General Certificate of Secondary Education

Additional Science 4408 / Physics 4403

PH2HP **Unit Physics 2**

Mark Scheme

2012 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 students' 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 students' 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 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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX

MARK SCHEME

Information 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 lines 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 students 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 error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 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.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 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.

Quality of Written Communication and levels marking

In Question 8 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

PH2HP

Question 1

question	answers	extra information	mark
1(a)(i)	**B C**	either order	1
1(a)(ii)	elastic <u>potential</u> (energy)	accept strain for elastic	1
1(b)(i)	measured / recorded the length of the spring (and not extension) extension does not equal zero when force = 0	mark both parts together accept measured **A**–**C** (and not **B**–**C**) accept did not work out/measure the extension accept line should pass through the origin	1 1
1(b)(ii)	point marked at 5.5 (N) up to that point force and extension are (directly) proportional	accept anywhere between 5.0 and 5.6 inclusive accept at the end of the straight part (of the graph line) accept past that point force and extension are no longer (directly) proportional accept the line starts to curve	1 1
1(c)	1.8	allow **1** mark for correct substitution, ie 25 x 0.072 provided no subsequent step shown an answer 1800 gains **1** mark an incorrect conversion from mm to m with a subsequent correct calculation gains **1** mark	2
Total			**8**

PH2HP

Question 2

question	answers	extra information	mark
2(a)(i)	1.25 (mSv)		1
2(a)(ii)	any **two** from: • (frequent) flying • living at altitude • living in areas with high radon concentrations • living in a building made from granite (blocks) • having more than the average number of X-rays or having a CT scan • working in a nuclear power station	 accept stated occupation that involves flying accept a specific area, eg Cornwall accept more medical treatments accept any suggestion that could reasonably increase the level from a specific source	2
2(b)(i)	to be able to see the effect of exposure (to radon gas) **or** as a control	accept to compare (the effect of) exposure (with no exposure)	1
2(b)(ii)	increased levels of exposure increases the risk (of developing cancer) smoking increases the (harmful) effect of radon	accept exposure (to radon gas) increases the risk answers that simply reproduce statistics are insufficient	1 1
2(c)	LNT model – risk increases with increasing radiation (dose) level Radiation hormesis – low radiation (dose) levels reduce the risk	accept in (direct) proportion accept low doses increase the risk	1 1

Question 2 continues on the next page . . .

PH2HP

Question 2 continued

question	answers	extra information	mark
2(d)	two valid points made – examples: • animals have no choice and so should not be used • should not make animals suffer • better to experiment on animals than humans • experiments lead to a better understanding / new knowledge • experiments may lead to health improvement / cures for humans	results for animals may not apply to humans is insufficient	2
Total			**10**

PH2HP

Question 3

question	answers	extra information	mark
3(a)	750	allow **1** mark for correct substitution, ie 75 x 10 provided no subsequent steps shown	2
	newton(s) / N	do **not** accept n	1

3(b)			6
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 2, and apply a 'best-fit' approach to the marking.			
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant content.	There is a brief attempt to explain why the velocity / speed of the parachutist changes. **or** the effect of opening the parachute on velocity/speed is given.	The change in velocity/ speed is clearly explained in terms of force(s) **or** a reasoned argument for the open parachute producing a lower speed.	There is a clear and detailed explanation as to why the parachutist reaches terminal velocity **and** a reasoned argument for the open parachute producing a lower speed

Question 3 continues on the next page . . .

PH2HP

Question 3 continued

question	answers	extra information	mark
3(b) (cont)	**examples of the physics points made in the response to explain first terminal velocity** • on leaving the plane the only force acting is weight (downwards) • as parachutist falls air resistance acts (upwards) • weight greater than air resistance **or** resultant force downwards • (resultant force downwards) so parachutist accelerates • as velocity / speed increases so does air resistance • terminal velocity reached when air resistance = weight **to explain second lower terminal velocity** • opening parachute increases surface area • opening parachute increases air resistance • air resistance is greater than weight • resultant force acts upwards / opposite direction to motion • parachutist decelerates / slows down • the lower velocity means a reduced air resistance • air resistance and weight become equal but at a lower (terminal) velocity	accept gravity for weight throughout accept drag / friction for air resistance accept terminal velocity reached when forces are balanced	

Question 3 continues on the next page . . .

