H156/02 Depth in physics

PRACTICE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

Version: Final
Last updated: 23/12/2015

(FOR OFFICE USE ONLY)

This document consists of 12 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the 10 practice responses ("scripts") and the 10 standardisation responses

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the scoris messaging system, or by email.

5. Work crossed out:
   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)
   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question

   Note: Award 0 marks - for an attempt that earns no credit (including copying out the question)

8. The scoris **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
   If you have any questions or comments for your team leader, use the phone, the scoris messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. The Assistant Examiner's Report Form (AERF) can be found on the RM Cambridge Assessment Support Portal (and for traditional marking it is in the *Instructions for Examiners*). Your report should contain notes on particular strength displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. **For answers marked by levels of response:**
Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

Once the level is located, award the higher or lower mark.

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

- **The science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **4(b) and 5(b).**

11. Annotations available in Scoris

Annotation	Meaning
BOD	Benefit of doubt given
CON	Contradiction
	Incorrect response
ECF	Error carried forward
FT	Follow through
NAQ	Not answered question
NBOD	Benefit of doubt not given
POT	Power of 10 error
^	Omission mark
RE	Rounding error or repeated error
SF	Error in number of significant figures
	Correct response
AE	Arithmetic error
	Wrong physics or equation

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
(1)	Separates marking points
reject	Answers which are not worthy of credit
not	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ecf	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Question			Answer	Marks	Guidance
1	(a)	(i)	Force x perpendicular distance from pivot/fulcrum	B1	
		(ii)	Clockwise moments = anticlockwise moments about any axis **or** zero resultant moment about any axis	B1	**Allow** alternatives such as about a given point
	(b)	(i)	Weight (or 17.6 or 18 kN) through **D** vertically down tension along **CB** reaction from **A** passing through point where weight arrow meets tension arrow	B1 B1 B1	
		(ii)	Taking moments about **A** 1800 x 9.8 x 3.0 x cos 30 = T x 6.0 x sin 30 T = 15(.3) kN	C1 C1 A1	for reversing sin and cos **Allow** 2 marks for 5.1 kN
	(c)		Moment of weight of arm decreases perpendicular distance of **BC** from **A** increases therefore tension decreases	M1 M1 A1	
			Total	11	

Question			Answer	Marks	Guidance
2	(a)	(i)	0.22 and 0.26 correct plotting of points on Fig. 2.2 sensible line not through origin	**B1** **B1** **B1**	 tolerance on each point ± 0.5 small scale division expect x-intercept at about 0.02
		(ii)	triangle with base at least half width of graph expected gradient close to 5	**B1** **B1**	must have appropriate triangle on Fig. 2.2 or two sets of data lying on the line clearly shown ecf line; typical values (1.4 – 0)/(0.30 – 0.02)
	(b)	(i)	All points lie below the theoretical line the error bars on each reading are not long enough to allow a worst line through the origin/AW	**B1** **B1**	accept quantitative answers e.g. error in s is half a square and in t^2 is 3 to 4% as several readings averaged 2 marks for two valid points
		(ii)	s is too small same shift in all values so no change to gradient t is too big constant error in t leads to increasing error in t^2 so gradient is changed/steeper	**B1** **B1** **B1** **B1**	Or s should be larger
		(iii)	sensible reason for t being too large or s too small	**B1**	e.g. electromagnet does not release instantaneously,trapdoor is stiff, faulty contacts,etc. e.g. scale on ruler does not start at the end/AW
			Total	**12**	

Question			Answer	Marks	Guidance
3	(a)	(i)	t = 0 to 1.5 s, constant force (of 30 N) causes constant acceleration t = 1.5 to 4.0 s zero (resultant) force so constant speed	**B1** **B1**	or reference to N2 or reference to N1
		(ii)	acceleration = 30/65 = 0.46 (m s^{-2}) speed v at 1.5 s = at = 0.46 x 1.5 = 0.69 (m s^{-1}) distance = ½at^2 + vt' = 0.23 x 1.5^2 + 0.69 x 2.5 s = 2.24 m	**M1** **A1** **C1** **A1**	 ecf acceleration value ecf acceleration and speed values
	(b)	(i)	power lost in circuit = 30^2 x 0.11 = 99 (W)	**C1** **C1**	Apply ecf rule as appropriate
			mechanical power = 640 x 0.70 = 448 (W) electrical power input = 28 x 30 = 840 (W) input power to motor = 741 (W) efficiency = 448/741 = 0.60 or 60%	**C1** **C1** **C1** **A1**	allow 3 marks for 53%
			Total	**12**	

