EDEXCEL GCSE PHYSICS

# PHYSICS



## EXAM QUESTION PACK

UNIT P3 FOUNDATION TIER 5PH3F PAPERS

STEMUP

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**Pearson Edexcel GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Physics

## Unit P3: Applications of Physics

**Foundation Tier**

Friday 23 June 2017 – Morning
**Time: 1 hour**

Paper Reference
**5PH3F/01**

**You must have:**
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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## FORMULAE

You may find the following formulae useful

power of lens = $\frac{1}{\text{focal length}}$

frequency = $\frac{1}{\text{time period}}$ $f = \frac{1}{T}$

The relationship between temperature and volume for a gas $V_1 = \frac{V_2 T_1}{T_2}$

The relationship between volume and pressure for a gas $V_1 P_1 = V_2 P_2$

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**Questions begin on next page.**

**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒.**
**If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

**Ionising and non-ionising radiations**

**1** (a) (i) Which of these radiations is **non-ionising**?

Put a cross (☒) in the box next to your answer.

**(1)**

☒ **A** gamma rays

☒ **B** light

☒ **C** alpha radiation

☒ **D** X-rays

(ii) State a medical use for an ultrasound scanner.

**(1)**

.....

.....

(b) Some patients are treated with ionising radiation.

Describe some of the risks to patients who are treated with ionising radiation.

**(2)**

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(c) Explain why all medical technicians must be outside the treatment room when a patient is treated with ionising radiation.

**(2)**

(d) Positrons are needed for a PET scanner to work.
The positrons are provided by isotopes.

Explain why these isotopes have to be produced at or near to the hospital.

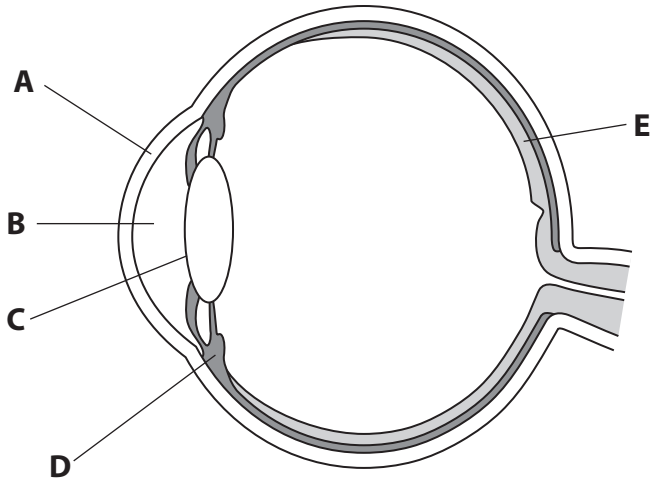
**(2)**

**(Total for Question 1 = 8 marks)**

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## The eye and lenses

**2** The diagram shows the features of the eye.




(a) Draw one straight line from each feature to the correct label.

**(3)**

| **feature** | **label** |
|---|---|
| ciliary muscle | **A** |
| cornea | **B** |
| retina | **C** |
| | **D** |
| | **E** |

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(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

**(1)**

The average adult human eye has a near point

☒ **A** at infinity

☒ **B** 10 cm from the eye

☒ **C** 25 cm from the eye

☒ **D** 100 cm from the eye

(c) Short sight is a defect of vision that can be corrected using a lens.

(i) State **one** symptom of short-sightedness.

**(1)**

.....

.....

(ii) Give **one** reason for a person being short-sighted.

**(1)**

.....

.....

(iii) A lens used to correct short sight has a focal length of –0.5 m.

Calculate the power of the lens.

**(2)**

power = ..... D

**(Total for Question 2 = 8 marks)**

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## Collisions and PET scanners

**3** (a) Complete the sentence by putting a cross (☒) in the box next to your answer.

**(1)**

PET scanners use radioactive isotopes produced when

☒ **A** a stable element is bombarded with neutrons

☒ **B** a stable element is bombarded with protons

☒ **C** an unstable element is bombarded with neutrons

☒ **D** an unstable element is bombarded with protons

(b) The collisions that produce radioactive isotopes are inelastic.

Explain, in terms of kinetic energy and momentum, what is meant by an **inelastic collision**.

**(2)**

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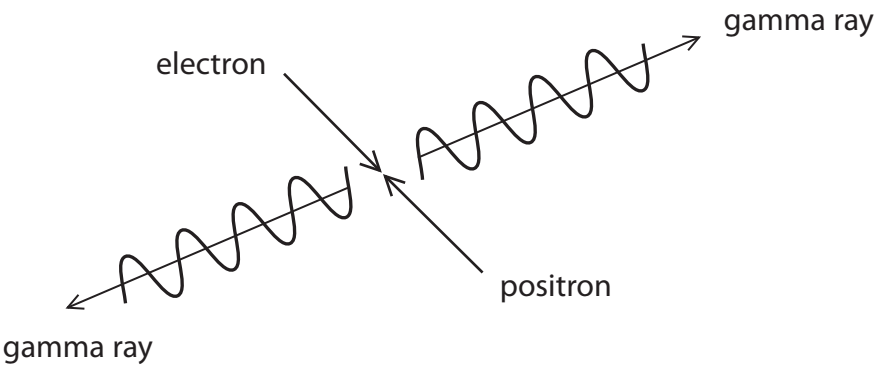
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(c) When electrons and positrons collide they are annihilated and gamma rays are produced.




(i) Before the annihilation, the electron and the positron are travelling at the same speed.

Explain why the total momentum of the electron and the positron is zero before the annihilation.

**(2)**

.....

.....

.....

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

**(1)**

Electrons and positrons have opposite charges.
Charge is conserved in electron-positron annihilation because the

☒ **A** gamma rays move in opposite directions

☒ **B** gamma rays have opposite charges

☒ **C** gamma rays have no charge

☒ **D** gamma rays have kinetic energy

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(iii) When annihilation of electrons and positrons takes place, mass energy is conserved.

Explain how mass energy is conserved.

**(2)**

(d) PET scanners use gamma rays to produce detailed images of internal organs of the body.

Describe the properties of gamma rays that make them suitable for this use.

**(2)**

**(Total for Question 3 = 10 marks)**

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## Properties of alpha and beta radiation

**4** (a) Complete the sentence by putting a cross (☒) in the box next to your answer.

**(1)**

Alpha radiation

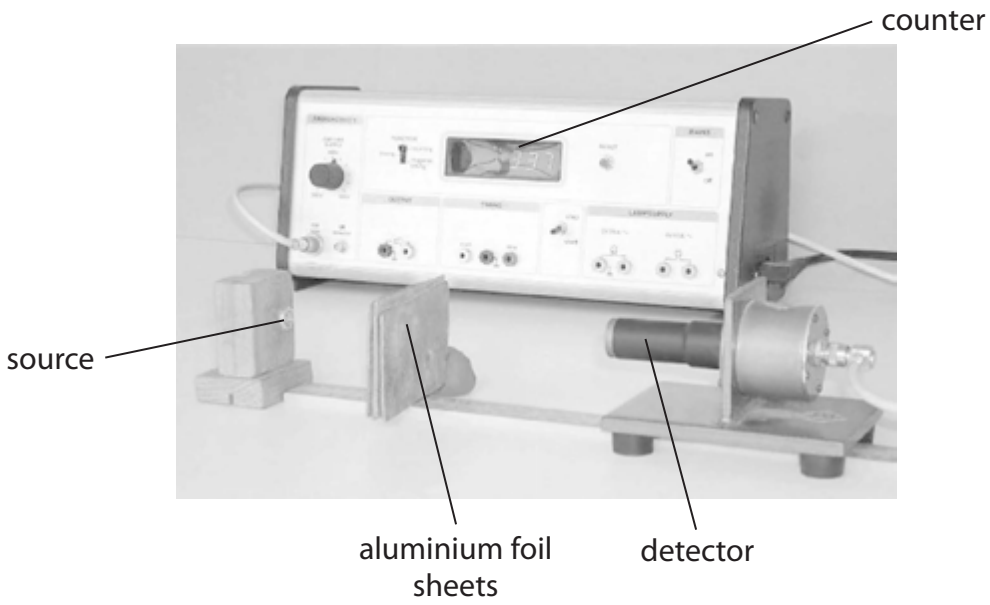
☒ **A** has no charge

☒ **B** is strongly ionising

☒ **C** is a wave

☒ **D** passes through paper

(b) A teacher uses this apparatus to investigate how beta particles are absorbed by aluminium foil sheets.



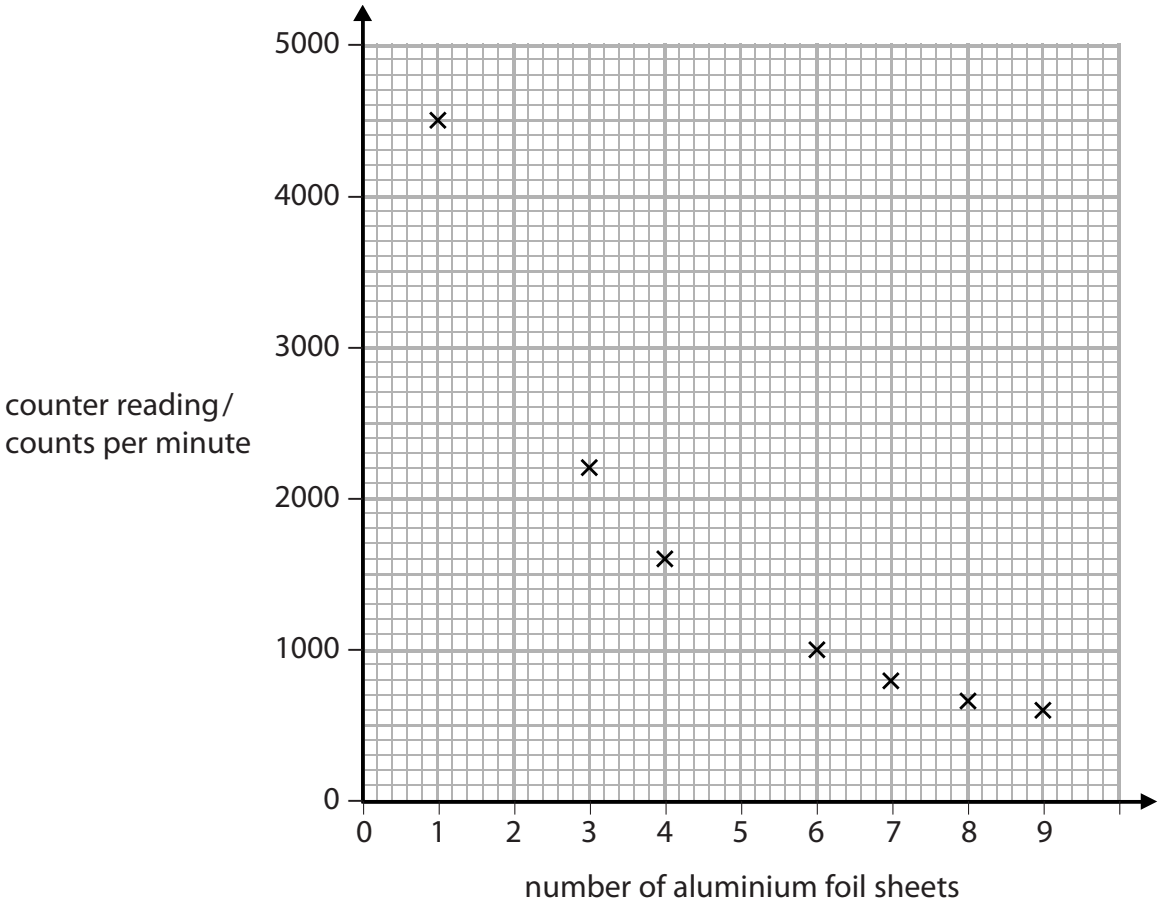

© Focus Investigations

In the experiment, different numbers of aluminium foil sheets are placed between a beta particle source and a detector.

The aluminium foil sheets are all the same thickness.

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The graph shows most of the results.




(i) The table shows the missing results.

Plot these results on the graph.

**(2)**

| number of aluminium foil sheets | counter reading / counts per minute |
|---|---|
| 2 | 3150 |
| 5 | 1200 |

(ii) Draw a best fit curve to fit the data.

**(1)**

(iii) State the relationship between the counter reading and the number of aluminium foil sheets.

**(1)**

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(iv) Suggest why the counter reading does not fall to zero.

**(1)**

(c) Describe what happens inside the nucleus of an atom when a beta particle ($\beta^-$) is emitted.

**(2)**

(d) Beta particles that are emitted by a source and focused into a beam can be described as an electric current.

Explain why a beam of beta particles can be described as an electric current.

**(2)**

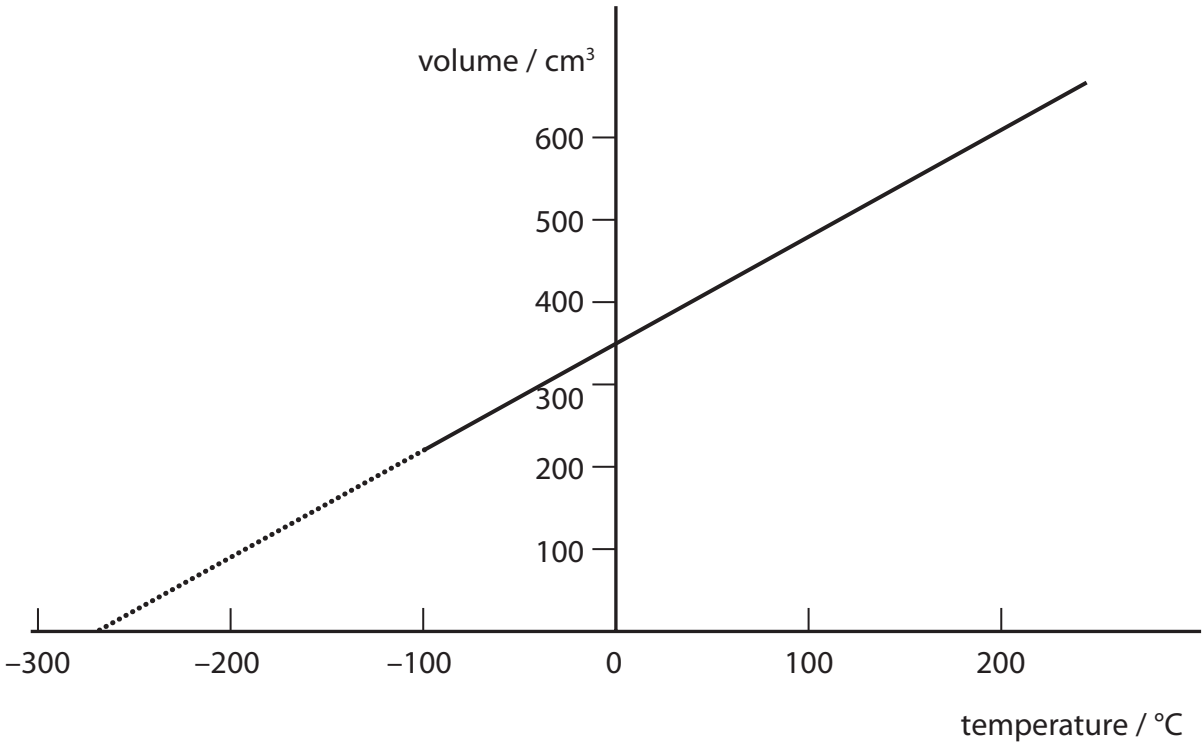
**(Total for Question 4 = 10 marks)**

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**Kinetic theory and gases**

**5** The graph shows the relationship between volume and temperature for an ideal gas.




(a) (i) Estimate the volume of the gas at 0 °C.

**(1)**

..... cm³

(ii) State the value of –273 °C in kelvin.

