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Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCSE in Physics (5PH3H) Paper 01 Unit P3: Applications of Physics

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

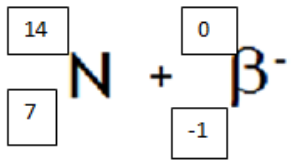
- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Acceptable answers	Mark
1(a)	☒ **D** too many neutrons.		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	☒ **A** a β^+ is positively charged and a β^- is negatively charged		**(1)**

Question Number	Answer	Acceptable answers	Mark
1 (c)	 Any two numbers correct (1) All four numbers correct (2)		**(2)**

Question Number	Answer	Acceptable answers	Mark
1 (d)	A description to include: Up and down (quarks) / Three (quarks) (1) Correct arrangement (quarks) (1)	Accept for two marks: uud up, up, down two up quarks and one down quark Ignore charges	**(2)**

Question Number	Answer	Acceptable answers	Mark
1 (e)	An explanation linking the following: **Either** proton changes to a neutron (1) positron/anti-electron (emitted) (1) OR up quark changes to a down quark (1) positron/anti-electron (emitted) (1) **OR** proton number goes down by one / neutron number goes up by one (1) number of nucleons stays the same (1)	Accept any correct set of statements for two marks $P \rightarrow n + \beta^+$ (1) Ignore positive electron atomic number goes down by one mass number is constant	**(2)**

Total for Question 1 = 8 marks

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	10.8 + or – 0.2 (cm)	Any value between 10.6(cm) and 11.0 (cm) Accept 11 cm	**(1)**

Question Number	Answer	Acceptable answers	Mark
2 (a)(ii)	B $2.1 \times 10^{-2}\ cm^3$		**(1)**

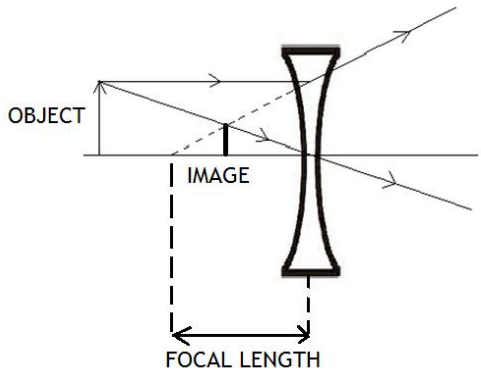
Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	Temperature conversion to K 50°C to 323K **OR** 100°C to 373K (1) Substitution $V_1 = \frac{2.31 \times 10^{-2} \times 373}{323}$ (1) Evaluation $2.67 \times 10^{-2}\ (cm^3)$ (1)	 If equation is transformed to give V_2, allow correct substitution mark. $0.0267(cm^3)$, $2.7 \times 10^{-2}\ (cm^3)$, $0.027(cm^3)$, $2.67 \times 10^{-8}\ m^3$, $2.7 \times 10^{-8}\ m^3$ Allow power of ten error for 2 marks e.g. 267 Allow 2.6×10^{-2} for 3 marks Full marks for correct answer with no working If temperature is not converted to Kelvin, maximum two marks e.g. $V_1 = \frac{2.31 \times 10^{-2} \times 100}{50}$ $4.62 \times 10^{-2}(cm^3)$ Allow power of ten error for 1 mark e.g. 4.62 2 marks for $4.62 \times 10^{-2}\ (cm^3)$ with no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(b)	A description including: (Average) KE/it increases as the temperature increases (1) Idea of proportionality / KE doubles when the temperature doubles (1) (when) temperature in Kelvin /K (1)	Allow energy for kinetic energy Or reverse argument (Average) KE/it is (directly) proportional to the Kelvin temperature gets all three marks (Average) KE/it is (directly) proportional to the temperature gets first two marks Allow absolute scale	**(3)**

Total for Question 2= 8 marks

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	**B** either real or virtual | either magnified or diminished		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	A description including:- Effect of change in shape (1) AND Gives greater/ larger power (1) The second mark is dependent on the first	 greater refraction/ more bending (of light) greater curvature / fatter / more curved/ thicker lens shorter focal length / shorter f Or reverse argument Credit clear labelled diagrams that show this difference.	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)		Accept symbols I and f Ignore arrow on image	**(2)**
(i)	Image, line at right angles to principal axis to where rays cross. Judge by eye (1)		
(ii)	Focal length, distance from where virtual ray crosses principal axis to centre of concave lens. Judge by eye (1)		

