OCR
Oxford Cambridge and RSA

Practice 1: P1

A Level Physics B (Advancing Physics)
H557/02 Scientific literacy in physics

MARK SCHEME

Duration: 2 hours 15 minutes

MAXIMUM MARK 100

Final

This document consists of 13 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 **required number** of practice responses ("scripts") and the **required number** of 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 50% 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, email or via the scoris messaging system.

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 their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths 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.
- Decide the level that **best fits** the answer – match the quality of the answer to the closest level descriptor.
- To select a mark within the level, consider the following:

  Higher mark: A good match to main point, including communication statement (in italics), award the higher mark in the level
  Lower mark: Some aspects of level matches but key omissions in main point or communication statement (in italics), award lower mark in the level.

Level of response questions on this paper are

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	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

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1	(a)	(i)	Wave crests from A_2 and A_4 in phase with those from A_1 ✓ One extra wave crest from A_2 and three extra wave crests from A_3 with correct separation ✓ Path difference correctly shown ✓	3	
		(ii)	1. With a path difference of a whole number of wavelengths✓ the waves superpose in phase ✓	2	
			2. The image is bright because light from many slits superposes in phase ✓ (producing a superposition of high amplitude)	1	
	(b)	(i)	Any two from: • White light composed of many wavelengths ✓ • Different wavelengths require different path differences to meet in phase ✓ • The angle for a maximum is wavelength dependent AW ✓	2	
	(b)	(ii)	$\sin\theta = 5.8 \times 10^{-7} / 1.6 \times 10^{-6}$ ✓ = 0.36(25) $\theta = 21^{o}$ ✓	2	Accept second order value of 46^{o}
			Total	**10**	

Question			Answer	Marks	Guidance
2	(a)		$\Delta p = m\Delta v$ = 72 kg × -11 m s^{-1} ✓ = –790 kg m s^{-1}✓	2	Accept –792 kg m s^{-1}
	(b)		force/weight= (790 kg m s^{-1}/0.15s)/(72 kg × 9.8 N kg^{-1}) ✓ = 7.5 ✓	2	No s.f. penalty on answer.
	(c)	(i)	Any two from: *F* rises before 60.0 ms ✓ area under graph is similar (by eye) ✓ F_{max} is less than the original **and** occupies a longer time ✓	2	
		(ii)	Any two from: *F* starts earlier because bag is closer to head than wheel is ✓ F_{max} is (much) less because d*p*/d*t* is less ✓ area same because momentum is conserved ✓	2	
		(iii)	any pair of effect of deflation + its implication effect of deflation: head will not bounce ✓ / head moves further (as it pushes out the air) ✓ implication for dummy/person: smaller momentum change on head ✓ / longer collision time and so smaller *F* ✓	2	
			Total	**10**	
3	(a)		Electron / beta particle ✓	1	
	(b)		$T_{½} = \ln(2)/\lambda = \ln(2)/3.8 \times 10^{-12}\ s^{-1} = 1.8 \times 10^{11}$ s✓ $= (1.8 \times 10^{11}/3.2 \times 10^{7})$ years✓ = 5700 years ✓	3	
	(c)		Number of atoms = 1.3×10^{-11} kg / ($14 \times 1.7 \times 10^{-27}$ kg) ✓ = 5.46×10^{14} atoms ✓ Activity = (-)λN= $3.8 \times 10^{-12}\ s^{-1} \times 5.5 \times 10^{14}$ = 2100 Bq ✓	3	
	(d)	(i)	Age ~$T_{½}$ so activity ~½ × 2 kBq = 1 kBq ✓	1	Ref. to time (about) 1 half-life gets ✓
		(ii)	Mass ~ hundredth of 65 kg ~ 0.6 kg✓ (substantial) damage to ancient relic ✓	2	
			Total	**10**	