**(1)**

..... K

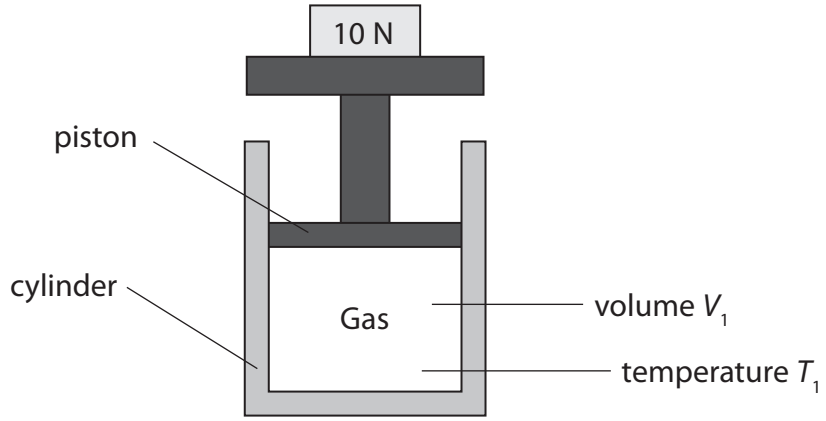
(iii) Suggest what would happen to a real gas when it is cooled to a very low temperature.

**(1)**

.....

.....

(b) Gas is held in a cylinder by a piston, as shown in the diagram.
The gas is kept at constant pressure.




(i) The original volume of gas $V_1$ is 25.0 cm$^3$ at a temperature of 293 K.
The gas is heated to 373 K.

Find the volume $V_2$ of the gas at 373 K.

Use the equation

$$V_2 = \frac{V_1 T_2}{T_1}$$

**(2)**

volume $V_2$ = ..... cm$^3$

(ii) Suggest how the pressure on the gas can be increased.

**(1)**

.....

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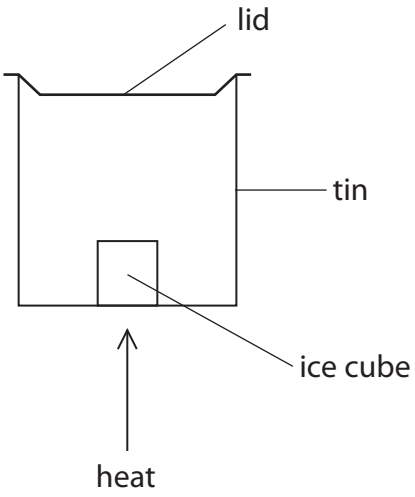
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*(c) Kinetic theory describes the movement of particles in the three states of matter.

The diagram shows a cube of ice in a tin.
The tin has a tight fitting lid.
When the tin is continuously heated, the lid explodes off the tin.

Explain why this happens using kinetic theory.

**(6)**

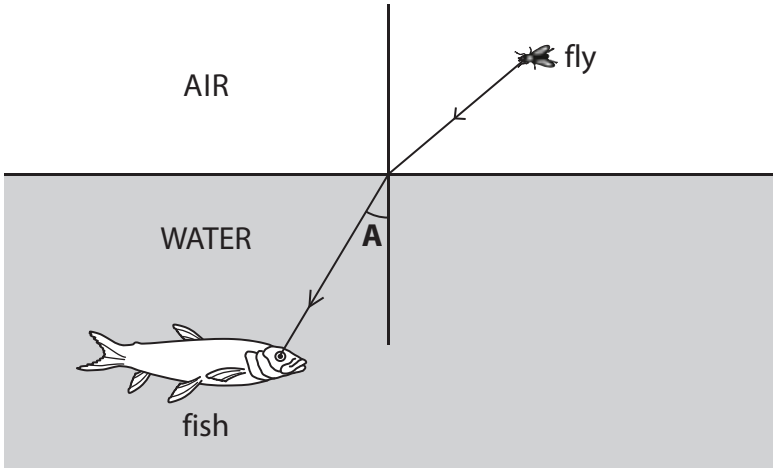



**(Total for Question 5 = 12 marks)**

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**Refraction and reflection**

**6** (a) The ray of light from the fly to the fish is shown on the diagram.
The fish can see the fly.




(i) Name the effect that produces the change in direction of the light at the surface of the water.

**(1)**

.....

.....

(ii) Explain why this change in direction occurs when light passes from air into water.

**(2)**

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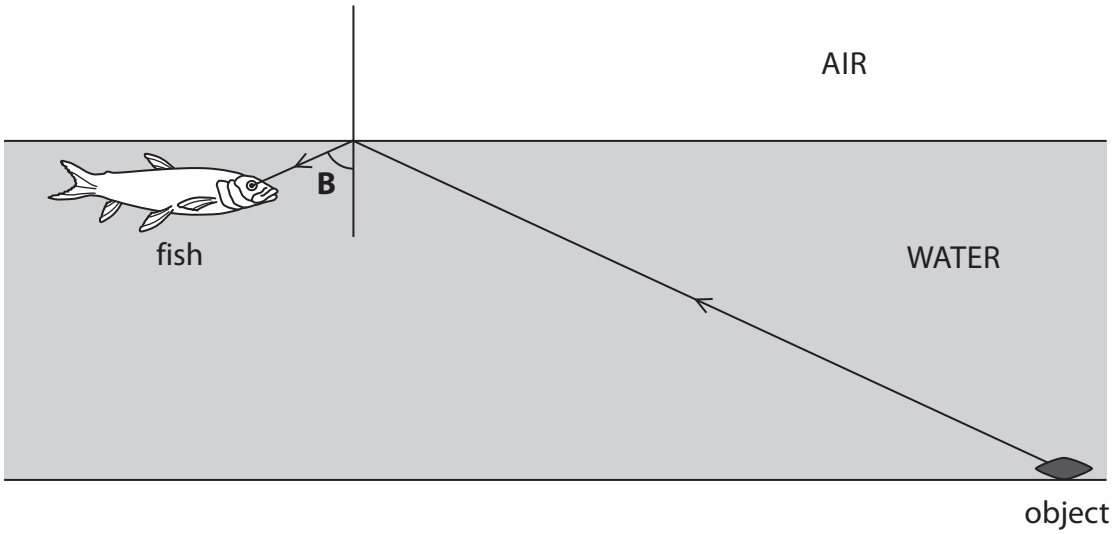
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(b) The fish moves and can now see an object in the water.
The ray of light from the object to the fish is shown in the diagram.
The angle B is greater than the critical angle.




Describe what happens to the light at the water surface.

**(2)**

.....

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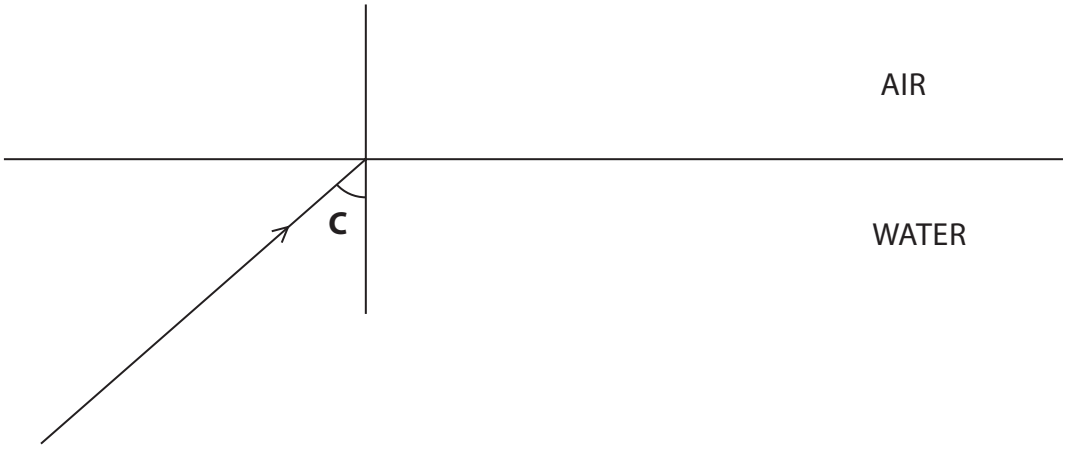
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(c) The diagram shows a ray of light inside the water.

Angle C is the critical angle.

Complete the diagram to show what happens to the ray of light after it hits the water surface.

**(1)**




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*(d) Describe how an endoscope works and what endoscopes are used for.

You may include a labelled diagram to help with the description of how the endoscope works.

**(6)**

**(Total for Question 6 = 12 marks)**

**TOTAL FOR PAPER = 60 MARKS**

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# Mark Scheme (Standardisation)

Summer 2017

Pearson Edexcel GCSE

In Physics (5PH3F) Paper 3F

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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.
- 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.

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(a)(i)** | ☒ **B** light<br><br>**The only correct answer is B**<br><br>**A** is not correct because gamma is ionising radiation<br><br>**C** is not correct because alpha is ionising radiation<br><br>**D** is not correct because X-rays are ionising | | **(1)** |

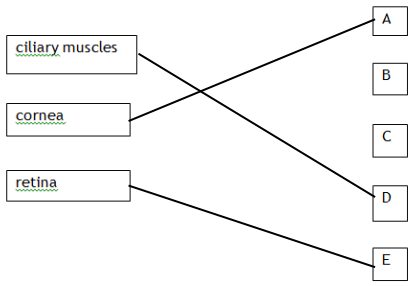
| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(a)(ii)** | Any of the following:<br><br>• Checking the condition of a fetus (1)<br>• Investigating heart/liver problems(1)<br>• Breaking down kidney stones and stones elsewhere in the body(1)<br>• Measuring the speed of blood flow in the body (1) | Accept fetal scanning/looking at baby in the womb<br><br>detecting cancer<br><br>Ignore pregnancy or pre-natal scan/check-ups | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (b)** | A description including two of the following:<br><br>• mutation of (healthy)cells/DNA (1<br>• kill/damage/destroy (healthy) cells/tissue<br>• cancer/tumours<br>• burns (1)<br>• hair loss(1)<br>radiation sickness(1) | | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (c)** | An explanation linking any two of the following:<br>• to reduce exposure to radiation (1)<br>• (because) greater distance (from the source)(1)<br>• intensity (of radiation) gets less (1)<br>• (because)radiation (used on patients) does not penetrate walls (1) | reduce risk/ so they are not exposed to/affected by the radiation<br>Ignore the effects of radiation such as cancer<br>No marks for responses that refer to technicians being inside the room. | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (d)** | Explanation linking two of the following:<br>• {isotopes/they} are radioactive/ decay (1) (have)<br>• short half-lives (1)<br>• only emit positrons for a short time (1) | emit radiation/ lose energy quickly<br>Ignore POSITRONS have a short half- life/decay/give off radioactivity.<br>Ignore any reference to transportation | **(2)** |

**Total for question 1 = 8 marks**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(i)** |  | One mark for each correct line<br><br>ignore a box with more than one line | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2 (b)** | ☒ C 25 cm from the eye<br><br>**The only correct answer is C**<br><br>**A** is not correct because infinity is the far point of the average human adult eye<br><br>**B** is not correct because 10 cm is too close to the eye to be the near point.<br><br>**D** is not correct because 100 cm is too far away from the eye to be the near point. | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(c)(i)** | Either<br>distant objects are not in focus (1)<br>or<br>near objects are in focus/clear (1)<br>or<br>the near point is too close(1) | distant objects cannot be seen clearly<br>can't see long distance/far away<br>allow can see near objects | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(c)(ii)** | Either<br>eyeball is too long (1)<br>or<br>cornea too curved (1)<br>or<br>lens too powerful (1)<br>or<br>focal length of lens too short (1)<br>or<br>far point closer than infinity (1)<br>or<br>ciliary muscles do not relax (1) | image formed in front of the retina<br>lens is too fat/focal point in front of the retina | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(c)(iii)** | substitution (1)<br>(power =) $\frac{1}{-0.5}$<br>evaluation (1)<br>-2.0 (D) | 2(D) | **(2)** |

**Total for question 2= 8 marks**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(a)** | ☒ B a stable element is bombarded with protons<br>**The only correct answer is B**<br><br>**A** is not correct because neutrons cannot be accelerated to bombard a stable element as they have no charge<br><br>**C** is not correct because unstable elements bombarded by protons will not produce radioactive isotopes.<br><br>**D** is not correct because neutrons cannot be accelerated to bombard an unstable element as they have no charge | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(b)** | An explanation linking two the following:<br>(but) momentum is conserved (1)<br><br><u>kinetic</u> energy is lost /decreases/ is not conserved (1) | Ignore do not rebound<br><br>allow lose all kinetic energy<br><br>momentum is conserved but KE is not conserved is awarded (2) | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c)(i)** | An explanation linking two of the following<br><br>electrons and positrons/they have the same mass (1)<br><br>velocities /momentums are + and - / in opposite directions (1)<br><br>momentum of particles cancel out (1) | Ignore opposite charges. | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c)(ii)** | ☒ C gamma rays have no charge<br>**The only correct answer is C**<br><br>**A** is not correct because the questions concerns conservation of charge not motion in opposite dirctions<br><br>**B** is not correct because gamma rays do not carry a charge<br><br>**D** is not correct because the question is concerned with conservation of charge not conservation of energy | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c)(iii)** | An explanation linking two of the following:<br><br>the electrons and positrons have mass (1)<br><br>gamma rays have no mass (1)<br><br>gamma waves have energy (1)<br><br>mass is converted to energy (1) | Ignore charges<br><br>(mass energy is conserved) as gamma rays<br><br>$E = mc^2$ | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(d)** | Description including two of the following:-<br><br>have a large range / penetrate the body (1)<br><br>may be detected (1)<br><br>(weakly) ionising (1)<br><br>produced at 180° to each other (1)<br><br>have large amounts of energy (1) | (using) gamma camera(s)<br><br>do not accept strongly ionising or not ionising<br><br>detected outside the body (2) | **(2)** |

**Total for Question 3 = 10 marks**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(a)(i)** | ☒ B is strongly ionising<br>**The only correct answer is B**<br><br>**A** is not correct because alpha particles carry two positive charges.<br><br>**C** is not correct because alpha radiation is made up of particles.<br><br>**D** is not correct because alpha radiation b is only weakly penetrating and is stopped by a sheet of paper. | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(b)(i) and 4bii** | Plot the points:<br>2,3150 (1)<br>5,1200 (1)<br><br>Smooth curve of best fit passing through/ within two squares of all points (1) | + or- half a square<br><br>Reject point to point and multiple curves | **(2)**<br><br>**(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(b)(iii)** | (as the) number of aluminium foil sheets /thickness of aluminium increases as<br>the counter reading decreases (1) | Allow (there is a) negative correlation<br>Allow inversely proportional | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(b)(iv)** | beta (radiation) detected by the counter<br>gamma (also) being emitted (1)<br>not enough aluminium sheets (1)<br>some beta particles travel through the aluminium foil (1) | background radiation | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(c)** | Description including:<br><br>neutron becomes a proton (1)<br><br>electron (ejected) (1) | Ignore equations<br><br>mass number stays the same<br>atomic number increases by one<br>award one mark<br><br>correct reference to quarks<br><br>udd goes to uud award two marks | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(d)** | An explanation linking two of the following:<br><br>mention of charge/electrons/charged particles(1)<br><br>mention of flow/movement (1)<br>DOP | Must score first marking point to be awarded second marking point | **(2)** |

**Total for question 4 = 10 marks**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(i)** | 350 ($cm^3$) | Any value between 330 and 370 inclusive. | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(ii)** | zero, nought, 0 (K) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(iii)** | (becomes a) liquid/solid | solidify / liquify / condenses<br><br>ignore freeze | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(b)(i)** | substitution<br>$(V_2) = \frac{373 \times 25.0}{293}$ (1)<br>evaluation<br>$(V_2) = 31.8$ ($cm^3$) (1) | Accept answers that round to 32 ($cm^3$) with any number of decimal places<br><br>Full marks are awarded for correct answers with no working | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(b)(ii)** | Increase the weight/force(on the piston) | Allow increase Newtons /N/mass<br><br>Ignore changes in temperature and volume . | **(1)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | ***5(c)** | An explanation including some of the following points :-<br><br>Before heating<br><br>• ice and air in tin<br>• ice particles vibrate about fixed positions<br>• do not exert pressure on tin lid<br>• air particles hit the lid and exert the same pressure as the air outside<br><br>Heat applied<br><br>Melting<br><br>• ice(solid) becomes water (liquid)<br>• water molecules move about within liquid<br>• Water molecules slide over each other<br>• do not exert pressure on lid.<br>• air particles move faster / have more (kinetic) energy<br>• exert more force/pressure on the lid/blow lid off<br><br>Vaporisation<br><br>• water becomes steam<br>• particles of water vapour move randomly and exert a force/ pressure on the lid by colliding with it.<br>• air and water vapour particles gain more energy as they are heated further and there are more collisions<br>• force/pressure on the lid increases as more heat is supplied<br>• force/pressure becomes great enough to blow the lid off of the tin | **(6)** |
| **Level** | **0** | No rewardable content | |
| **1** | **1 - 2** | • a limited explanation of changes in state of matter without referring to kinetic theory e.g. the ice when heated becomes water<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy | |
| **2** | **3 - 4** | • a simple explanation using Kinetic Theory that gives the behaviour of particles in a least one state of matter.<br>e.g.the particles in a solid vibrate/in a gas the particles move freely.<br><br>• the answer communicates ideas showing some evidence of clarity | |

| | | |
|---|---|---|
| | | and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy |

