June 20XX – Morning/Afternoon

AS Level Physics B (Advancing Physics)

H157/02 Physics in depth
PRACTICE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

Version: Final
Last updated: 09/12/15

(FOR OFFICE USE ONLY)

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 **3, 4(c)(ii) and 5(d).**

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)	1/300 000 (1) (= 3.3×10^{-6} m)	1	
(b)	$\sin\theta = 633 \times 10^{-9} \times 300\,000 = 0.1899$ (1) $\theta = 11^{o}$ (1)	2	**Allow** alternative routes to $\sin\theta$
(c)	$1 = n\lambda/d$ (1) $n = d/\lambda = 1/(300000 \times 633 \times 10^{-9}) = 5$ (1)	2	**Allow** alternative methods such as trial and error
2 (a)	Reaching $v = (2gh)^{1/2}$ (1) calculating $v = 5.4(2)$ m s^{-1} (1)	2	Working must be shown as it is a 'show that' question
(b) (i)	$s = ½\ gt^2$: $t = (1.2/4.9)^{1/2}$ (1) = 0.49 s (1)	2	Accept bald answer
(ii)	s = vt = 5.4 x 0.49 = 2.7 m (1)	1	Expect (correct use) of calculator answer to **(a)** and **(b) (i)** Accept e.c.f. **2(a)**
(c)	magnitude of velocity = $(5.4^2 + 4.8^2)^{1/2} = 7.2$ m s^{-1} (1) $\sin\theta = 4.8/7.2$ (1) (=0.67) $\theta = 42^{o}$ (1)	3	Accept e.c.f. **2(a)**
3	**(Level 3)** (5 – 6 marks) Marshals argument in a clear manner describing the concept of polarisation and the action of the polarising filters. Correctly describing the variation of transmitted intensity as a consequence of rotation through 180 ^{o} and the reduction of glare due to the (partial) polarisation of the reflected light. *There is a well developed line of reasoning which is clear and logically structured.* **(Level 2)** (3 – 4 marks) Covers at least two aspects of the argument. Includes a clear link between the observations made in the lab and the use of polarising filters in sunglasses. *There is partial structuring of the ideas with the communication of the science generally clear.* **(Level 1)** (1 – 2 marks) Makes at least two independent points that are relevant to the argument. *Structuring of the answer may be poor.* **(Level 0)** (0 marks) Insufficient or irrelevant physics. Answer not worthy of credit.	6	**Indicative scientific points may include:** **Polarisation** • (E field/ B field) in (plane) polarised light only oscillate in one plane. • Plane of field oscillation is randomly varying in unpolarised light. These points can be made diagrammatically. **Action of filters** • Transmit light in one plane of polarisation. • When 'crossed' no light is transmitted. These points can be made diagrammatically. • Explanation of second bullet point in terms of light from first filter having zero component of oscillation in the orientation of second filter. • Description of variation of transmitted intensity with angle bright/dark/bright. **Sunglasses** • Reflected light is (partially plane) polarised. • Filters are oriented to cut out light of this plane of polarisation.

4	**(a)**	**(i)**	6 x 2048 x 2048 = 2.52 x 10^7 bits (1)	**1**	Don't penalise sfs more than 3
		(ii)	2^6 = 64 (1)	**1**	
		(iii)	Fewer bits per pixel (1) less data to store/quicker transmission of data (1)	**2**	Independent marking points. Noisy images require fewer bits.
	(b)		resolution = 2.2(2048 x 5.73×10^{-5}) (1) = 18.7 μrad per pixel(1) (statement suggests a slightly better resolution)	**2**	ORA
	(c)	**(i)**	Recognition of u much greater than v (1) 1/v = 1/u + 1/f When 1/u → zero (1), 1/v = 1/f	**2**	Or the object distance is very great (1) so rays are nearly parallel when they reach the camera/curvature of wavefronts is zero/ image is formed at the focal point (1)
		(ii)	**(Level 3)** (5 – 6 marks) Marshals argument in a clear manner, linking correct calculation of magnification to size of the image on the camera, to reasoned argument relating image size and pixel size and coming to a conclusion as to whether or not it can be resolved consistent with the data cited. *There is a well developed line of reasoning which is clear and logically structured.* **(Level 2)** (3 – 4 marks) Covers at least two aspects of the argument, for example, correctly calculates magnification and image size with clear reasoning. *There is partial structuring of the ideas with the communication of the science generally clear.* **(Level 1)** (1 – 2 marks) Makes at least two independent points that are relevant to the argument, for example, calculating magnification and image size. *Structuring of the answer may be poor with no connection between points made.* **(Level 0)** (0 marks) Insufficient or irrelevant physics. Answer not worthy of credit.	**6**	**Indicative scientific points may include:** **Magnification :** • Calculation of v = 0.718 m • Use of 0.717 m for image distance • Correct calculation (m= 7.2 x 10^{-4}). **Image size** • Use of correct equation • Leading to expected answer (1.43 x 10^{-5} m). **Resolution** • Linking length to pixel size • Comparison of image size with pixel size. Note that it is possible to argue that i) The image size is larger than the pixel size, therefore it can be resolved ii) The image size is equivalent to a single pixel and therefore it cannot be resolved.