PH2HP

Question 3 continued

question	answers	extra information	mark
3(c)(i)	any **one** from: • mass/weight of the (modelling) clay • material parachute made from • number / length of strings	 accept size/amount/volume/ shape of clay accept plasticine for (modelling) clay accept same (plastic) bag	1
3(c)(ii)	**C** smallest (area) so falls fastest (so taking least time)	reason only scores if **C** is chosen accept quickest/quicker for fastest if **A** is chosen with the reason given as 'the largest area so falls slowest' this gains **1** mark	1 1
Total			**12**

PH2HP

Question 4

question	answers	extra information	mark
4(a)	13 500 (J)	allow **1** mark for correct substitution, ie 90 x 10 x 15 provided no subsequent step shown	2
4(b)	17 **or** $\sqrt{\frac{their\ (a)}{45}}$ correctly calculated and answer given to 2 or 3 significant figures	accept 17.3 allow **2** marks for an answer with 4 or more significant figures, ie 17.32 **or** allow **2** marks for correct substitution, ie 13 500/ their (a) = ½ x 90 x v^2 **or** allow **1** mark for a statement or figures showing KE = GPE	3
4(c)	work is done (against) friction (between the miner and slide) (due to the) slide not (being perfectly) smooth **or** causing (kinetic) energy to be transferred as heat/internal energy of surroundings	 accept 'air resistance' **or** 'drag' for friction accept miners clothing is rough accept lost/transformed for transferred accept air for internal energy of surroundings	1 1 1
Total			**8**

PH2HP

Question 5

question	answers	extra information	mark
5(a)	electric current (rate of) flow of (electric) charge / electrons	accept $I = \frac{Q}{t}$ with Q and t correctly named	1
	potential difference work done / energy transferred per coulomb of charge (that passes between two points in a circuit)	accept $V = \frac{W}{Q}$ with W and Q correctly named	1
5(b)	metals contain free electrons (and ions)	accept mobile for free	1
	as temperature of filament increases ions vibrate faster / with a bigger amplitude	accept atoms for ions accept ions/atoms gain energy accept vibrate more for vibrate faster do not accept start to vibrate	1
	electrons collide more (frequently) with the ions **or** (drift) velocity of electrons decreases	do not accept start to collide accept increasing the p.d. increases the temperature (**1** mark) **and** (and) resistance increases with temperature (**1** mark) if no other marks scored	1
5(c)	7.8	allow **1** mark for obtaining value 1.3 from graph **or** allow **1** mark for a correct calculation using an incorrect current in the range 1.2-1.6 inclusive	2
Total			**7**

PH2HP

Question 6

question	answers	extra information	mark
6(a)	a protostar is at a lower temperature **or** a protostar does not emit radiation / energy	accept heat or light for energy	1
	as (nuclear) fusion reactions have not started		1
6(b)	by (nuclear) fusion	accept nuclei fuse (together) nuclear fusion and fission negates this mark	1
	of hydrogen to helium		1
	elements heavier than <u>iron</u> are formed in a <u>supernova</u>	accept a specific example e.g. heavier elements such as gold are formed in a supernova accept heavier elements (up to iron) formed in red giant/red super giant reference to burning (hydrogen) negates the first 2 marks	1
Total			**5**

PH2HP

Question 7

question	answers	extra information	mark
7(a)(i)	50 000	allow **1** mark for correct substitution, ie 6 = 0.00012 x R **or** 6 = 0.12 x R **or** answers of 25 000 or 50 gain **1** mark **or** allow 1 mark for an incorrect answer caused by one error only ie using 3V or an incorrect conversion of current	2
	ohm / Ω	an answer 50kΩ gains **3** marks	1
7(a)(ii)	(body) resistance changes **or** body fat/resistance affected by (many) factors	accept named factor, eg age, gender, height, fitness, bone structure, muscle, drinking water related to body fat/resistance	1
7(a)(iii)	gives misleading / wrong/inaccurate value	do not credit if specifically linked to a change in mass/weight	1
	(because) high water content changes body resistance	accept a specific change to resistance water changes body mass is insufficient	1
7(b)(i)	RCCB – detects difference between current in live and neutral (wires)	accept RCCB can be reset	1
	fuse – (overheats and) melts	accept blows for melts	1

Question 7 continues on the next page

PH2HP

Question 7 continued

question	answers	extra information	mark
7(b)(ii)	switches the circuit / hedge trimmers off within 60 milliseconds	allow for **1** mark the RCCB/it is (very) fast. do not accept the bigger the current the faster the RCCB switches off	2
Total			**10**

UMS Conversion Calculator www.aqa.org.uk/umsconversion