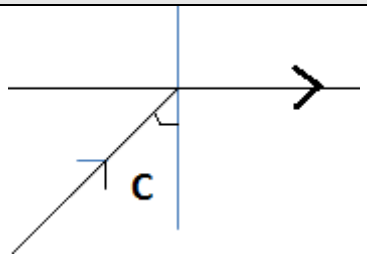
| | | |
|---|---|---|
| **3** | **5 - 6** | • a detailed explanation using Kinetic Theory to explain how a gas exerts a pressure on the tin lid e.g. the gas molecules/particles move fast and collide with the lid/tin/container exerting a pressure.<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors |

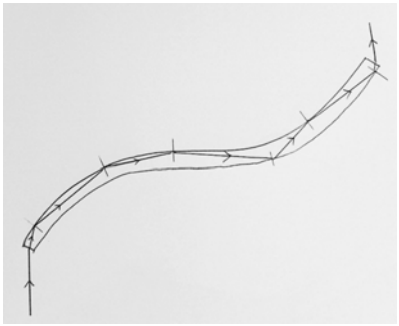
**Total for question 5 = 12 marks**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(a) (i)** | refraction | Note refraction and reflection seen together loses the mark | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(a) (ii)** | Explanation linking:<br><br>the speed of light changes (1)<br><br>correct change identified (1) | <br><br>(optical) density of mediums change (1)<br><br>correct change identified(1)<br><br>Light slows down in water gets two marks<br><br>Water is more dense (than air) gets two marks | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(b)** | Description including:<br><br>reflection (1)<br><br>total internal (1) | <br><br>allow bounces back/ into fishe's eye<br><br>Total internal reflection/TIR awarded 2 marks | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(c)** | <br>Ray drawn to the right from the intersection of the normal and the water surface along the boundary between the air and the water (1) | ignore reflected ray<br>arrows helpful but not necessary | **(1)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | ***6(d)** | A description of how the endoscope works and some uses, including some of the following points:<br><br>How it works<br><br><br><br>credit drawing accurate by eye<br><br>• uses optical fibres<br>• multiple reflections occur in fibre– may be seen in diagram<br>• due to total internal reflection taking place<br>• angle(s) of incidence > critical angle<br>• light transmitted along optical fibre<br>• reflected light allows images to be seen and recorded<br><br>Uses<br><br>Medical diagnosis<br><br>• looking inside the boy<br>• to investigate the gastro-intestinal tract (stomach etc.<br>• to look for ulcers / cancers etc.<br>• for other internal investigations e.g. uterus, bladder etc. (laparoscopes etc. as versions of endoscopes)<br><br>Medical treatment<br><br>• to carry laser light to treat ulcers/cancers<br><br>• Key hole surgery<br><br>Non-medical uses<br><br>• plumbing<br>• car mechanics | **(6)** |

| | | | |
|---|---|---|---|
| | | • any remote access | |
| **Level** | **0** | No rewardable content | |
| **1** | **1 - 2** | • a limited description of either the how the endoscope works OR its uses e.g. made of optical fibres / total internal reflection OR looking inside people etc.<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy | |
| **2** | **3 - 4** | • a simple description of how the endoscope works and one of its uses e.g made of optical fibres AND looking inside people<br>OR<br>a detailed description of how the endoscope works e.g. sends light up and down optical fibres /optical fibres using TIR/diagram<br>OR<br>A detailed description of the use e.g. looking inside people to look for cancers/ulcers<br>• answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy | |
| **3** | **5 - 6** | • a detailed description 0f one AND a simple description of the other e.g. sends light up and down optical fibres **AND** looking inside the body<br>OR<br>made of optical fibres AND looking inside the body to look for cancers/ulcers<br>• for example to look for cancers<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors | |

**Total for question 6 =12 marks**

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Write your name here

| Surname | Other names |
|---|---|
| | |

**Pearson Edexcel GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Physics

## Unit P3: Applications of Physics

**Foundation Tier**

Friday 24 June 2016 – Morning
**Time: 1 hour**

Paper Reference
**5PH3F/01**

**You must have:**
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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P 4 6 5 1 4 A 0 1 2 4

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## FORMULAE

You may find the following formulae useful

$$\text{power of lens} = \frac{1}{\text{focal length}}$$

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

The relationship between temperature and volume for a gas $\qquad V_1 = \frac{V_2 T_1}{T_2}$

The relationship between volume and pressure for a gas $\qquad V_1 P_1 = V_2 P_2$

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**Questions begin on next page.**

**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒.**
**If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

## Gases

**1** Three states of matter are solid, liquid and gas.

(a) (i) Particles in each state of matter move in different ways.

Draw a line from each state of matter to the description of the way in which the particles move.

**(3)**

| State of matter | Particles |
|---|---|
| solid | move randomly and are close together |
| liquid | do not move |
| gas | move around quickly and are far apart |
| | vibrate about fixed positions |

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

**(1)**

When a gas is cooled most of the particles

- ☒ **A** become heavier
- ☒ **B** become lighter
- ☒ **C** move faster
- ☒ **D** move slower

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(b) The volume of dry air in a sealed balloon can be changed by cooling the balloon.

The temperature of the air in the balloon is 20 °C.

(i) Complete the sentence by putting an (☒) in the box next to your answer.

When 20 °C is changed to kelvin it becomes

**(1)**

☐ **A** 253 K

☐ **B** 273 K

☐ **C** 293 K

☐ **D** 373 K

(ii) At this temperature, the volume of air in the balloon is 0.25 $m^3$.

When the balloon is cooled the volume becomes 0.10 $m^3$.

Assume that there is no change in pressure.

Calculate the new temperature of the air in the balloon in kelvin.

Use the equation $T_2 = \frac{V_2 T_1}{V_1}$

**(2)**

temperature of the air in the balloon = ..... K

(iii) Suggest one way of increasing the volume of the balloon.

**(1)**

.....

.....

**(Total for Question 1 = 8 marks)**

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## Electrical activity of the heart

**2** (a) Diagram 1 shows the electrocardiogram (ECG) trace for a single heartbeat.

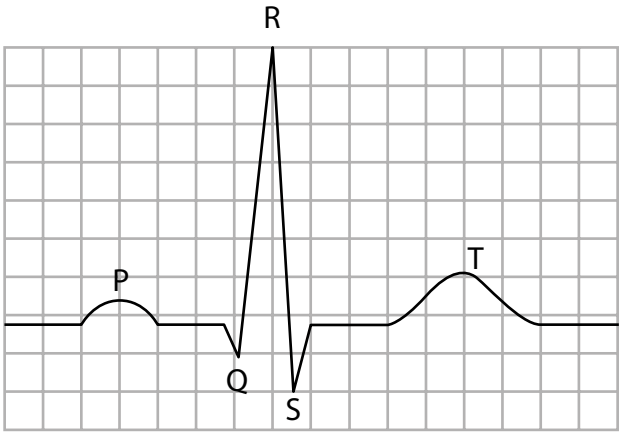



Diagram 1

On the vertical scale each square represents 0.2 mV.

Complete the sentence by putting an (☒) in the box next to your answer.

**(1)**

The potential difference between R and S is about

☒ **A** 0.9 mV

☒ **B** 1.8 mV

☒ **C** 9.0 mV

☒ **D** 1.8 V

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(b) Diagram 2 shows the ECG trace for a heart that is beating too fast.

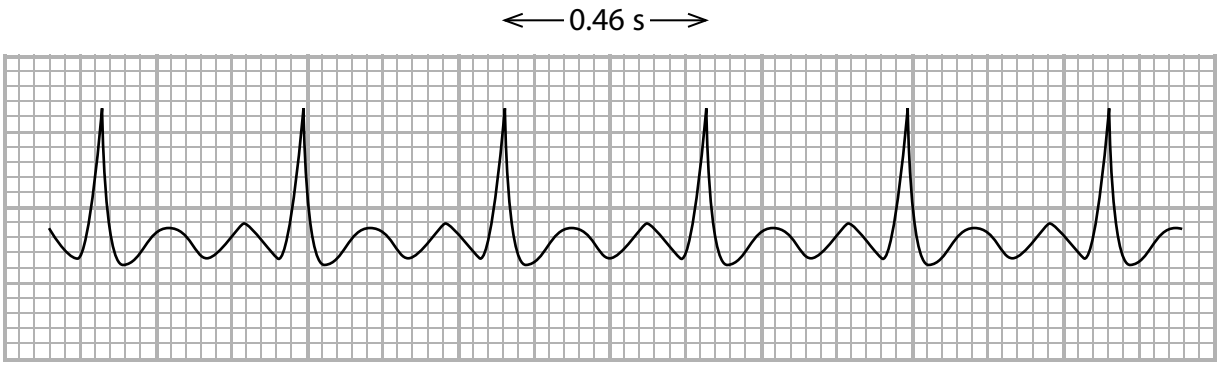



Diagram 2

(i) The time between beats for this heart is 0.46 s.

Calculate the frequency of the heartbeats.

**(2)**

frequency of heartbeats = ..... Hz

(ii) When a heart is beating at a normal rate it has a frequency of 1.25 Hz.

Calculate this heart rate in beats per minute.

**(2)**

heart rate = ..... beats per minute

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(c) Suggest how good contact is made between the patient's skin and the electrodes of the ECG machine.

**(1)**

.....

.....

(d) Describe what a pacemaker does when it is put inside the body of a patient.

**(2)**

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**(Total for Question 2 = 8 marks)**

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## Centripetal force and circular motion

**3** (a) In the box are the names of some forces that can provide a centripetal force.

| friction | gravity | magnetism | reaction | tension |
|---|---|---|---|---|

Choose words from the box to complete each sentence.

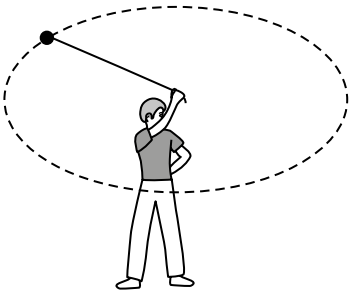
**(2)**

(i) When a satellite orbits the Earth the centripetal force is provided by

..... .

(ii) When a motorbike goes around a flat circular track the centripetal force is provided by ..... .

(b) A student investigates circular motion by whirling a ball about his head.
The ball travels in a **horizontal** circle.



(i) State in which direction the centripetal force on the ball acts.

**(1)**

.....

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

**(1)**

The centripetal force on the ball is provided by the

☐ **A** air resistance

☐ **B** force of gravity

☐ **C** weight of the ball

☐ **D** pull of the string

(c) The student measures the force on the ball and the speed of the ball.
He repeats his experiment for different values of force.

The results of the student's experiment are shown in the table.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Force / N | 0.00 | 0.25 | 0.50 | 1.00 | 2.00 | 3.00 | 4.00 |
| Speed / m /s | 0.0 | 1.7 | 2.5 | 3.5 | 4.9 | 6.0 | 6.9 |

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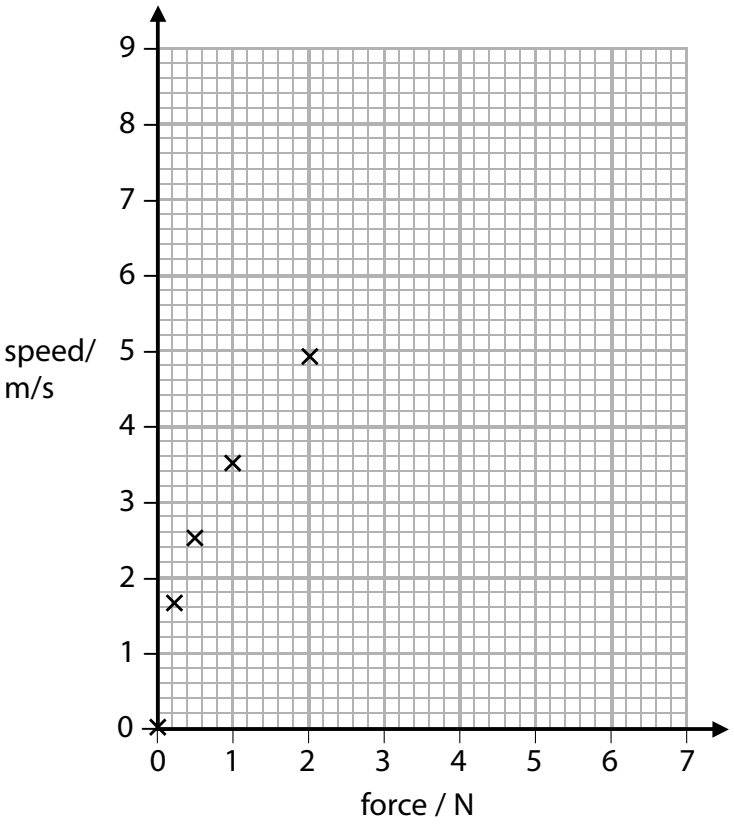
He plots the first five points.

(i) Complete the graph by plotting the other two points.

**(2)**

(ii) Draw a curve of best fit.

**(1)**




(iii) Use your graph to estimate the speed of the ball when the force is 6 N.

**(1)**

.....

(iv) Use the graph to describe how the speed varies with the force on the ball.

**(2)**

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**(Total for Question 3 = 10 marks)**

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**Ionising radiation**

**4** (a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Alpha radiation is ionising because alpha particles

**(1)**

- ☐ **A** are charged
- ☐ **B** are heavy particles
- ☐ **C** contain neutrons
- ☐ **D** have a low frequency

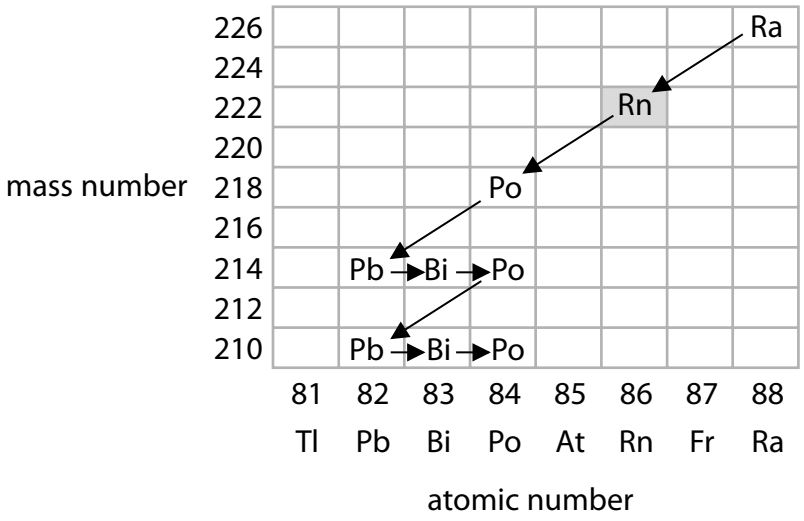
(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

Beta plus ($\beta^+$) particles are

**(1)**

- ☐ **A** electrons
- ☐ **B** neutrons
- ☐ **C** positrons
- ☐ **D** protons

(b) The chart shows part of a radioactive decay series




(i) From the chart find the mass number and atomic number of radon (Rn).

**(2)**

Mass number of radon = .....

Atomic number of radon = .....

(ii) Radon (Rn) decays by emitting an alpha particle from the nucleus.

State what happens to the mass number **and** to the atomic number of radon (Rn) when an alpha particle is emitted.

**(2)**

.....

.....

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(iii) Some unstable isotopes of lead (Pb) decay by the emission of a beta minus ($\beta^-$) particle.

Describe what happens to a nucleus in the process of the beta minus ($\beta^-$) decay.

**(2)**

(iv) Gamma radiation is often emitted with the alpha or beta particles.

Explain what happens to the nucleus when gamma radiation is emitted.

**(2)**

**(Total for Question 4 = 10 marks)**

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## Medical physics

**5** Cyclotrons and X-rays are both used in medical physics.

(a) Cyclotrons are used to accelerate particles.

(i) Which type of field is used in a cyclotron to keep protons moving in a circle?

Put a cross (☒) in the box next to your answer.