Question	Answer	Marks	Guidance
5 (a) (i)	Correct working of c.s.a (1): $E = (24.5/(\pi \times (1.2 \times 10^{-4})^2)/(8.0 \times 10^{-3}/3.2)$ (1) $= 2.2 \times 10^{11}$ N m^{-2} (1)	3	Must show working and have own value
(ii)	Taking MAX force and length and MIN diameter and extension (1), percentage uncertainty = (2.5 – 2.2/2.2) x 100% (1) = 14%(1)	3	Other routes to percentage uncertainty acceptable
(iii)	Diameter (1) percentage uncertainty = 4% (1). Realisation that the percentage uncertainty in the area is 8% (1) (which is greater than the 6% uncertainty in extension)	3	Candidates are NOT required to know about adding percentage uncertainties when multiplying etc. This question seeks to discover whether the candidate is thinking carefully about the physics under consideration.
(b)	$S = (I/V) \times L/A$ (1) = $(0.21/2.8) \times (3.2/4.5 \times 10^{-8})$ $= 5.3 \times 10^{6}$ S m^{-1}(1)	2	Algebraic manipulation can be implicit but working must be shown. Own value needed.
(c)	T = 3kN/sin 6^{o} (1) = 29 kN (1)	2	Working must be shown. Own value needed.
(d)	**(Level 3)** (5 – 6 marks) Marshals argument in a clear manner linking material and electrical properties and making calculations to support arguments. Make connections between physics and HSW issues such as efficiency. Considers possible advantages and disadvantages of the same material. *There is a well developed line of reasoning which is clear and logically structured.* **(Level 2)** (3 – 4 marks) Covers at least one aspect of the argument including calculations where appropriate. *There is partial structuring of the ideas with the communication of the science generally clear.* **(Level 1)** (1 – 2 marks) Makes at least two independent points that are relevant to the argument. *Structuring of the answer may be poor with no connection between points made.* **(Level 0)** (0 marks) Insufficient or irrelevant physics. Answer not worthy of credit.	6	**Indicative scientific points may include:** **Mechanical** • Stress at join with pylon calculated = 1.5 x 10^{7} Pa • Aluminium nearer this value • Suggested reasons for increased stress (wind/ice) • Economic factors (stronger cables require fewer pylons) • Aluminium lower density so cable is lighter • Steel higher yield stress means less cable needed to support mechanical weight • Stiffness means less sag, lower tension at connection. **Electrical** • Aluminium higher conductivity means less resistive losses in transport of power • Aluminium higher conductivity means that narrower cables could be used for the same resistance • Ratio of resistivities calculated.

6	**(a)**	Any three from: • waves travel through the air in the tube in both directions • the waves are reflected from the closed end of the tube • waves travelling in different directions superpose/interfere • points of maximum displacement are antinodes • points of minimum displacement are nodes	**3**	Accept 'reflect from both ends'
	(b)	A standing wave in a tube closed at one end has a node at one end and an antinode at the other (1). When the tube length is $\lambda/2$ there will require (either) a node at both the closed and open ends or an antinode at the closed and open ends (1)	**2**	Do not penalise antinodes at the closed end or nodes at the open end – the candidate might be considering velocity or pressure nodes.
	(c)	$L_2 - L_1 = (\frac{3\lambda}{4} - c) - (\frac{\lambda}{4} - c)$ (1) $= \frac{\lambda}{2}$	**1**	Alternative routes are acceptable but working must be clear and complete
	(d) **(i)**	0.78 (m)	**1**	
	(ii)	v = 0.78 x 440(1) = 340 m s^{-1} (1) 2 sf to match data (1)	**3**	
	(e) **(i)**	Best fit straight line ignoring 400 Hz value Gradient: e.g. (680 – 340)/(2.0 -1.0) Result in range 300 – 380 m s^{-1} (1) Estimate of uncertainty from possible gradients passing through range bars (1) Uncertainty given: (acceptable range +/- 10 m s^{-1} to +/- 20 m s^{-1}) (1)	**5**	Accept calculating percentage uncertainty in middle of range and using this value. This gives an uncertainty of about 6 % so this method would give a range of +/- 20 m s^{-1}

(e) (ii)	Any three from: • Drawing a best fit line allows any anomalies to be spotted easily • such as the value at 400 Hz • Average would be skewed by the 400 Hz value • lobf establishes trend across the range rather than any single point (owtte)	**3**	