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ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Education

# Physics 5456

*Specification B*

## PHB1 Foundation Physics

# Mark Scheme

*2007 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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.



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## NOTES

Letters are used to distinguish between different types of marks in the scheme.

**M** indicates OBLIGATORY METHOD MARK
This is usually awarded for the physical principles involved, or for a particular point in the argument or definition. It is followed by one or more accuracy marks which cannot be scored unless the M mark has already been scored.

**C** indicates COMPENSATION METHOD MARK
This is awarded for the correct method or physical principle. In this case the method can be seen or implied by a correct answer or other correct subsequent steps. In this way an answer might score full marks even if some working has been omitted.

**A** indicates ACCURACY MARK
These marks are awarded for correct calculation or further detail. They follow an M mark or a C mark.

**B** indicates INDEPENDENT MARK
This is a mark which is independent of M and C marks.

**e.c.f** is used to indicate that marks can be awarded if an error has been carried forward (e.c.f. must be written on the script). This is also referred to as a 'transferred error' or 'consequential marking'.

Where a correct answer only **(c.a.o.)** is required, this means that the answer must be as in the Marking Scheme, including significant figures and units.

**c.n.a.o**. is used to indicate that the answer must be numerically correct but the unit is only penalised if it is the first error or omission in the section (see below).

Only **one** unit penalty **(u.p.)** in this paper unless there is a mark allocated specifically for giving a correct unit in the marking. Note that the unit is only penalised in the final answer to the question.

Only **one** significant figure penalty **(s.f.)** in this paper.
Allow 2 or 3 s.f unless otherwise stated. s.f penalties include recurring figures and fractions for answers.

Marks should be awarded for **correct** alternative approaches to numerical question that are not covered by the marking scheme. A correct answer from working that contains a physics error (PE) should not be given credit. Examiners should contact the Team Leader or Principal Examiner for confirmation of the validity of the method, if in doubt.

**Quality of Written Communication**

Before accessing marks for the Quality of Written Communication (QWC) a candidate must first score a minimum of one mark for the physics that is being communicated – this will allow access to 1 mark for QWC. If the candidate scores more marks for physics (a minimum of two or three – depending upon the total mark for that part of the question) then this will allow access to 2 marks for QWC.

| | | |
|---|---|---|
| **Good QWC**: the answer is fluent/well argued with few errors in spelling, punctuation and grammar | **2** | |
| **Poor QWC**: the answer lacks coherence or spelling, punctuation and grammar are poor | **1** | **Max 2** |
| **Very Poor QWC**: the answer is disjointed, with significant errors in spelling, punctuation and grammar | **0** | |

## PHB1 Foundation Physics

| **Question 1** | | | |
|---|---|---|---|
| (a) | terminal speed/velocity | **B1** | **1** |
| (b) | **clearly estimates** number of squares<br>**quotes** size of one square<br>**gives** answer to 3+ s.f. in range 2.6 – 2.9 m [2.75 m] | **B1**<br>**B1**<br>**B1** | **3** |
| (c) | 0.075 × 9.8 × b (i)<br>2.01 J [e.c.f] [2.21 J from 3 m] | **C1**<br>**A1** | **2** |
| | | | **Total 6** |

| **Question 2** | | | |
|---|---|---|---|
| (a) | zero (**not** low) resistance…<br>…at/below a transition/critical temperature | **B1**<br>**B1** | **2** |
| (b) | (zero resistance means) reduced/no power loss<br>or mention of $I^2 R$<br>**or** use of lower/zero voltage (M1)<br>mention of $V = IR$ (A1) | **M1**<br>**A1** | **2** |
| | | | **Total 4** |

| **Question 3** | | | |
|---|---|---|---|
| (a) | attempt to equate moments<br>$0.8F_1 = 0.75 \times 0.4 + 0.50 \times 0.3$<br>$F_1 = 0.56$ N | **C1**<br>**C1**<br>**A1** | **3** |
| (b) | $F_1$ (ecf) + $F_2$ = 1.25/correct moments<br>$F_2$ = 0.69 N (e.c.f. from (a)) | **C1**<br>**A1** | **2** |
| | | | **Total 5** |

| Question 4 | | | |
|---|---|---|---|
| (a) | $F = m\,a$ quoted<br>$a$ = 23/9.4<br>= 3670 N/3700 N/3680 N c.a.o. | **C1**<br>**C1**<br>**A1** | **3** |
| (b) | use of appropriate kinematic equation or average speed<br>11.5 × 9.4 = 108 m [110] | **C1**<br>**A1** | **2** |
| | | | **Total 5** |

| Question 5 | | | |
|---|---|---|---|
| (a) | parallel circuit shown/clearly used<br>correct substitution into appropriate equation<br>375 ohm | **M1**<br>**C1**<br>**A1** | **3** |
| (b) | **max 3 from:**<br>metal resistance increases **and** thermistor resistance decreases<br>appreciation of greater impediment to flow **in both cases**<br>extra charge carriers released in thermistor<br>second effect greater than first in thermistor | <br>**B1**<br>**B1**<br>**B1**<br>**B1** | **max 3** |
| | | | **Total 6** |