**(1)**

- ☒ **A** electric
- ☒ **B** frictional
- ☒ **C** gravitational
- ☒ **D** magnetic

(ii) Explain how the protons accelerated in a cyclotron are used to produce radioactive isotopes.

**(2)**

(iii) Suggest why neutrons cannot be accelerated in a cyclotron.

**(1)**

(b) X-rays are used in hospitals for diagnosis and treatment.

(i) Explain why the properties of X-rays make them suitable for the treatment of cancer.

**(2)**

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*(ii) Exposure to X-rays can be dangerous for patients receiving a diagnosis or treatment and for radiographers who use the X-ray equipment.

Explain the precautions that are taken to ensure the safety of both patients and radiographers exposed to radiation.

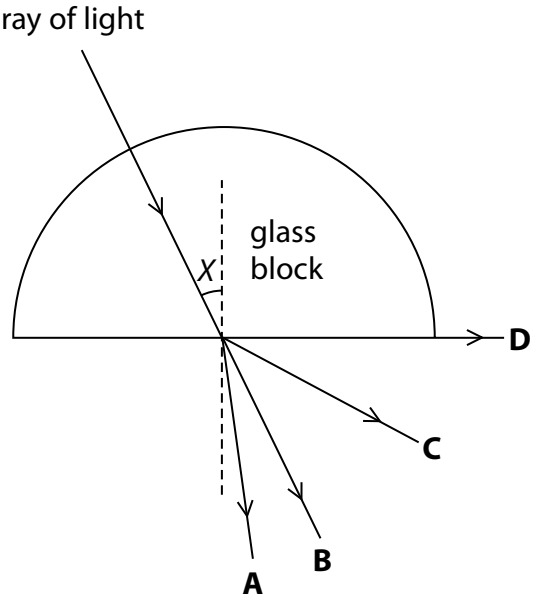
**(6)**

**(Total for Question 5 = 12 marks)**

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## Effects produced by light

**6** (a) The diagram shows light incident on the centre of a semi circular glass block. Angle *X* is less than the critical angle.




Complete the sentence by putting a cross (☒) in the box next to your answer.

The ray of light emerges from the glass block along the path towards

**(1)**

☒ **A**

☒ **B**

☒ **C**

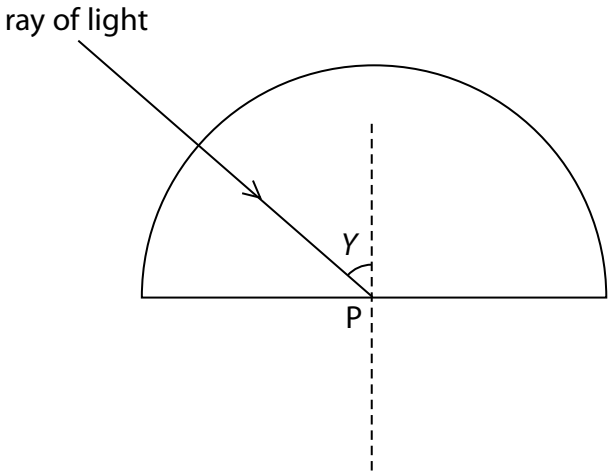
☒ **D**

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(b) In the diagram, the angle *Y* is greater than the critical angle.

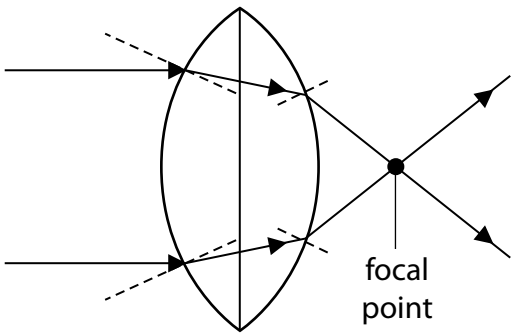
Complete the diagram to show what happens to the ray of light after it reaches the surface of the glass at point P.

**(1)**




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(c) The diagram shows light passing through a powerful converging lens.




Explain why the light changes direction when it passes from air into the glass lens.

**(2)**

.....

.....

.....

.....

(d) The focal length of a lens is 0.25m.

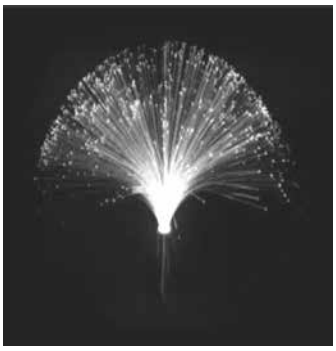
Calculate the power of the lens.

**(2)**

power of the lens = ..... D

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*(e) The photographs show two effects of light.



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**Fibre optic lamp**



© www.scienceblogs.com

**Plane mirror**

Discuss what is happening to the light in each example.

(You may draw diagrams to help with your answer.)

**(6)**

**(Total for Question 6 = 12 marks)**

**TOTAL FOR PAPER = 60 MARKS**

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# Mark Scheme (Results)

## Summer 2016

## Pearson Edexcel GCSE in Physics (5PH3F) Paper 01
## Unit: 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.

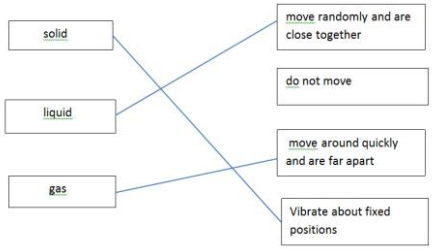
## Quality of Written Communication

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 | Notes | Marks |
|---|---|---|---|
| 1 (a) (i) |  | each correct line 1 mark<br><br>two lines from any box on the left loses the mark for that box | (3) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 1 (a) (ii) | **D** move slower, | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 1 (b) (i) | **C** 293K | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 1 (b) (ii) | substitution (1)<br><br>$(T_2) = \frac{0.10 \times (293)}{0.25}$<br><br>evaluation (1)<br>117(K) | Correct substitution of volumes with any temperature<br>Reject 0.25 as a temperature.<br>Reject answers which show squared or cubed volumes<br><br>accept 120(K), 117.2(K)<br><br>accept for a maximum of one mark 8(°C), 281(K) 109(K),128(K),149(K)<br><br>Accept correct answer with no working for 2 marks. | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 1 (b) (iii) | Any sensible suggestion such as<br><br>increasing pressure (inside) (1)<br><br>increasing the temperature (1)<br><br>increasing the number of particles (1)<br>heating/warming the balloon (1)<br><br>reducing pressure outside (1) | <br><br><br><br>Allow 'blowing the balloon up'<br>'put more air in' | (1) |

**Question 1 = 8 marks**

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (a) | B 1.8mV | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (b) (i) | substitution (1)<br><br>$(f) = \frac{1}{0.46}$<br><br>Evaluation (1)<br>2.2 (Hz) | <br><br>Ignore additional decimal places<br><br><br>Allow 2.17 (Hz)<br>Condone 2.1 (Hz) | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (b) (ii) | Use of 60 (1)<br><br>Evaluation<br>75 (beats /minute) (1) | Sight of 60 is sufficient<br><br>Accept correct answer with no working | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (c) | A suggestion such as:-<br>use of gel / paste (1)<br><br>sticking pads to the skin/using sticky pads (1)<br><br>shave/clean the skin (1) | Ignore attachments to finger<br>Allow taped(to the skin/body/chest) | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (d) | a description to include any two from<br>sends electrical signals /pulses/shocks (to the patient) (1)<br><br>detects heart rate/beats per minute/action potentials (1)<br><br>controls/regulates heart rhythm/pattern (1) | <br><br>Ignore 'measures pulse rate'<br><br><br><br>Allow 'keeps heart beating properly' | (2) |

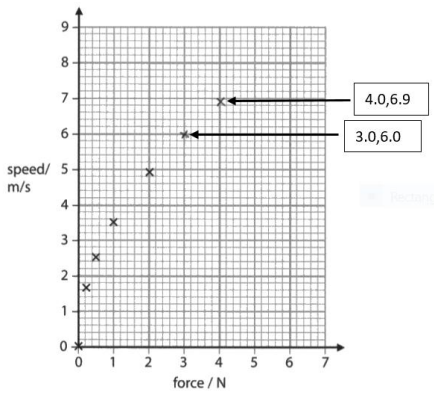
**Question 2 = 8 marks**

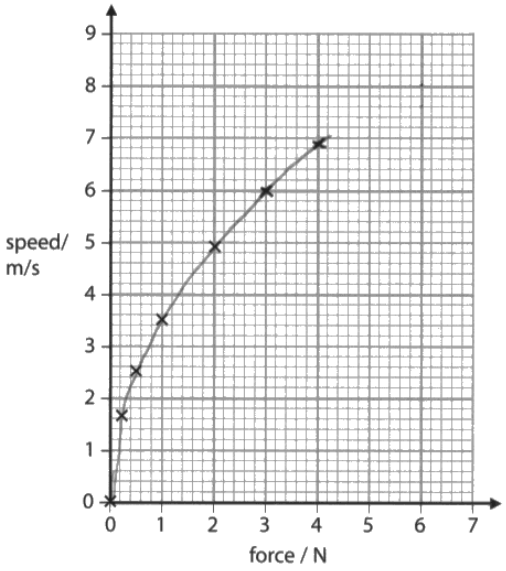
| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (a) (i) | gravity (1) | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (a) (ii) | friction (1) | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (b) (i) | towards the centre (of the circle) / student /student's head/hand | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (b) (ii) | **D** pull of the string | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3(c)(i) | Points 3.00, 6.0 (1)<br>4.00, 6.9 (1)<br><br> | Allow +or- one square | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (c) (ii) |  | Smooth curve through the origin and at least 4 points<br><br>Ignore extrapolated line.<br><br>Must not be along the y-axis from the origin<br><br>No double lines | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (c) (iii) | 7.7 + or – 0.5 (m/s)<br><br>7.2(m/s) to 8.2 (m/s) | Extrapolated curve not required | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (c) (iv) | A description including:<br>• as force increases speed increases (1)<br><br>• not proportional/ speed increases faster for lower forces/rate of change of speed gets smaller (1) | ORA<br>Allow 'gets faster' for 'speed increases<br><br>Reject positive correlation and unqualified quoted values | (2) |

**Question 3 = 10 marks**

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (a) (i) | A are charged | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (a) (ii) | C positrons | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (b) (i) | Rn mass number 222 (1)<br>Rn atomic number 86 (1) | If values reversed allow 1 mark | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (b) (ii) | A statement<br><br>mass number deceases by 4 (1)<br><br>atomic number decreases by 2 (1) | Allow for one mark if no other mark scored<br>'both mass number and atomic number decrease' | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (b) (iii) | Description including two of the following<br>neutron becomes a proton (1)<br><br>atomic number increases by one (1)<br>mass number constant (1)<br><br>electron emitted (from nucleus) (1) | Allow these points to score within an equation<br><br><br><br>Do not allow electron emitted from outer shell | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (b)(iv) | An explanation linking two of the following:-<br><br>nucleus is not stable / excited / has too much energy/meta-stable (1)<br><br>(so)(nucleus) rearranges (1) (by)<br><br>losing energy (1)<br>(nucleus) becomes stable (1) | If no other mark awarded allow 'gamma has no charge/mass/is a wave/ charge on the nucleus does not change (so emission has no effect on mass number or atomic number)'<br><br>Allow mass energy link | (2) |

**Question 4 = 10 marks**

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (a) (i) | **D** magnetic | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (a) (ii) | An explanation linking any two of the following:-<br><br>(proton/it is)<br>absorbed by (1)<br><br>(stable) nucleus/atom/element (1)<br>(to produce)<br><br>unstable /radioactive/new<br>{ isotopes /nuclei/element} (1) | <br><br>accept<br>collides with/hits/<br>bombards<br><br><br><br><br>accept new nucleus<br>ignore 'daughter' | (2) |

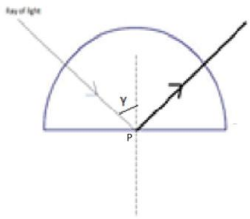
| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (a) (iii) | neutrons have no charge/ are neutral | Accept' unaffected by magnetic field' | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (b) (i) | Explanation linking two of the following :<br><br>high energy / frequency (1)<br><br>ionising (1)<br><br>destroy cancerous cells (1)<br><br><br>penetrate soft tissue (1)<br><br><br>can be produced in a fine beam (1) | <br><br><br><br><br>Accept kill/mutate /denature/ionise cells<br><br><br>Accept body for soft tissue<br><br><br>can target/focus on cancerous cells | (2) |

| Question number | Answer | Marks |
|---|---|---|
| 5 (b)(ii)* | Indicative content<br><br>A explanation including some of the following points :-<br><br>Safety of patients<br>• limiting the dosage<br>• minimising time of exposure<br>• protecting parts of the body not to be treated (using lead covering)<br>• finding exactly the position of the tumour<br>• using narrow/multiple beam(s) to limit the damage to non-cancerous(good) cells<br><br>Safety of radiographers<br>• lead aprons<br>• operate the X-ray machine from behind a screen<br>• stop people entering the room when X-ray machines are being used<br>• stay a safe distance away from the X-ray machine<br>• check exposure regularly (badges) | (6) |

**Question 5 = 12 marks**

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (a) | C | | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (b) | <br><br>total internal reflection (1) | Do not credit answers which show a refracted ray as well as the reflected ray.<br><br>arrow not required<br>no labelling required | (1) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (c) | An explanation linking two of the following :-<br><br>speed of light changes (1)<br><br>slows down (in glass) (1)<br>because<br><br>glass is (optically) denser (1) | light travels faster in air than in glass (2) ORA<br><br>allow one mark for refraction if no other marks awarded | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (d) | Substitution (1)<br><br>(Power) = $\frac{1}{0.25}$<br><br>Evaluation (1)<br>4.0 (D) | <br><br><br><br><br>Accept 4 (D) | (2) |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (e)* | Indicative content<br><br>Optical fire lamp<br>• Light comes from a bulb in the base of the lamp<br>• Light travels through the fibres<br>• Light is emitted at the ends of the fibres<br>• (Ideally) no light is lost through the sides of the fibres<br>• Light travels through the fibres by total internal reflection<br>• Diagram showing total internal reflection<br><br>Plane mirror<br>• Light strikes the mirror<br>• Light is reflected from the surface of the mirror<br>• Angle of incidence is equal to the angle of reflection<br>• Light is reflected to the eye<br><br>• Shows an image (the person)<br>• Image same size as object<br>• Image is laterally inverted (back to front)<br>• Image is virtual.<br>• Diagram showing reflection from a mirror | Ignore any reference to LED<br><br>Labelling not required<br><br>Labelling not required | (6) |

| Level | 0 | No rewardable content |
|---|---|---|
| 1 | 1 - 2 | • a limited description of at least one of the observations from the effects of light. e.g. light comes out of the end of the fibres / the mirror reflects light<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy |
| 2 | 3 - 4 | • a simple description of one effect OR a limited description of both effects e.g.The light goes through the fibres because of total internal reflection/The mirror reflects light with angle of incidence equal to angle of reflection /The mirror reflects light and light comes out of the ends of the fibres.<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy |
| 3 | 5 - 6 | • a detailed description for BOTH effects e.g.The light travels through the fibres by total internal reflection and the mirror reflects light with the angle of incidence equal to the angle of reflection<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors |

**Question 6 = 12 marks**

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| Surname | Other names |
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**Pearson Edexcel GCSE**

| Centre Number | Candidate Number |
|---|---|
| | |

# Physics

## Unit P3: Applications of Physics

**Foundation Tier**

Friday 19 June 2015 – Morning
**Time: 1 hour**

Paper Reference
**5PH3F/01**

**You must have:**
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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## FORMULAE

You may find the following formulae useful

power of lens = $\frac{1}{\text{focal length}}$

frequency = $\frac{1}{\text{time period}}$ $f = \frac{1}{T}$

The relationship between temperature and volume for a gas $V_1 = \frac{V_2 T_1}{T_2}$

The relationship between volume and pressure for a gas $V_1 P_1 = V_2 P_2$



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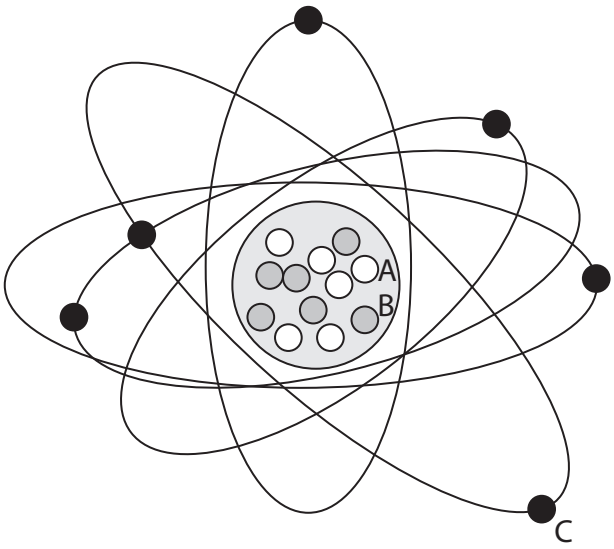
**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒.**
**If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

## Radioactivity and atoms

**1** The diagram shows an atom of carbon.

A, B and C are three different particles.