Question			Answer	Marks	Guidance
4	(a)		R (at any point) = V/I 1.2 – 1.5 V R = infinity 1.5 – 1.8 V R <u>decreases/falls</u> to 1.8/10 x 10^{-3} = 180 Ω 1.8 – 2.0 V R continues to decrease because I increases more than V	**B1** **B1** **C1** **A1** **B1**	no mark if reference to slope/gradient of line **Allow** POT error , i.e. 0.18 Ω scores 1 out of 2 **or** falls to 53 Ω at 2.0 V / AW (no RE here for 0.053 Ω)
	(b)*		*Please refer to the marking instructions on page 3 of this mark scheme for guidance on how to mark this question.* **Level 3 (5 - 6 marks)** Typically, circuit including meters is correctly drawn on Fig. 4.2(b). Explanation of action of **both** circuits is correct. Presence of 100 Ω explained. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3 – 4 marks)** Typically, circuit including meters is correctly drawn on Fig. 4.2(b). Action of only Fig. 4.2(b) circuit explained correctly. Purpose of 100 Ω stated but value not justified. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1 – 2 marks)** Typically, circuit including meters is correctly drawn on Fig. 4.2(a). No correct explanations **or** basic information on the action of circuit **or** presence of 100 Ω resistor. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear*	**B1** **X 6**	**Indicative scientific points may include** **circuit diagram** **1.** resistor and LED in series **2.** ammeter in series and voltmeter in parallel with LED **3.** correct symbols for LED, ammeter, voltmeter, etc. **4.** correct polarity of LED **action of circuit** **1.** circuit completed on Fig. 4.2(b) **2.** voltage across **AB** can be varied from 0 to 6 V **3.** some justification; e.g. potential divider circuit **4.** in Fig. 4.2(a) circuit voltage only varies from 6 to about 5.6 V as resistance can only be varied from 110 to 100 Ω (+ LED)/AW **presence of 100 Ω resistor** 1. the current in the circuit is limited by the resistor so ensures LED cannot burn out 2. at 6 V the potential divider across **AB** gives 2 V across LED as its resistance is about 50 Ω/AW

Question			Answer	Marks	Guidance
			0 marks No response or no response worthy of credit.		
			Total	**11**	

Question			Answer	Marks	Guidance
5	(a)		Select $\lambda = ax/D$ and x = 6.0 x 10^{-3}/5 = 1.2 x 10^{-3} m λ = 0.8 x 10^{-3} x 1.2 x 10^{-3} /1.6 λ = 600 (nm)	**C1** **C1** **A1**	**Allow** 2 marks for 500 nm
	(b)*		*Please refer to the marking instructions on page 3 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Expect all points to be addressed, coherence or means of achieving this, all experimental measurements, and an identification of the greatest uncertainty consistent with the methodology described. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Sufficient detail is given to demonstrate an understanding of the execution of the experiment and taking measurements of different orders of magnitude. Reference is made, with limited reasoning to uncertainty. Some detail may be omitted. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** Basic information on equipment and measurements or measurements and uncertainty are given. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit	**B1** **X 6**	**Indicative scientific points may include** **Coherence (C)** 1. Light from slits must be coherent/have constant phase relationship 2. use narrow slit close to lamp or lens to focus beam 3. diffract 'same' light through both slits **Experiment (E)** 1. S_1S_2 : vernier caliper or micrometer, travelling microscope, projected image with known lens 2. AB : vernier caliper, calipers, mm rule (magnifying glass) 3. D from slits to screen : ruler or tape measure with mm markings **Uncertainty (U)** 1. S_1S_2 : 0.1 mm in 0.8 mm with travelling microscope,vernier or micrometer, 2. AB on screen : 0.1 mm in 6 mm with travelling microscope or vernier, 1mm in 6mm with rule 3. D from slits to screen: 1 mm in 1.6.m so very small uncertainty **Conclusion** Expected answer S_1S_2, 12.5% uncertainty Alternatives based on equipment selected should be credited: AB on screen with ruler giving 16.7% uncertainty

Question			Answer	Marks	Guidance
	(c)		percentage uncertainty in *a* decreases fringes move closer together/percentage uncertainty in *x* increases/actually measuring 5*x* so smaller effect/**AW** with both measurements to 0.1 mm, measurement of *a* gives larger improvement so decrease in uncertainty in *λ*	**B1** **B1** **B1**	**Allow** any argument qualitative or quantitative, which considers: effect on *a*, effect on *x* and correct conclusion **Allow** alternative arguments, e.g. D is easily increased increasing *x* so increase in a will decrease uncertainty in *λ* as *Δa/a* smaller
			Total	**12**	

Question			Answer	Marks	Guidance
6	(a)		$\varepsilon = hc/\lambda$ $3.5 \times 10^{-19} = 6.6 \times 10^{-34} \times 3.0 \times 10^{8}/\lambda$ $\lambda = 5.66 \times 10^{-7}$ (m)	**C1** **M1** **A1**	
	(b)	(i)	$\varepsilon = eV = 12 \times 1.6 \times 10^{-19} = 1.92 \times 10^{-18}$ (J) $½mv^2 = 1.92 \times 10^{-18}$ $v^2 = 2 \times 1.92 \times 10^{-18}/9.1 \times 10^{-31} = 4.22 \times 10^{12}$ $v = 2.05 \times 10^{6}$ (m s^{-1})	**B1** **C1** **C1** **A1**	**Allow** ecf for energy value
		(ii)	accelerates from 0 to v so use v/2 $t = 5 \times 10^{-3}/1 \times 10^{6} = 5 \times 10^{-9}$ (s)	**C1** **A1**	**ecf b(i)** **Allow** 1 mark for 2.5×10^{-9} s
	(c)		electrons emitted/s = $1.0 \times 10^{-9}/1.6 \times 10^{-19} = 6.25 \times 10^{9}$ photons arriving = $6.25 \times 10^{9} \times 20 = 1.25\ 10^{11}$ $\varepsilon = 1.25\ 10^{11} \times 4.0 \times 10^{-19} = 5.0 \times 10^{-8}$ (J s^{-1})	**C1** **C1** **A1**	**Allow ecf** :1 out of 3 for correct answer from any quoted number of electrons emitted/s
			Total	**12**	