Question			Answer	Marks	Guidance
4	(a)		$k=F/x$=4.0 N/0.10 m = 40 N m^{-1} ✓	1	
	(b)		$F \propto x$ as above ✓; $a \propto F$ by Newton II ✓ a in opposite direction to x ✓ /reference to vector nature	3	
	(c)	(i)	0.7 s ≤ T ≤ 1.0 s✓	1	Graph gives 0.92 s
		(ii)	$T = 2\pi\sqrt{1.0\,\text{kg}/40\,\text{N m}^{-1}} = 2\pi \times 0.158$ s = 0.99 s ✓s✓e Rapid changes in x/v/a not modelled ✓	3	
		(iii)	Model with shorter time intervals ✓ Give example of shorter time interval ✓ Reasoning: velocity held constant for shorter time so shorter time scale changes can be modelled/error will be smaller as the model will recalculate after shorter time ✓	3	
	(d)		Description of exponential decay: equal ratio (or fractional AW) changes (drops AW) ✓ in equal times AW✓ Experimental test: measure amplitude over time✓ Check for constant ratio property/plot ln A vs time graph ✓	4	
			Total	15	

Question			Answer	Marks	Guidance
5	(a)	(i)	F =- 6.7×10^{-11} N m^2 kg^{-2} ×3×10^{12} kg×1100 kg/ (5×10^2 m)^2 ✓ = 0.88 N ~ 0.9 N ✓	2	Must have own answer and show working
	(a)	(ii)	$\frac{mv^2}{r} = \frac{GMm}{r^2}$ ✓ Maximum velocity = $\sqrt{\frac{GM}{r}}$ ✓ = 0.63 m s^{-1} ✓ $\frac{2\pi}{80 \times 60}$ = 0.65 m s^{-1}✓ Comparison of speeds and clear conclusion ✓	5	Alternative approaches possible, e.g. $\frac{mv^2}{r} = \frac{GMm}{r^2}$ ✓ $T^2 = \frac{4\pi^2 r^3}{GM}$ ✓ $T = \sqrt{\frac{4\pi^2 r^3}{GM}}$ (=$2\pi\sqrt{\frac{r^3}{GM}}$) T = 4955 s ✓ = 83 min ✓ Comparison of times and clear conclusion ✓
	(a)	(iii)	Zero of potential energy defined at infinity ✓ Need to supply energy to remove L.P from surface/ reference to gravitational potential well AW ✓	2	
	(a)	(iv)	Calculation of k.e. at about 450 J ✓ This is sufficient to escape potential well AW ✓	2	Need clear link with energy required to leave potential well.
	(b)	(i)	Hydrogen and nitrogen molecules differ in mass ✓	1	
	(b)	(ii)	kT = 1.38 × 10 $^{-23}$J K^{-1} × 93 K ✓ = 1.3 × 10 $^{-21}$J✓ For H_2, kT ~ 9 E_{grav}, so molecule can escape ✓ For N_2, kT ~ 150 E_{grav}, so molecule cannot escape ✓	4	Needs explicit comparison between E & kT
			Total	**16**	
6	(a)	(i)	$A = \pi r^2 = \pi \times (0.75 \times 10^{-3}\text{m})^2 = 1.77 \times 10^{-6}$ m^2 ✓ G = (5.9 x 10^7 S m^{-1}×1.77 × 10^{-6} m^2)/(60 m) ✓ = 1.7 S ✓	3	Stages can be implicit
	(a)	(ii)	$V = I/G$ = 13 A/1.7 S ✓ = 7.8 V ✓	2	ecf from a i