Not to scale

**Key**

| | |
|---|---|
| A | ○ |
| B | ◌ |
| C | ● |

(a) (i) Name the three different particles shown.

**(3)**

A = .....

B = .....

C = .....

(ii) What is the mass (nucleon) number of this carbon atom?

**(1)**

.....



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(b) Which **one** of these statements about alpha radiation is correct?

Put a cross (☒) in the box next to your answer.

**(1)**

☒ **A** Alpha radiation has no charge.

☒ **B** Alpha radiation is very ionising.

☒ **C** Alpha radiation travels very far in air.

☒ **D** Alpha radiation is an electromagnetic wave.

(c) Choose words from the box to complete the following sentences.

Words may be used once, more than once or not at all.

| alpha | beta | gamma | positron |
|---|---|---|---|

The radiation that is a wave is .....

**(1)**

The particle that is negatively charged is .....

**(1)**

(d) When an atom emits an alpha particle its nucleus changes.

Which describes the changes in the nucleus?

Put a cross (☒) in the box next to your answer.

**(1)**

| | **proton number** | **mass number** |
|---|---|---|
| ☒ **A** | decreases by 2 | decreases by 4 |
| ☒ **B** | increases by 2 | decreases by 4 |
| ☒ **C** | decreases by 2 | increases by 4 |
| ☒ **D** | increases by 2 | increases by 4 |

**(Total for Question 1 = 8 marks)**

## Kinetic theory and gases

**2** (a) Kinetic theory describes the movement of particles in the three states of matter.

Gas is one of the states of matter.

(i) Name the other two states of matter.

**(2)**

1 .....

2 .....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The average kinetic energy of the particles in a gas is directly proportional to

**(1)**

☒ **A** the pressure of the gas

☒ **B** the temperature of the gas measured in degrees Celsius

☒ **C** the temperature of the gas measured in Kelvin

☒ **D** the volume of the gas



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(b) The photograph shows an oxygen cylinder that can be used in an ambulance.



(i) Explain how particles of oxygen gas exert a pressure on the inside of the cylinder.

**(2)**

.....

.....

.....

.....

(ii) This cylinder can release 340 litres of oxygen at a pressure of 101 000 Pa.

The inside volume of the cylinder is 2.5 litres.

Use the equation

$$P_2 = \frac{P_1 V_1}{V_2}$$

to calculate the pressure of the oxygen in the cylinder before the gas is released.

**(3)**

pressure of oxygen = ..... Pa

**(Total for Question 2 = 8 marks)**

## X-rays

**3** (a) A CAT scanner uses X-rays.

It is used in hospitals to 'see' inside the body.

(i) Describe **one** other use of X-rays.

**(2)**

.....

.....

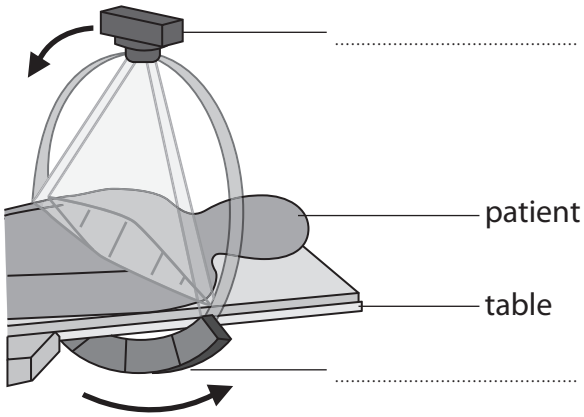
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(ii) The diagram shows a CAT scanner in use.

Label the two parts of the scanner.

**(2)**




(b) A beam of electrons is needed to produce X-rays.

Explain how this beam of electrons is produced.

**(2)**

.....

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.....

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(c) People can be protected from X-rays by using an absorber.

(i) Which of these materials is the best absorber of X-rays?

Put a cross (☒) in the box next to your answer.

**(1)**

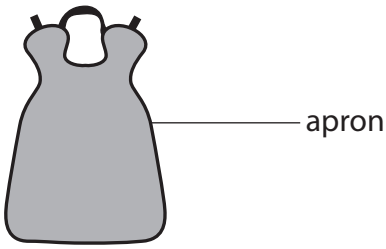
☒ **A** aluminium

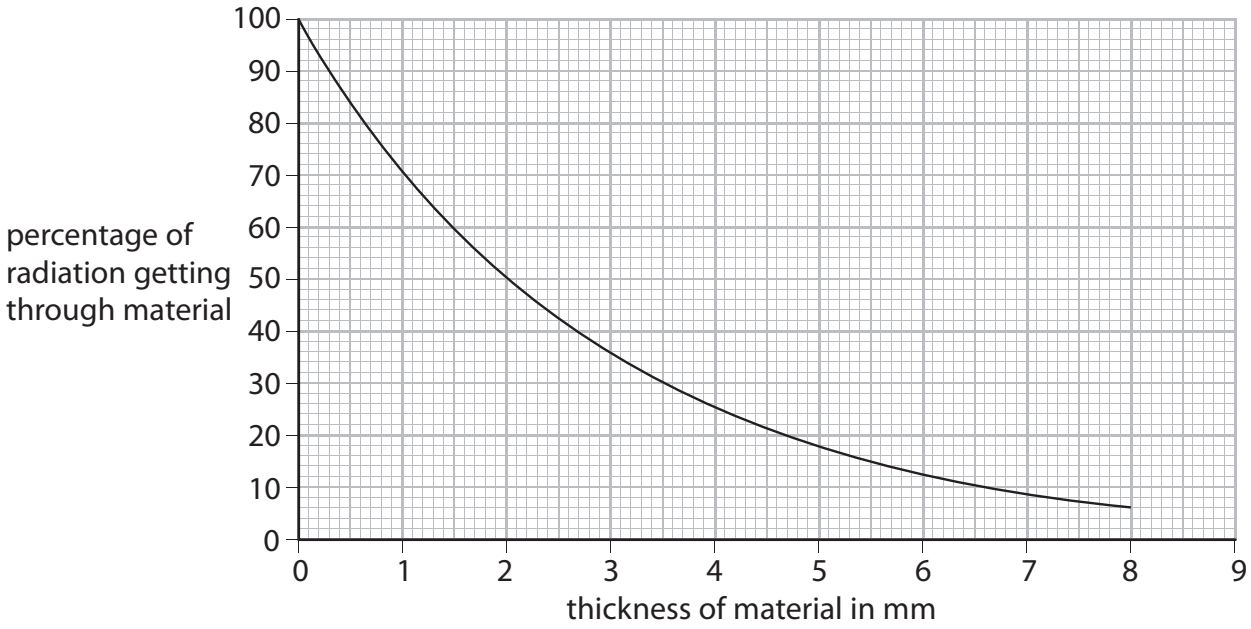
☒ **B** copper

☒ **C** glass

☒ **D** lead

(ii) A new material is used to make an apron to protect people from X-rays.




Describe the relationship shown on the graph using data from the graph.

**(3)**

.....

.....

.....

.....

.....

**(Total for Question 3 = 10 marks)**

## Cyclotrons and collisions

**4** (a) Cyclotrons are used to make radioactive isotopes for medical purposes.

Charged particles move in a circular path.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The field used to keep charged particles moving in a circular path in a cyclotron is

**(1)**

☒ **A** nuclear

☒ **B** magnetic

☒ **C** gravitational

☒ **D** electric

(ii) State what causes the charged particles to increase their speed as they go around the cyclotron.

**(1)**

.....

(iii) Describe how scientists use the charged particles from a cyclotron to produce radioactive isotopes.

**(2)**

.....

.....

.....

.....

(b) Some radioactive isotopes emit positrons.

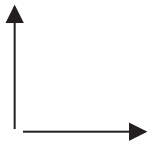
Positrons are used to make gamma rays.

When a positron annihilates an electron, two gamma rays are produced.

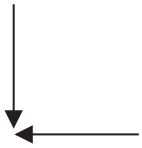
(i) Which diagram shows the directions of the two gamma rays produced?

Put a cross (☒) in the box next to your answer.

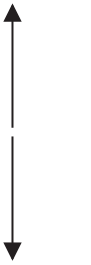
**(1)**



☒ **A**



☒ **B**



☒ **C**



☒ **D**

(ii) Explain how charge is conserved when an electron annihilates a positron.

**(3)**

.....

.....

.....

.....

(iii) Explain how mass and energy are conserved when an electron annihilates a positron.

**(2)**

.....

.....

.....

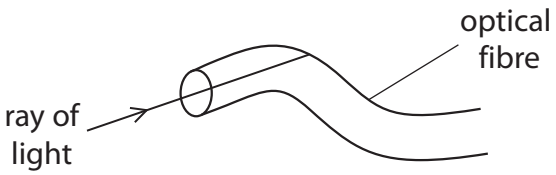
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**(Total for Question 4 = 10 marks)**

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## Scanning – endoscopy

**5** (a) An endoscope uses glass fibres to enable doctors to 'see' inside a person.




Complete the sentence by putting a cross (☒) in the box next to your answer.

Rays of light travel along the glass fibres by

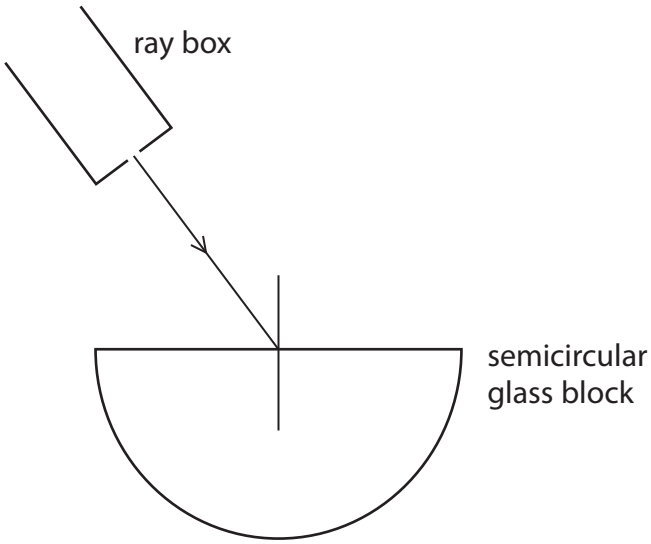
**(1)**

- ☒ **A** total internal correction
- ☒ **B** total internal diffraction
- ☒ **C** total internal reflection
- ☒ **D** total internal refraction

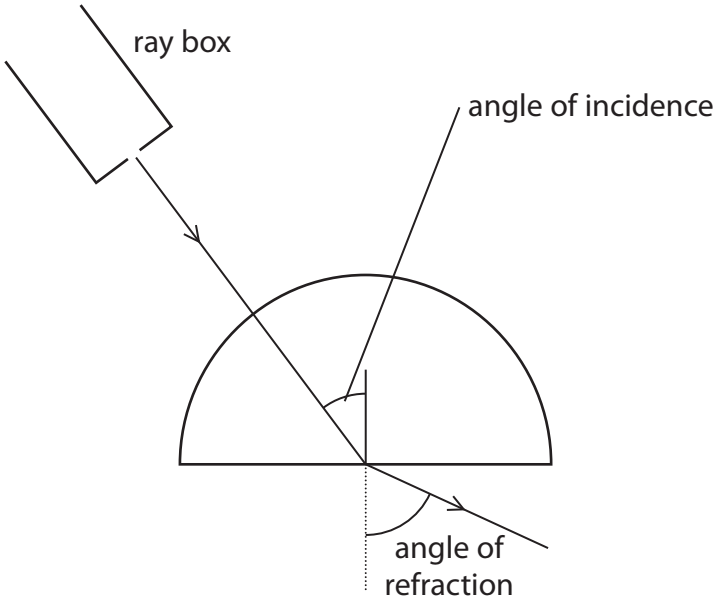
(b) The diagram shows a ray box shining a ray of light at a semicircular glass block.

Complete the diagram to show the path of the ray of light inside the glass block.

**(2)**

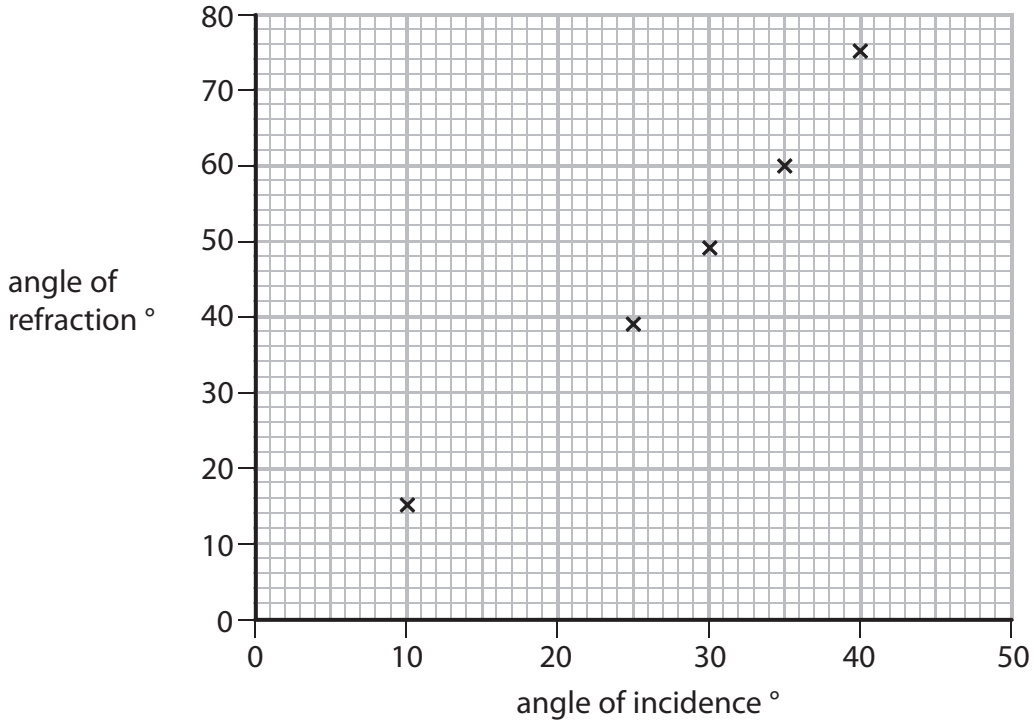


(c) A student shines a ray of light into the block as shown.




He measures the angle of incidence inside the block as shown.
He measures the angle of refraction outside the block as shown.
He repeats these measurements for different angles of incidence.
He records his results in this table and plots a graph.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| angle of incidence ° | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| angle of refraction ° | 15 | 23 | 31 | 39 | 49 | 60 | 75 |



(i) Two points are highlighted in the table.

Plot these points on the graph.

**(2)**

(ii) Draw the curve of best fit.

**(1)**

*(iii) The student continues to increase the angle of incidence until it reaches 80°.

The critical angle for this glass is 42°.

Explain what happens to the ray of light as the angle of incidence is increased from 10° to 80°.

**(6)**

**(Total for Question 5 = 12 marks)**

## Radiation in medicine

**6** (a) Many different types of radiation are used by doctors.

Which type of radiation comes from radioactive sources?

Put a cross (☒) in the box next to your answer.

**(1)**

- ☒ **A** gamma rays
- ☒ **B** ultrasound
- ☒ **C** ultraviolet
- ☒ **D** X-rays

(b) Explain how radiation from radioactive sources can be dangerous to people.

**(2)**

(c) Medical staff who use radioactive materials need more protection than their patients.

Describe some precautions that medical staff can take to ensure their safety from radioactive materials.

**(3)**

*(d) Describe how radioactive materials can be used in the diagnosis and treatment of some illnesses.