| Question 6 | | | | |
|---|---|---|---|---|
| (a) | | workable circuit, ammeter correct, cell symbol correct | **B1** | **3** |
| | | voltmeter correctly placed | **B1** | |
| | | means for varying resistance in circuit | **B1** | |
| (b) | (i) | clear use of graph, drawn line | **B1** | **4** |
| | | $0.8 \pm 0.02$ V *condone 0.8 V* | **B1** | |
| | (ii) | appreciates gradient equals internal resistance **or** $\varepsilon = V + Ir$ (or alt) **or** solves for 2 pts on line | **B1** | |
| | | typically $0.8/5.4 \times \mathbf{10^{-3}}$ or alternative correct values from any above method seen | **B1** | |
| (c) | | any evidence of $Q = It$ used | **C1** | **3** |
| | | $[72 \times 5.0 \times 10^{-6} \times 3600 =]$ 1.3 C | **A1** | |
| (d) | (i) | electrons | **B1** | **2** |
| | (ii) | ions | **B1** | |
| (e) | (i) | series (circuit) | **B1** | **2** |
| | (ii) | large internal resistance so current small | **B1** | |
| | | | | **Total 13** |

| Question 7 | | | |
|---|---|---|---|
| | **up to 4: wind disadvantages** | | |
| | 1 aesthetic (appearance/sound) | **B1** | |
| | 2 environmental (e.g. wildlife, ecosystem) | **B1** | |
| | 3 unreliability/inefficiency | **B1** | |
| | 4 economic argument | **B1** | |
| | 5 capacity argument (linked to space) | **B1** | |
| | **up to 2 of: conversion processes** | | **max 5** |
| | 6 wind **kinetic** energy to turbine (rotational) k.e. | **B1** | |
| | 7 turbine rotates dynamo/generator/describes dynamo | **B1** | |
| | 8 turbine rotational **kinetic** energy to electrical energy | **B1** | |
| | *allow turbine/rotor/blades, condone 'kinetic' appearing only once* | | |
| | At least 2 marks for physics + **Good QWC**<br>At least 2 marks for physics + **Poor QWC**<br>At least 2 marks for physics + **Very Poor QWC**<br>1 mark for physics + sufficient attempt + **Good or Poor QWC**<br>1 mark for physics + insufficient attempt or **Very Poor QWC**<br>No marks for physics or **Very Poor QWC** | **2**<br>**1**<br>**0**<br>**1**<br>**0**<br>**0** | **max 2** |
| | | | **Total 7** |

| Question 8 | | | | |
|---|---|---|---|---|
| (a) | (i) | cos θ = 1900/2100 | **B1** | **4** |
| | | θ = 25.2º *must see 3+ s.f.* | **B1** | |
| | (ii) | force = 2100 sin 25 | **C1** | |
| | | = 894/890 N | **A1** | |
| (b) | (i) | time for one complete oscillation – 'complete' specified clearly | **B1** | **4** |
| | (ii) | centre to max displacement/equilibrium point/distance (travelled) | **B1** | |
| | (iii) | longer period | **M1** | |
| | | because larger mass | **A1** | |
| (c) | | lift acts upwards | **B1** | **3** |
| | | weight/gravity pull acts downwards | **B1** | |
| | | forces equal and opposite/cancel out (for horizontal flight) | **B1** | |
| | | **or** no resultant vertical force | | |
| | | | | **Total 11** |

| **Question 9** | | | |
|---|---|---|---|
| (a) | one volt across device when current is one amp owtte | **B1** | **1** |
| (b) | $R = \rho l/A$ quoted<br>area = $(5 \times 10^{-3}) \times$ thickness seen<br>$1.3 \times 10^{-6}$ m [1.25] | **C1**<br>**C1**<br>**A1** | **3** |
| (c) | power = $3^2/1200$ *condone power of 10 error in this mark*<br>7.5 mW [*allow* 8 mW] | **C1**<br>**A1** | **2** |
| (d) (i) | use of $V_1 = VR_1/(R_1+R_2)$ (values or lengths)<br>0.48 V [*allow* 0.5 V] | **C1**<br>**A1** | **4** |
| (ii) | fresh calculation **or** 0.96 V less than 3 V<br>2.04/2.0/2 V | **C1**<br>**A1** | |
| (e) | $V$ readoff correct [1.8 – 1.9 V]<br>conversion correct 1001 [c.a.o.] | **B1**<br>**B1** | **2** |
| (f) | **max 4 from**<br>1 simultaneous multi-channel capture possible<br>2 frequency of sampling<br>3 possibility of data manipulation<br>4 length of experiment<br>5 more data storage (in smaller places)<br>6 up to **2 max** analogue instrument errors<br>7 any other valid, physically correct idea [e.g. parallax, reaction time, etc] | <br>**B1**<br>**B1**<br>**B1**<br>**B1**<br>**B1**<br>**B1**<br>**B1** | **max 4** |
| | At least 2 marks for physics + **Good QWC**<br>At least 2 marks for physics + **Poor QWC**<br>At least 2 marks for physics + **Very Poor QWC**<br>1 mark for physics + sufficient attempt + **Good or Poor QWC**<br>1 mark for physics + insufficient attempt or **Very Poor QWC**<br>No marks for physics or **Very Poor QWC** | **2**<br>**1**<br>**0**<br>**1**<br>**0**<br>**0** | **max 2** |
| | | | **Total 18** |