Question Number	Answer	Acceptable answers	Mark
3(b)(iii)	Short sight / short sightedness	Myopia/ myopic/ near sight	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(iv)	Substitution $\frac{1}{0.5} + \frac{1}{v} = \frac{1}{-0.33}$ (1) Transformation $\frac{1}{-0.33} - \frac{1}{0.5}$ (1) Evaluation $\left(\frac{1}{v}\right) = -3 - 2 = -5$ (1) $\left(v\right) = -0.2$ (m) (1)	Substitution and transformation in any order -5.03 gets 3 marks +5, +5.03 gets 2 marks Any value that rounds up to + or - 0.2 m/ + or - 20 cm gets 4 marks Allow power of ten error for 3 marks Correct answer with no working awarded 4 marks	**(4)**

Total for Question 3 = 10 marks

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	**B** a few hours		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	An explanation including three of the following: MP1 alpha/the radiation is (highly) ionising (1) MP2 the radiation destroys cancers/tumours (1) MP3 alpha particles/ do not penetrate very far in the body/inserted close to the cancer (1) MP4 half-life is long enough for the treatment to take effect (1) MP5 half-life is short enough so that the pellets do not need to be removed (1)	 kills/ destroys/mutates cells mutates DNA alpha particles do not/ get out of the organ being treated/ damage cells in other organ Ignore patients being radioactive Ignore replacement of pellets	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(b)	An explanation to include: reduces the size of tumours/cancers (1) reduces pain/ relieves symptoms / extends life expectancy / Improves quality of life (1)	 stops tumours growing/ slows rate of growth or spread of cancer	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	An explanation linking two of the following:- CT scan lasts much longer / X-ray short exposure (1) CT scan is many X-ray (slices) (1) The intensity of radiation for CT scans is higher than for normal X-rays (1)	 For CT scan X-ray machine moves (slowly) around the body many pictures / series of X-rays/ 3D image	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	Justification including:- appreciation that there would be risks (1) ONE from:- non-invasive/ not painful (1) OR more accurate/better/earlier diagnosis (1) OR life-saving/ provide cure (1)	 the benefits outweigh the risks/drawbacks/concerns/dangers gives more useful information	**(2)**

Total for question 4 = 10 marks

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	zero	nothing, they have none, 0	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	substitution $1.6 \times 10^{-13} = m\ (3.0 \times 10^{8})^2$ (1) transformation $\frac{1.6 \times 10^{-13}}{(3.0 \times 10^{8})^2}$ (1) Evaluation 1.8×10^{-30} (kg) (1)	transformation and substitution in any order 1.77 recurring $\times 10^{-30}$ (kg) gets full marks. Ignore number of significant figures 1.78×10^{-30} or any correctly rounded number of significant figures gets full marks 0.18×10^{-29} (kg), 18×10^{-31} (kg) 2×10^{-30} (kg) Correct answer with no working gets full marks.	**(3)**

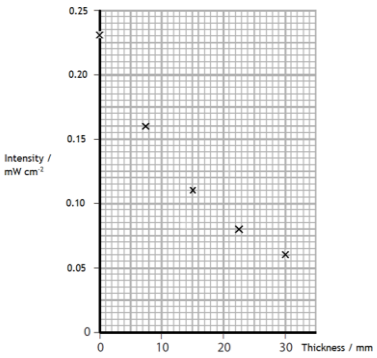
Question Number	Answer	Acceptable answers	Mark
5(a)(iii)	An explanation linking:- BEFORE positron charge is +1, electron charge is -1 (+e and –e) (1) OR total charge is zero before (annihilation) (1) AFTER gamma rays have no charge (1)	 +1 + -1 = 0 photons have no charge	**(2)**