**(6)**

**(Total for Question 6 = 12 marks)**

**TOTAL FOR PAPER = 60 MARKS**



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# Mark Scheme (Results)

## Summer 2015

## Pearson Edexcel GCSE in Physics (5PH3F) Paper 01 Unit: 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) (i)** | A protons<br><br>B neutrons<br><br>C electrons | OR<br>A neutrons<br><br>B protons<br><br>C electrons | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(a) (ii)** | **12** | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(b)** | **B** It is very ionising | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (c)** | gamma (1)<br><br>beta (1) | | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(d)** | **A decreases by 2**<br>**decreases by 4** | | **(1)** |

Total for Question 1 = 8 marks

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(i)** | solid<br><br>liquid | in either order<br><br>plasma as an alternative to either. | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(ii)** | **C** temperature of the gas measured in Kelvin | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(i)** | an explanation **linking** two of the following three points:-<br><br>particles move (1)<br><br>bombarding/colliding (1)<br><br><br><br>with wall/side (1) (only give if one of the previous marks is there)<br>(of container) | <br><br><br>molecules/they move<br><br>hit<br>ignore 'pushing'<br><br><br><br><br>e.g. molecules push on walls = 0<br>bounce off inside of container =2 | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(ii)** | substitution<br>$P_2 = \frac{101\ 000 \times 340}{2.5}$<br>(1)<br>Evaluation<br>13.7 to any power of 10<br>(1)<br>13 700 000(Pa), 13 700kPa<br>(1) | <br><br><br><br><br>1.37(36) X $10^7$/ 13736000<br>14 to any power of 10<br>14 000 000 (Pa), 14 000 (kPa)<br><br>Full marks are awarded for the correct answer with no working | **(3)** |

Total for Question 2 = 8 marks

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(a i)** | Description including<br>• the use<br>• further detail | <br>e.g. security in airports / treat cancers<br>e.g. to detect illegal items etc./ by killing cancer cells / they are ionising radiation<br>'to kill tumours' by itself = 1 mark<br>'to see broken bones' = 1 mark (crediting **different** detail compared to CAT scans)<br>ignore scanning for tumours | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(aii)** | UPPER label → X-ray tube (not just 'emitter' by itself) **(1)**<br>LOWER label → detector(s) **(1)** | accept source / emitter or equivalent as alternative to tube.<br>accept sensor(s) / photomultiplier(s) / receiver / camera | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(b)** | An explanation linking two of the following<br>• heated (1)<br>• filament / wire (1)<br>• any correct reference to potential (difference). (1)<br>• vacuum (1) | <br><br><br>cathode at a negative voltage / (electrons attracted to) anode at positive voltage (accept charge as alternative to voltage)<br><br>alternative: thermionic emission (2) | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c)(i)** | **D** lead | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c) (ii)** | A description to include<br><br>• as thickness increases the radiation getting through decreases (1)<br><br>• uses data from the graph quantitatively (1)<br><br>• reference to curve/non-linear (1) | <br><br>accept negative correlation (ignore inverse proportion)<br><br>one mark for using **two** sets of data to show reduction<br><br>levels off<br><br>allow three marks for using at least two sets of data to apply the halving idea<br><br>ignore phrases not describing the relationship e.g. 'it slowly decreases'. | **(3)** |

Total for Question 3 = 10 marks

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(a)(i)** | **B** magnetic | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(a)(ii)** | (high frequency alternating) voltage | electric field / electrostatic force<br>electrodes + and – (not just 'electrodes')<br>potential difference (p.d.) | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(a)(iii)** | A description using the following:-<br>(charged) particles bombard (1)<br><br>atoms/molecules/nuclei / (stable) elements (1) | <br>(charged) particles {hit / shoot into / fired into / collide with}<br><br>generally accept 'it' / 'they' as alternatives to 'charged particles'<br><br>target (material) / nucleus / **stable** isotope<br><br>'neutrons hitting a target' would get second mark only (neutrons not charged)<br><br>2nd mark needs idea of hitting target nuclei / atoms, not (charged) particles hitting other particles. | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(b)(i)** | **C**  | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(b)(ii)** | An explanation linking any three of the following:-<br><br>positron has a positive (charge)<br>(1)<br><br>electron has a {negative (charge) / opposite charge(s) }<br>(1)<br><br>these charges cancel out<br>(1)<br><br>gamma rays /waves have no charge<br>(1) | <br><br>positron has +1 / +e (charge)<br>positron charge is +<br><br>electron has -1 / -e (charge)<br>electron charge is –<br><br>neutralise / overall charge is zero<br><br>Accept for three marks:<br>electron and positron have equal and opposite charges which cancel out. | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4 (b)(iii)** | An explanation linking :<br><br>positron and electron have mass(before the annihilation)<br>(1)<br><br>gamma (rays produced by annihilation) have energy (1)<br>(the equation shows) | <br><br><br><br><br>mass (of particles) becomes energy of gamma (rays) (2)<br><br>all the mass before the collision becomes the energy of the gamma (rays) after the particles have been annihilated (2)<br><br>$E=mc^2$ reference (1)<br>explained will get the other (1) | **(2)** |

Total for Question 4 = 10 marks

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(i)** | **C** total internal reflection | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(b)** | drawn ray changing direction at the boundary as it goes into the glass (1)<br><br>towards the normal after entering the glass (1) | line should be near to straight allow dotted lines / don't need arrows<br><br>ignore lines outside the glass block<br><br>**reject** lines in the block going to the left of the normal. | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(c)(i)** | each point plotted to within half a small square. | i.e. first plotted point to lie within 22→24, second 30→32<br><br>must be plotted; can't assume under any line they draw | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(c)(ii)** | one best fit **curved** line close to / through most of points | **the best fit line does not have to extend beyond the plotted points.**<br><br>reject very shaky / point to point drawing and tramlining (multiple lines). Reject lines forced through the origin involving kinks / changing directions in order to do so. | **(1)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | **5c (iii)** | An explanation including some of the following ideas :-<br><br>• idea(s) of refraction / reflection / TIR conveyed<br>• as angle of incidence increases so angle of refraction increases<br>• becomes increasingly steep/ gradient increases (non-linear)<br>• because of refraction (light speeding up)<br>• at 42° light stops refracting / up to 42° limit idea<br>• critical angle case described in terms of an emerging ray along the boundary (or similar)<br>• beyond 42° reflection occurs<br>• this is total internal reflection<br>• then angle of incidence = angle of reflection (in the glass) | **(6)** |
| **Level** | **0** | No rewardable content | |
| **1** | **1 - 2** | • a limited explanation including isolated facts e.g. about light bending / refraction<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy | |
| **2** | **3 - 4** | • a simple explanation linking facts about a part of the process e.g. as angle of incidence increases so angle of refraction increases<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy | |
| **3** | **5 - 6** | • a detailed explanation which links ideas about more than one part of the whole process e.g. an accurate explanation of refraction before 42° and TIR after 42°<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors | |

Total for Question 5 = 12 marks

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(a)** | **A** gamma | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6 (b)** | An explanation linking the following:-<br><br>(it is) ionising (1)<br>(can cause)<br><br>damage to tissue/ mutation/cancer/tumours (1) | <br><br>has high frequency/energy<br><br><br>kill cells / (causes) burns | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(c)** | Any three from:<br><br>• keep distant from sources / (stand) in a separate room (behind leaded window etc.)<br><br>• limit **time** exposed to the radioactivity<br><br>• use lead shielding for the sources / handle sources with tongs etc. / dispose radioactive material(s) safely<br><br>• wear lead aprons / used lead-lined clothing / lead-lined gloves<br><br>• monitor exposure with some detector / badge / use of (radiation) meters | <br><br>(distance also involved if you) use computer controlled equipment<br><br>the time aspect must be clear here.<br><br><br><br>ignore goggles / (special) gloves without detail. Similarly ignore 'radiation resistant' (clothes) | **(3)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | **6(d)** | A description including some of the following points :-<br><br>Diagnosis<br>• radioactive tracers used in the body<br>• to check systems e.g. skeleton / bone, blood flow, thyroid activity, kidney function.<br>• attached to some compound which targets a particular area of the body<br>• radioactive tracers are isotopes with short half-lives put into the body<br>• may go into PET scans, since this involves beta+ emitters<br>• gamma cameras, used to detect emissions from radioactive tracers<br><br>Treatment<br>• radiotherapy, use of gamma rays (from cobalt 60) / gamma rays aimed at a tumour to destroy cancerous cells. (Use of multiple beams) May cause damage to normal cells.<br>• radioactive inserts placed into the body to destroy cancerous cells, mainly used for prostate cancer.<br><br>ignore chemotherapy, ultrasound scans, endoscopes etc. | **(6)** |

| Level | 0 | No rewardable content |
|---|---|---|
| **1** | **1 - 2** | • a limited description of one procedure used for either diagnosis **OR** treatment e.g. idea of tracers or an elementary notion of radiotherapy given<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy |
| **2** | **3 - 4** | • a simple description of one procedure used for either diagnosis **OR** treatment e.g. the tracer emits gamma rays which are detected using a gamma camera showing up area of high uptake / radioactivity; uses radioactive sources emitting beta / gamma radiation to destroy cancer cells.<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy |
| **3** | **5 - 6** | a detailed description a procedure used for diagnosis and a procedure used for treatment. e.g. a short-lived radioactive tracer is injected into the body which then shows up areas of high activity via a gamma camera **AND** radiotherapy uses gamma to destroy cancer cells in a targeted way, with some detail. PET scanning details acceptable on the diagnosis side. (N.B. The diagnosis aspect may be covered in more detail than the treatment or vice-versa)<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors |

Total for Question 6 = 12 marks

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Write your name here

| Surname | Other names |
|---|---|
| | |

**Pearson Edexcel GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Physics

## Unit P3: Applications of Physics

**Foundation Tier**

Monday 23 June 2014 – Morning
**Time: 1 hour**

Paper Reference
**5PH3F/01**

**You must have:**
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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## FORMULAE

You may find the following formulae useful.

power of lens = $\dfrac{1}{\text{focal length}}$

current = number of particles per second × charge on each particle $\quad I = Nq$

frequency = $\dfrac{1}{\text{time period}}$ $\quad f = \dfrac{1}{T}$

The relationship between temperature and volume for a gas $\quad V_1 = \dfrac{V_2 T_1}{T_2}$

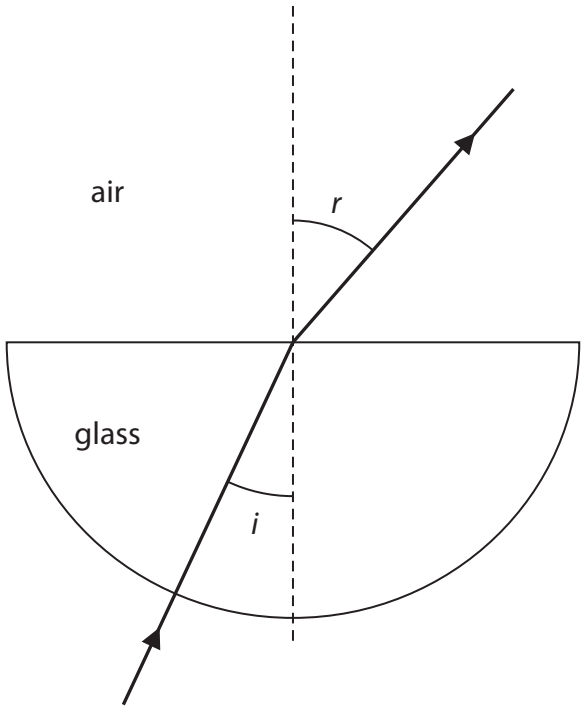
The relationship between volume and pressure for a gas $\quad V_1 P_1 = V_2 P_2$

**Answer ALL questions**

**Some questions must be answered with a cross in a box ☒.**
**If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

## Light

**1** A student investigates the way light passes through glass.
The diagram shows the path of a ray of light through the glass.




(a) State the scientific name for the dotted line in the diagram.

**(1)**

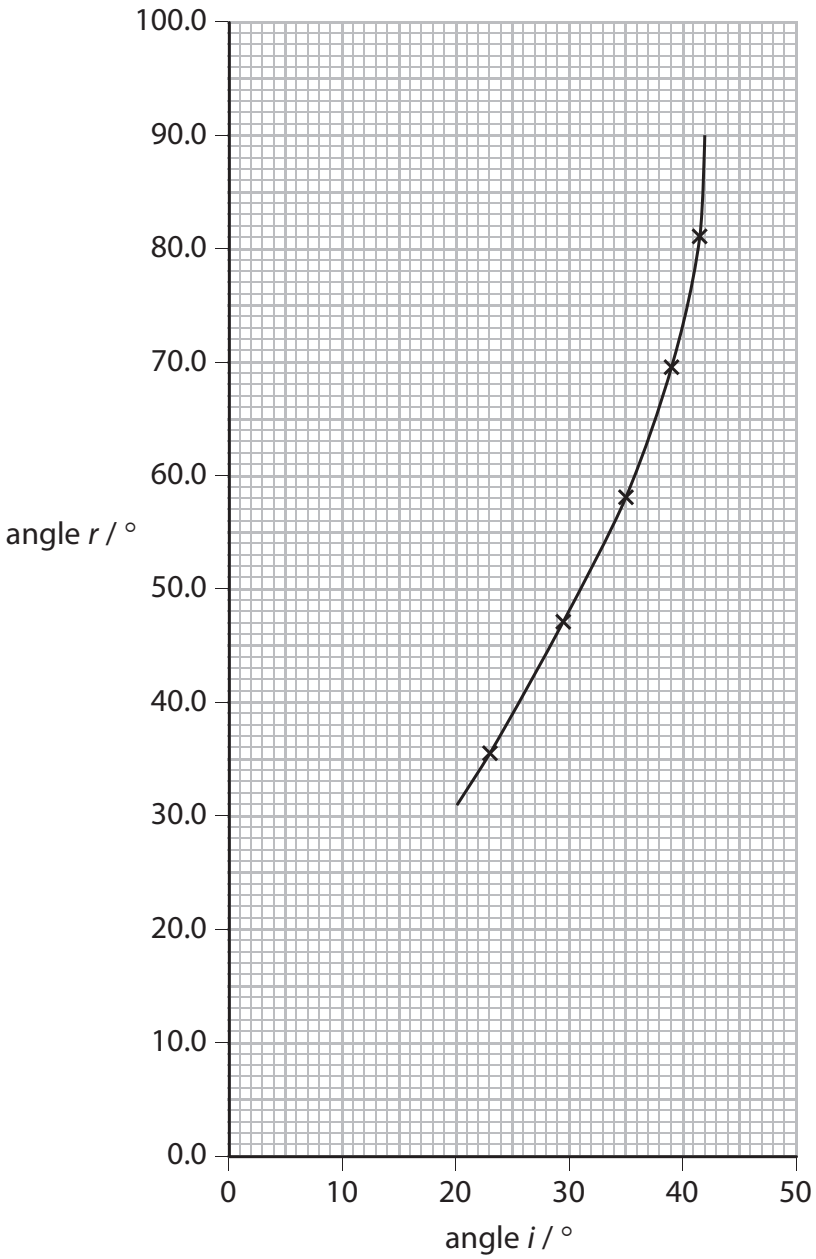
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(b) The student measures several values of angle *i* and angle *r*.
She plots some of her results on the graph.
The table shows results that she has not plotted.

| angle *i* | angle *r* |
|---|---|
| 0° | 0° |
| 6° | 9° |

(i) Plot these results on the graph.

**(2)**




(ii) Continue the line on the graph through the results you have plotted.

**(1)**

(iii) Write down the value of angle *i* when angle *r* = 90°.