Question			Answer	Marks	Guidance
6	(a)	(iii)	any three points from: • 2.8 kW means $I \approx 13$ A as in (a)(ii) • p.d. across kettle reduced from 'normal' 230 V (to 223 V) reducing the current (to ≈223/230 of 'normal') so power is reduced (to ≈$(223/230)^2$ of 'normal') • 500 W drill draws smaller current (≈2 A), so fewer 'lost volts' (≈1.3 V) than for kettle • p.d. across/current in drill not significantly different when using extension cable	3	
	(b)	*	**Level 3 (5–6 marks)** Marshals argument in a clear manner linking calculated power to temperature rise with little thermal transfer to surroundings. Makes sensible estimates throughout. Correctly calculates the thermal capacity of the cable *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)** Makes a clear argument explaining the manufacturers' recommendation but does not use all available data to support the argument. *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)** Makes some correct calculations but these are not linked to the central argument and the incomplete nature of the argument significantly weakens it. *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	6	**Indicative scientific points may include:** • Correct calculation of power dissipated (100 W to 1 s.f.) • Correct calculation of mass of cable (1 kg to 1 s.f.) • Sensible choice of time of current flowing in a wound state • Correct calculation of temperature rise • Statement about thermal loss in wound cable • Statement about thermal loss in unwound cable • Statement about consequences of high temperature in wound cable • Statement about effect of reducing current
			Total	**14**	

Question			Answer	Marks	Guidance
7	(a)		Any long random linear molecular structure ✓	1	Chemical type chains OK, or just zigzags
	(b)	(i)	Not brittle/doesn't crack/deforms before breaking/ absorbs energy on breaking/ AW✓	1	
	(b)	(ii)	Molecules tightly wound ✓ ; Strongly bonded / difficult to separate helical 'strands'✓	2	Force or energy argument acceptable for (b)(ii) and (iii)
	(b)	(iii)	Molecules separate ✓ ; Less strongly bonded ✓	2	
	(c)		Virtually all water ✓	1	
			Total	7	
8	*		**Level 3 (5-6 marks)** Data used make quantitative comparisons of metals related to speed of cooking and temperature control. The size and shape of the pan is considered in terms of conduction through the base. *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)** Data used make qualitative comparisons of metals related to use in a pan with some consideration of their use in the pan base. *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)** Data from the table used to decide on a suitable metal with little or no consideration of the pan design. *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.*	6	**Indicative scientific points may include:** **structure of pan** • large area of base • constrained by size of heating plate/burner • (relatively) thin bottom • only the bottom needs to conduct well **comparing metals** • copper is the best conductor • iron is a poor conductor • aluminium is nearly as good as copper
			Total	6	

Question			Answer	Marks	Guidance
9	a		70 kJ mol^{-1} = 70 × 10^3 J/6.0 × 10^{23} molecules = 1.17 × 10^{-19} J molecule $^{-1}$ ✓	1	
	b	i	ln 2.8 x 10^{-8} = -1.2 ×10^{-19}/(1.4 × 10^{-23} x *T*) ✓ *T* = -1.2 x10^{-19}/(1.4 × 10^{-23} × ln 2.8 x 10^{-8}) ✓ = 490 K (2 sf) ✓	3	Accept 493 K. NOT 292 K (rounding error) bald correct answer scores 3 use of 1.17 x 10^{-28} gives 480 or 481 K
		ii	reaction rate depends on number of molecules having enough energy to react ✓ ; Boltzmann factor gives fraction of molecules with enough energy ✓	2	
		iii	ratio of Boltzmann factors at 410 K and 360 K = 6.15 × 10^{-10}/3.23 × 10^{-11} = 20 ✓ (rule suggests that) rate of reaction should increase by 2^5 = 32 ✓ Sensible comment e.g. correct order of magnitude/ assuming that BF is proportional to reaction rate/not a good rule over this range as increase is only 2/3 of that predicted.	3	Candidates can gain 1 mark by correctly calculating a BF for 370 K (= 6.2 x 10^{-11}) **and** comparing the BF ratio for the two temperatures (= 1.92) The third mark is still available. Third marking point needs more than an opinion.
			Total	**9**	
10	(a)		12 mV is much too small to read on 2.5 V scale ✓	1	
	(b)		Gradient not constant ✓ ; Show/ calculate that emf > 1.25 V ✓	2	
			Total	**3**	