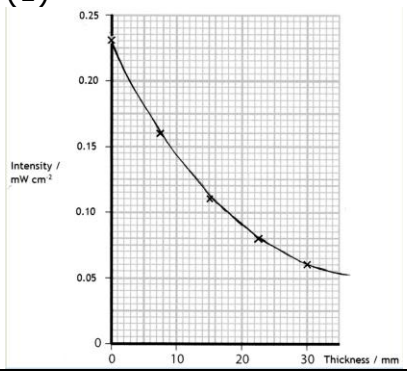
Question Number		Indicative Content	Mark
QWC	***5 (b)**	A comparison and similarity including some of the following points :- particle accelerators use:- • charged particles • magnetic fields • high frequency alternating voltages • collisions • centripetal force hospital particle accelerators • cyclotrons • small, size of a garage • fast moving particle hit targets • particles absorbed by nuclei • produce isotopes with short half lives • only a few people needed to work them research particle accelerators • cyclotrons, synchrotrons, • Large Hadron Collider, CERN • very large, LHC more than 2 km across • use superconducting electromagnets • accelerate particles to close to the speed of light • use hundreds of research scientists • make particles collide • try to discover new particles (Higgs Boson)	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited comparison including a difference OR similarity OR two separate statements e.g. The hospital one is small and the research accelerator is big (one difference) / Cyclotrons use a magnetic field (one similarity)/ The Large Hadron Collider is used for research and small cyclotrons are used in hospitals (one difference)/ The hospital accelerator is small and makes isotopes (two statements). • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple comparison including differences and/or similarities that include BOTH sorts of accelerators e.g. Cyclotrons use magnetic fields and use high frequency alternating voltages (two similarities)/ Hospital cyclotrons are small and produce isotopes. Research ones are large and used to discover new particles (different size and different purpose)/ The research one uses collisions to discover new particles, and the hospital one uses collisions to make isotopes (one similarity and one difference). • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	a detailed comparison including differences AND/OR a similarities between BOTH sorts of accelerators that includes further qualified detail on one e.g. Cyclotrons use magnetic fields to make particles move in circles and use high frequency alternating voltages (two similarities with extra detail)/ Hospital cyclotrons are small and produce isotopes with short half-lives. Research ones are large and used to discover new particles (different size and different purpose with extra detail)/ The research one uses collisions to discover new particles such as the Higgs Boson, and the hospital one uses collisions to make isotopes (one similarity and one difference). • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Total for question 5 = 12 marks

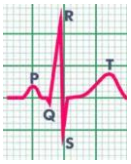
Question Number	Answer	Acceptable answers	Mark
6(a)	**C** Red light has a shorter wavelength than infra-red.		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(b) (i)	All 3 points correctly plotted to +or- half a square (2)  	Any 2 points correctly plotted 1 mark Just one point gains 0 marks The extra points are: thickness 7.5 15.0 22.5 intensity 0.16 0.11 0.08	**(2)**

Question Number	Answer	Acceptable answers	Mark
6(b)(ii)	Line of best fit (1)  	Gauge quality of line by eye according to points plotted Ignore line beyond 30 mm	**(1)**

Question Number	Answer	Acceptable answers	Mark
6(b)(iii)	14±1 (mm) (1)	Any value between 13.0 (mm) and 15.0 (mm)	**(1)**

Question Number	Answer	Acceptable answers	Mark
6(b)(iv)	Accept values from 0.02 to 0.05 (mW/cm^2) (1)		**(1)**

Question Number		Indicative Content	Mark
QWC	***6 (c)**	An explanation including some of the following points :- Shape • standard labelling for electrocardiogram signal  • pattern shows heart action • all shapes are the same so no heart irregularity • patterns shows the parts of the heart pumping blood • pattern produced reflects the electrical activity of the heart • changes in the shape can show weaknesses in different parts of the heart (heart attacks) • the trace shows potential differences across different parts of the heart when the muscles contract and relax • action potentials (electrical signals) originate in the right atrium of the heart • P wave shows muscle contraction spreading through the atria (depolarisation) • QRS shows the ventricles contracting to pump blood to lungs and the rest of the body • T wave is repolarisation when ventricles fill with blood Distance between peaks • shows heart rate.(60 to 90 beats per minute considered normal) • the time for one beat of the heart is represented by the distance between the peaks (could be shown on diagram) • one beat is 0.78s to 0.82s • frequency of 1.25Hz to 1.3 Hz • beats per minute 74 to 80	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited explanation about the signal shape OR the distance between peaks e.g. The distance between peaks shows how fast the heart is beating. / The trace shows the electrical signals which make the heart pump. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple explanation about the signal shape AND the distance between peaks OR a detailed explanation of one e.g. Action potentials originate in the right atrium and happen about every second.(shape and distance) / The ventricles contracting gives the QRS trace, and one heart beat takes about 0.8 s (shape and distance) / The distance between P waves shows the time between heart beats is 0.8s giving a frequency of 1.25 Hz. (detailed distance) / The change in potential difference shows when the muscles contract and relax to pump blood around the body. (detailed shape) • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed explanation about the signal shape AND a quantitative discussion of the distance between the peaks e.g. The ventricles contracting gives the QRS trace, and one heart beat takes about 0.8 s giving 75 beats per minute. / The action potentials show voltages across muscles of the heart. One heart beat take 0.78 s this is a frequency of 1.28 Hz giving 77 beats each minute. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Total for question 6 =12 marks

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