**(1)**

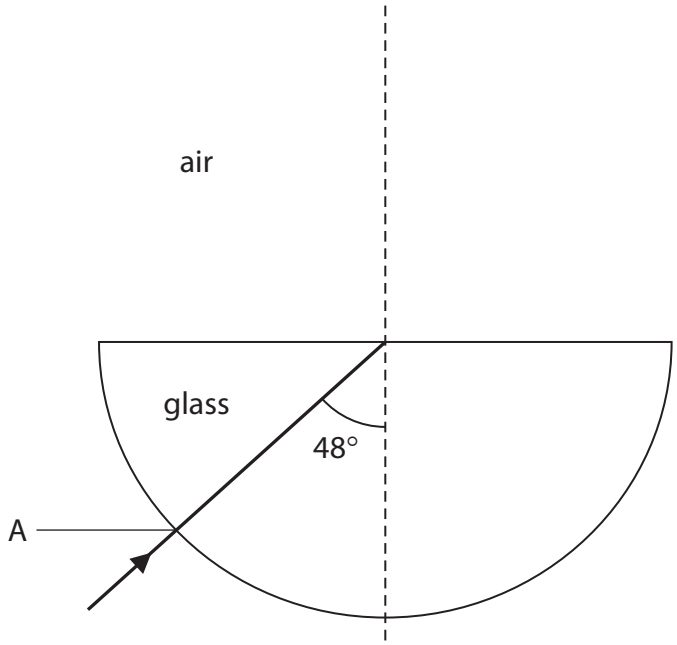
angle *i* = ..... °



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(c) (i) Complete the diagram to show what happens to the ray of light when angle *i* is 48°.

**(2)**




(ii) State why the ray of light does not change direction when it enters the glass at A.

**(1)**

.....

.....

**(Total for Question 1 = 8 marks)**

## Gases

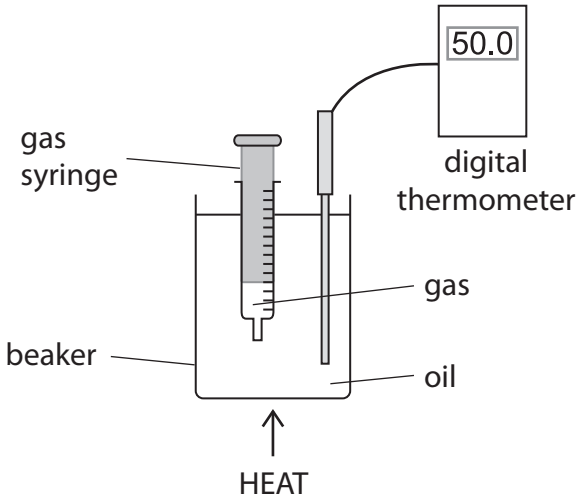
**2** (a) Complete the sentence by putting a cross (☒) in the box next to your answer.

Kinetic theory describes gases as particles that

**(1)**

- ☒ **A** only vibrate
- ☒ **B** do not move at absolute zero
- ☒ **C** only move at high temperatures
- ☒ **D** only move at low temperatures

(b) The apparatus shown in the diagram is used to investigate how the volume of a gas changes with temperature when its pressure is constant.




(i) Explain how the particles in the gas exert a pressure on the syringe.

**(2)**

.....

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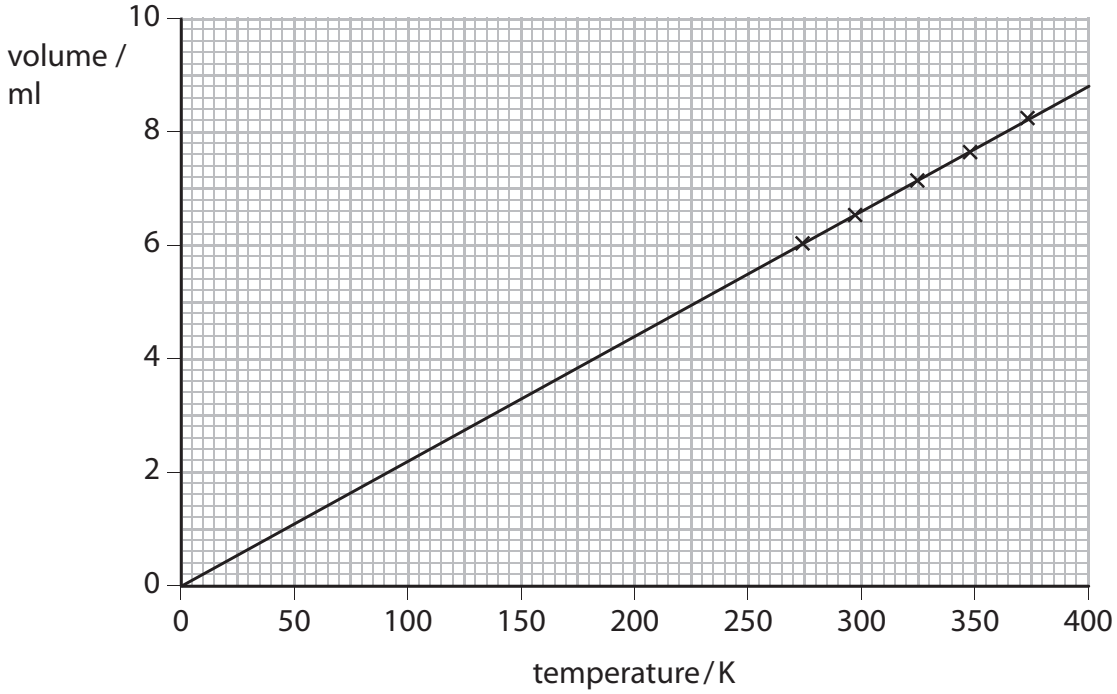
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(ii) The results from the investigation are given in the table.
Fill in the gap in the table.

**(1)**

| volume / ml | temperature / °C | temperature / K |
|---|---|---|
| 6.0 | 0.0 | 273 |
| 6.5 | 25 | 298 |
| 7.1 | 50 | |
| 7.6 | 75 | 348 |
| 8.2 | 100 | 373 |

(iii) The volume of the gas is plotted against the temperature in Kelvin and a line of best fit is drawn.




Describe what this line of best fit shows about how the volume of the gas varies with temperature.

**(2)**

.....

.....

.....

.....

(c) When the temperature of the gas is 298 K, the volume of the gas in the syringe is 6.5 ml.

Calculate the volume of gas when its temperature is increased to 450 K.

Use the equation $V_2 = \frac{V_1 T_2}{T_1}$

**(2)**

volume of gas = ..... ml

**(Total for Question 2 = 8 marks)**



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## Lenses

**3** Diagram 1 shows an eye.

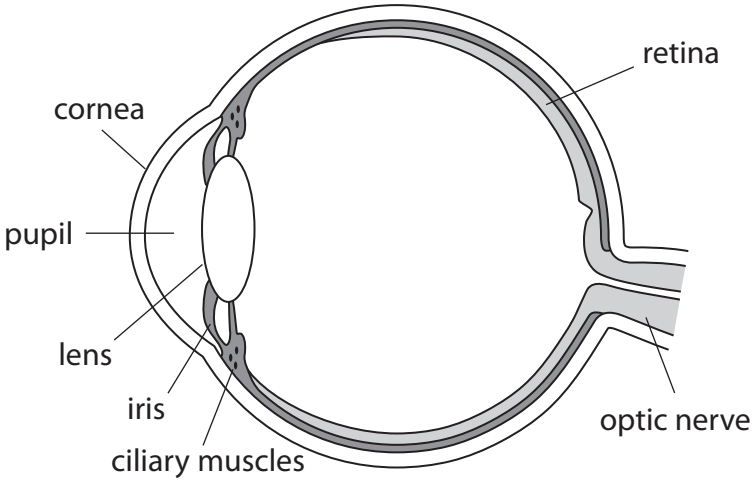



Diagram 1

(a) (i) Use words from the labels on diagram 1 to complete the sentence.

The parts of the eye which focus light are the

**(2)**

..... and the .....

(ii) Lenses of different powers are shown in diagram 2.




Diagram 2

Explain which lens has the greater power.

**(2)**

.....

.....

.....

.....

(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The unit for the power of a lens is the

**(1)**

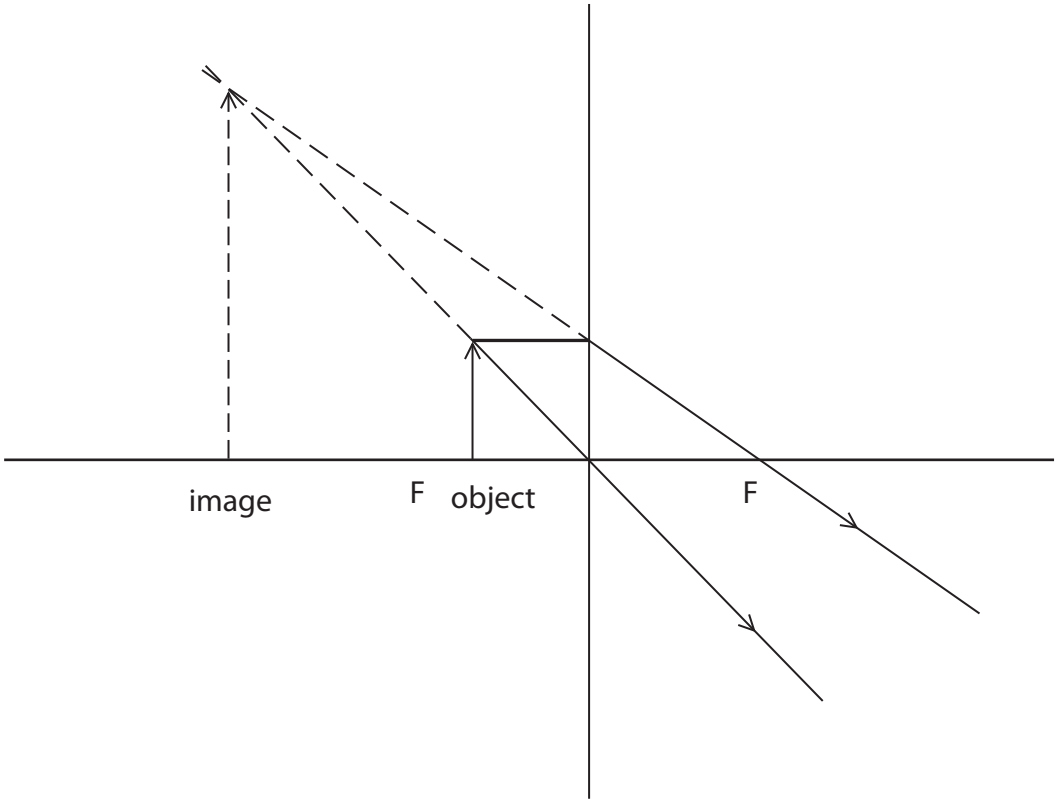
☒ **A** decibel

☒ **B** dioptre

☒ **C** metre

☒ **D** watt

(b) The ray diagram shows the image of an object formed by a converging lens when it is used as a magnifying glass.




(i) The object has a height of 4 cm.
Estimate the height of the image.

**(2)**

height of image = ..... cm



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(ii) Which of these describes the image formed by this converging lens when it is used as a magnifying glass?

Put a cross (☒) in the box next to your answer.

**(1)**

☒ **A** inverted, real

☒ **B** right way up, real

☒ **C** inverted, virtual

☒ **D** right way up, virtual

(c) Explain why a converging lens is used for the treatment of long sight.

You may draw a diagram to help with your answer.

**(2)**

.....

.....

.....

.....

**(Total for Question 3 = 10 marks)**

## Radioactive sources

**4** (a) Cobalt-60 is a radioactive substance.
A nucleus of cobalt-60 contains 27 protons and 33 neutrons.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The number of electrons in a neutral atom of cobalt-60 is

**(1)**

☒ **A** 87

☒ **B** 60

☒ **C** 33

☒ **D** 27

(ii) Cobalt-60 decays by emitting gamma radiation.

Explain what happens to the mass of a cobalt-60 atom when a gamma ray is emitted.

**(2)**

.....

.....

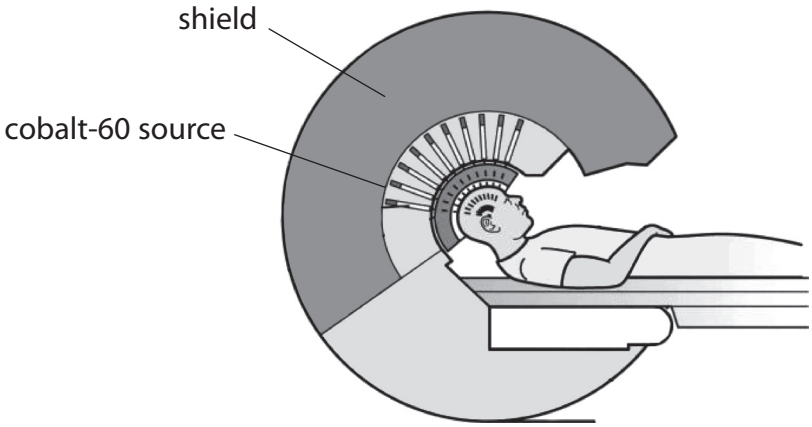
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(b) Gamma radiation from cobalt-60 can be used to destroy tumours.
The diagram shows how gamma radiation is used to destroy a brain tumour.




(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Gamma radiation is used because

**(1)**

☒ **A** gamma can penetrate further than alpha or beta

☒ **B** gamma is more ionising than alpha or beta

☒ **C** gamma is always safer than alpha or beta

☒ **D** gamma has a shorter half-life than alpha or beta

(ii) Describe what the shield is used for.

**(2)**

.....

.....

.....

.....

(iii) Suggest **two** advantages that this kind of treatment has over other forms of treatment for tumours.

**(2)**

1 .....

.....

2 .....

.....

(iv) Explain why several beams of gamma radiation are used instead of just one.

**(2)**

.....

.....

.....

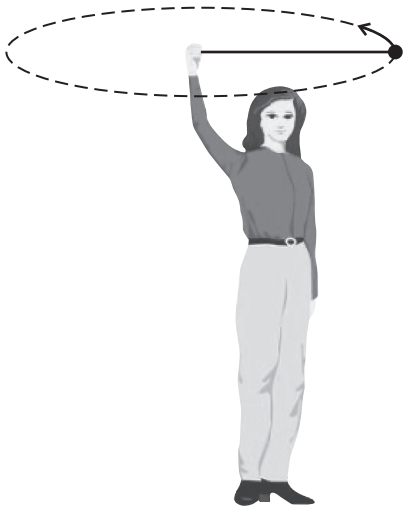
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**(Total for Question 4 = 10 marks)**

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## Circular motion

**5** (a) The diagram shows a girl swinging a rubber ball in a horizontal circle above her head.



(i) In which direction does the resultant force act on the ball?

Put a cross (☒) in the box next to your answer.

**(1)**

☒ **A** away from the centre of the circle

☒ **B** in the direction of the arrow on the diagram

☒ **C** in the opposite direction to the arrow on the diagram

☒ **D** towards the centre of the circle

(ii) State the name of the resultant force acting on the ball.

**(1)**

.....

(iii) Suggest what would happen to the ball as the girl gets tired.

**(2)**

.....

.....

.....

.....



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(iv) The girl lets go of the string and the ball hits a wall.

The collision is not elastic.

Explain what happens to both momentum and kinetic energy when the ball hits the wall.

**(2)**

.....

.....

.....

.....

*(b) Describe a cyclotron and how charged particles move inside it.

You may draw a labelled diagram to help with your answer.

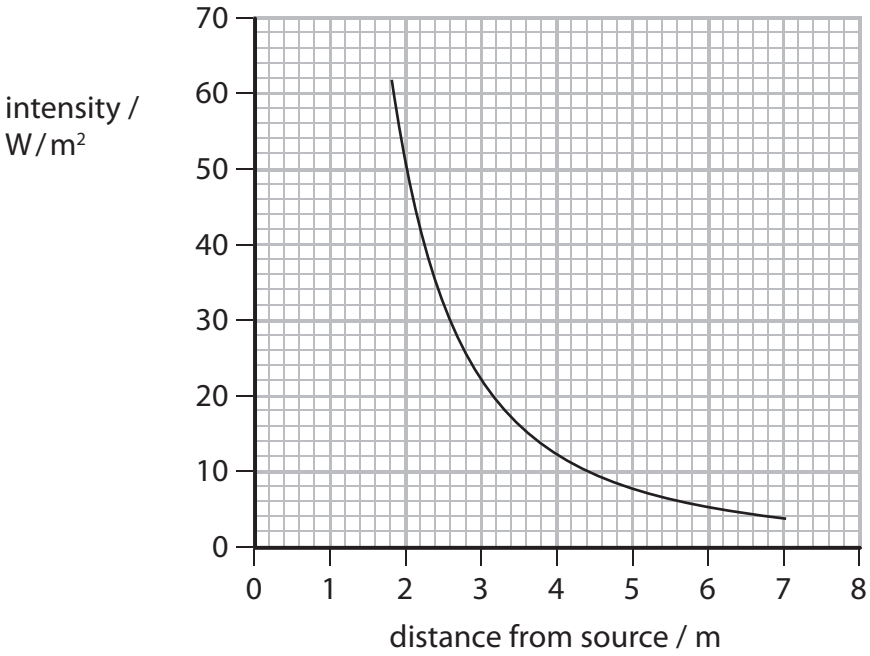
**(6)**

**(Total for Question 5 = 12 marks)**

## X-rays

**6** X-rays are electromagnetic radiation.

(a) The graph shows how the intensity of electromagnetic radiation changes with distance from the source.




(i) State the intensity when the distance from the source is 2 m.

**(1)**

intensity = ..... W / m²



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(ii) The equation linking the intensity of this radiation to the distance from the source is

$$\text{intensity} = \frac{200}{(\text{distance})^2}$$

Calculate the intensity when the distance is 0.9 m.

**(3)**

intensity = ..... $W/m^2$

(b) X-rays have many uses.

Which of the following uses X-rays?

Put a cross (☒) in the box next to your answer.

**(1)**

- ☒ **A** CAT scan
- ☒ **B** endoscope
- ☒ **C** pulse oximeter
- ☒ **D** ultrasound scan

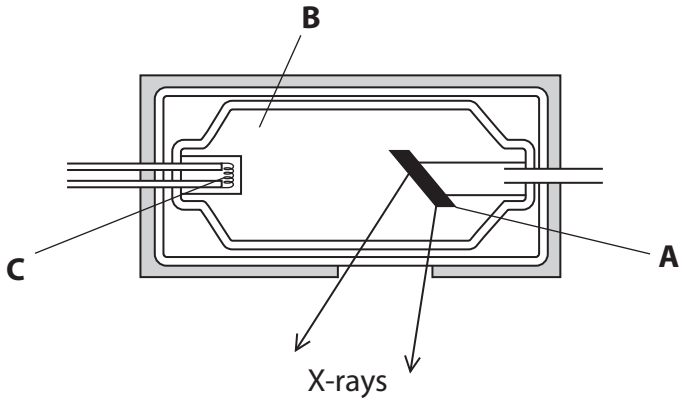
(c) State one harmful effect of X-rays.

**(1)**

.....

.....

*(d) The diagram shows an X-ray tube.




Describe how X-rays are produced in this type of tube.

You may refer to the letters on the diagram in your answer.

**(6)**

**(Total for Question 6 = 12 marks)**

**TOTAL FOR PAPER = 60 MARKS**



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edexcel

# Mark Scheme (Results)

## Summer 2014

## Pearson Edexcel GCSE in Physics (5PH3F) Paper 01



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Summer 2014
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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.
- 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.

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (a)** | normal (1) | normal line | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (b)(i)** | plot the points:<br>• 0,0 (1)<br>• 6,9 (1) | allow within one square tolerance.<br><br>Bod if 0,0 not clearly visible but must be able to see a plotted point for 6,9<br>If they plot more than 2 points, take a mark off for each incorrect one plotted. | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (b)(ii)** | straight line through both points joining existing curve (1) | Reject multiple lines and unreasonably wavering lines.<br>allow ecf from wrongly plotted points, including curves if plausible | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (b)(iii)** | $42^{o}$ (1)<br><br>+/- $0.5^{o}$ | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (c)(i)** | diagram showing:<br>• reflection (1)<br>• angle of incidence = angle of reflection (1) | reject (for this marking point) with an additional partial refraction / ray along boundary<br>judge by eye<br>allow angles marked as equal | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1 (c)(ii)** | The idea that it enters along the normal | At 90 $^{o}$ to the surface / at right angles to the surface / along a radius / perpendicular to the tangent / hits straight on<br>reject 'goes through centre of glass' | **(1)** |

**(Total for Question 1 = 8 marks)**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)** | B do not move at absolute zero | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(i)** | An explanation linking:<br>• particles move / collide (1) with<br>• the walls of the syringe (1)<br>2nd mark dependent on first | hit/strikes/bounces<br>ignore vibrate<br>with the syringe<br>'hits the syringe' = 2 marks<br>ignore 'push against the syringe' | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(ii)** | 323K (1)<br>Volume/ml \| Temperature/°C \| Temperature/K<br>6 \| 0 \| 273<br>6.5 \| 25 \| 298<br>7.1 \| 50 \| **323**<br>7.6 \| **75** \| 348<br>8.2 \| 100 \| 373 | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(iii)** | A description including:<br>• V increases as T increases (or reverse) / there is a positive correlation (1)<br>• proportional / goes up in equal steps / constant increase (1) | hotter leads to greater volume / cooler leads to smaller volume<br>do not allow 'as heat rises'<br>accept a doubling argument for the second mark.(Ignore readings taken from graph if not supporting doubling.)<br>volume is (directly) proportional to temperature for 2 marks | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(c)** | • Substitution<br>$\frac{6.5 \times 450}{298}$ (1)<br><br>• evaluation<br>9.8 (ml)<br>(1) | Any answer between 9.8(ml) and 9.9(ml) (ignore dp / rounding off)<br>Accept answer with no working for full marks | **(2)** |

**(Total for Question 2 = 8 marks)**

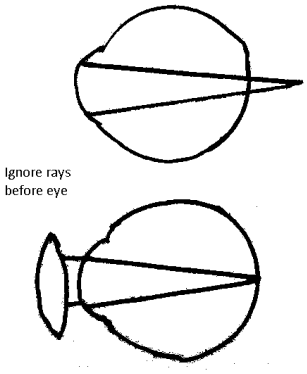
| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(a)(i)** | • cornea (1)<br>• lens / ciliary muscles (1) | In either order<br>accept misspellings where meaning is clear | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3 (a)(ii)** | An explanation linking:<br>• Lens B (1)<br>with one of<br>• smaller radius of curvature<br>• (because) it is thicker (1)<br>• (because) bends/refracts light more (1) | <br><br><br><br>more curved<br>fatter / wider (not 'bigger')<br>has a shorter focal length | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(a)(iii)** | B dioptre | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(b)(i)** | • 4 x3 (1)<br>• Evaluation<br>12(cm)<br>(1) | <br><br>10.0 (cm) to 15.0(cm)<br>Correct answer with no working for 2 marks | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(b)(ii)** | D right way up, virtual | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c)** | An explanation linking any two of the following:<br><br>• the eyeball is too short / the image is formed behind the retina (eye) / the eye lens does not bend the light enough / is not powerful enough / person cannot see objects close up (clearly) (1)<br>• (lens) bends / refracts the light more (1)<br>• (lens) focuses the image (of an object) on the retina / back of eye (1) | Credit diagrams<br><br><br><br><br>reject contradictions where short sight is shown or described i.e. lens focusing rays before the retina. | **(2)** |

**(Total for Question 3 = 10 marks)**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| 4(a)(i) | **D** 27 (1) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| 4(a)(ii) | an explanation linking:<br>• no change in mass (number) (1)<br>• (because) gamma is a wave (electromagnetic) / has no mass (itself) (1)<br><br>OR<br>• mass decreases (1)<br>• idea of mass – energy equivalence (1) (must be clearly stated) | gamma is only energy / not a particle<br><br>nucleus de-excites / rearranged for one mark<br><br>do not allow 'mass number decreases' | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| 4(b) (i) | **A** gamma can penetrate further than alpha or beta (1) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| 4(b) (ii) | description to include:<br>• protects / stops radiation escaping (1)<br>• affecting operator/doctor/nurse (1) | absorbs (radiation)<br><br>other people / others | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| 4(b) (iii) | two from:<br>• non invasive / no surgery required (1)<br>• no radioactive substances left in the body (1)<br>• no anaesthetic used<br>• patient does not become radioactive (1)<br>• outpatient procedure (1)<br>• does not affect the whole body (1)<br>• (accurate) targeting of tumour (1)<br>• painless (at the time) for the patient<br>• procedure (may be) quicker | no need to operate / cut open patient / reduces risk of infection<br><br>no harmful side effects like chemotherapy<br><br>ignore answers\that apply equally to other treatments e.g. 'kills cancer' | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| 4(b) (iv) | explanation linking two from:<br>• idea of targeting / beams concentrate / focus on tumour (1)<br>• avoid damage to healthy cells / tissue (1)<br>• (reaching / getting to) all parts of the tumour (1) | more rays hit tumour / beams overlap at tumour<br>ignore '(more) beams penetrate more' / (more) accurate | **(2)** |

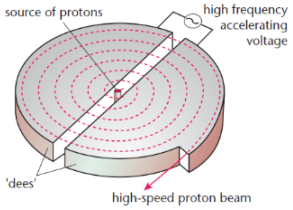
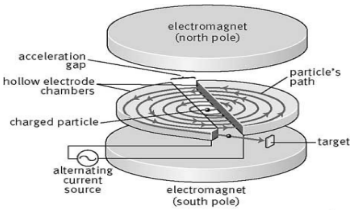
**(Total for Question 4 = 10 marks)**

| **Question Number** | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(i)** | D towards the centre of the circle | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(ii)** | centripetal (force) | reject centrifugal force<br>accept misspellings where meaning is clear e.g. centripedal | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(iii)** | Any two of the following :-<br><br>ball slows down (1)<br><br>ball / it drops (down) / circles at a lower height (1)<br><br>go in smaller circles (1) | <br><br>less **<u>kinetic</u>** energy / momentum<br><br>any lowering / less **<u>potential</u>** energy<br><br>stops going in circles<br>the ball/it would not make complete circles<br>(not just 'stops') | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(iv)** | An explanation linking:<br><br>• the idea that momentum (of the closed system) would stay the same (1)<br><br>• the idea that kinetic energy would not be conserved (1) | <br><br>momentum **<u>of the ball</u>** decreases / changes (direction) / passed to wall<br><br>must specify which momentum; do not credit 'momentum decreases' by itself<br><br>kinetic energy → heat/sound/wall<br><br>ignore 'KE decreases / is lost' without qualification<br>allow 'KE is lost because it's not elastic' (i.e. qualified) | **(2)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | ***5(b)** | A description including some of the following points :-<br>Cyclotron<br>• two D-shaped halves<br>• gap between the Dees<br>• (alternating) voltage across the gap<br>• magnetic field (at right angles to the moving particles)<br>• vacuum enables free movement of particles<br><br>Particle movement<br>• accelerate<br>• start at the centre<br>• move in a circular path<br>• spiral outwards<br>• exit in a straight line<br><br>Examples of labelled diagrams which would give Level 3 by themselves<br>(not all labels / details needed)<br><br><br><br><br>Level 2 if no labels but Dees AND particle path shown.<br>Level 1 if no labels but either Dees OR spiral of particle shown<br>Ignore uses of cyclotron | **(6)** |

| Level | 0 | No rewardable content |
|---|---|---|
| 1 | 1 - 2 | • a limited description of either particle movement OR cyclotron e.g. The particles move in a circle OR Cyclotrons have two Dees OR Cyclotrons are particle accelerators OR there's a vacuum<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy |
| 2 | 3 - 4 | • a simple description of particle movement AND cyclotron OR a more detailed description of one e.g. A cyclotron has two D-shaped halves and the particles inside accelerate OR A cyclotron has a magnetic field and a voltage across the gap OR Charged particles increase in speed as they spiral outwards OR vacuum allows free movement of particles<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy |
| 3 | 5 - 6 | • a description of particle movement AND cyclotron with a detailed description of one of them e.g. the charged particles get faster as they accelerate across the gap in the Dees **OR** the magnetic field (of the cyclotron) causes the particles to move in a circle<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors |

**(Total for Question 5 = 12 marks)**

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(a)(i)** | 50 ($W/m^2$) (1) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(a)(ii)** | • using distance$^2$ (1)<br>($0.9^2$) = 0.81<br><br>• substitution(1)<br><br>(intensity) = $\frac{200}{(0.9^2)}$<br><br>• evaluation (1)<br>250 ($W/m^2$) | <br><br><br>Allow ecf from mp1<br><br>200/0.81 has achieved first two marks<br><br>correct answer with no working scores full marks<br><br>246.9<br><br>numbers which would correctly round up to 250 (e.g. accept 246)<br><br>222 scores two marks (using 200/0.9) | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6(b)** | A CAT scan (1) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6 (c)** | damage to cell/DNA (1) | causes cancer / stops cell division / causes tumours / causes radiation burns<br><br>for cell accept tissue / named tissue / organ /<br><br>for damage accept kills / destroys / mutates / denatures / ionises<br><br>but not just ionising by itself 'radiation poisoning' by itself insufficient | **(1)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | ***6(d)** | An description including some of the following points<br><br>• C is heated<br>• C is the cathode / filament<br>• A is the anode<br>• A is the (metal) target<br>• electrons produced at C<br>• by thermionic emission (boil off filament)<br>• p. d. (voltage) between A and C<br>• electrons move towards A<br>• through a vacuum B<br>• electrons accelerated by voltage (between A & C)<br>• electrons collide with A | **(6)** |
| **Level** | **0** | No rewardable content | |
| **1** | **1 - 2** | • a description limited to isolated facts e.g. B is a vacuum<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy | |
| **2** | **3 - 4** | • a simple description linking some facts e.g. electrons / negative particles come from the cathode OR electrons collide with the anode OR electrons accelerate in the tube<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy | |
| **3** | **5 - 6** | • a detailed description e.g. **electrons** come from the cathode and hit the anode N.B. must mention electrons to get level 3<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors | |

**(Total for Question 6 = 12 marks)**

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Write your name here

| Surname | Other names |
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**Edexcel GCSE**

| Centre Number | Candidate Number |
|---|---|
| | |

# Physics

## Unit P3: Applications of Physics

**Foundation Tier**

Wednesday 5 June 2013 – Afternoon
**Time: 1 hour**

Paper Reference
**5PH3F/01**

**You must have:**
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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## FORMULAE

You may find the following formulae useful

power of lens = $\dfrac{1}{\text{focal length}}$

current = number of particles per second × charge on each particle $I = Nq$

frequency = $\dfrac{1}{\text{time period}}$ $f = \dfrac{1}{T}$

The relationship between temperature and volume for a gas $V_1 = \dfrac{V_2 T_1}{T_2}$

The relationship between volume and pressure for a gas $V_1 P_1 = V_2 P_2$



P 4 1 9 4 6 A 0 2 2 0

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**Questions begin on next page**







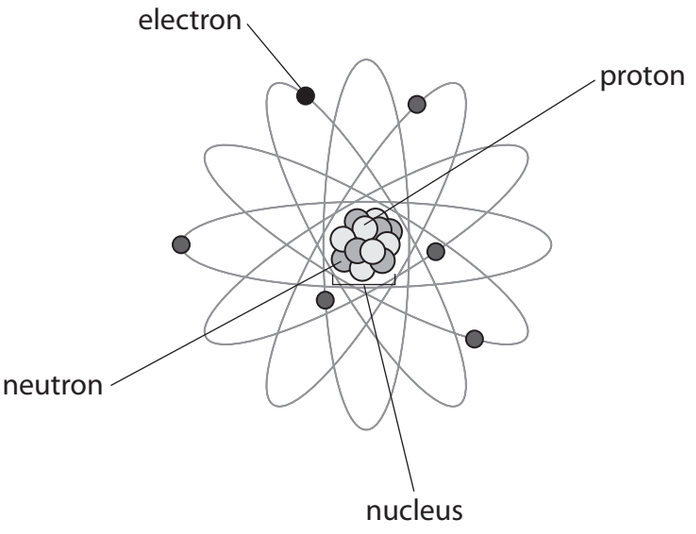
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**Answer ALL questions**

**Some questions must be answered with a cross in a box ☒.**
**If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

## Atoms and radioactivity

**1** The diagram shows the structure of an atom.




(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The size of the charge on each electron is

**(1)**

☒ **A** a third of the charge on the proton

☒ **B** half the charge on the proton

☒ **C** the same as the charge on the proton

☒ **D** twice the charge on the proton

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The atomic number of a neutral atom is always the same as the number of

**(1)**

☒ **A** electrons

☒ **B** electrons and neutrons

☒ **C** protons and neutrons

☒ **D** neutrons





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(b) The element radium has a radioactive isotope, radium-226.

This can be written as $^{226}_{88}Ra$.

This radioactive isotope emits alpha particles.

The alpha particle has a mass number of 4 and contains two protons.

Using the numbers in the box complete the following sentences.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 82 | 84 | 86 | 90 | 222 | 224 | 228 | 230 |

(i) When an alpha particle is emitted by $^{226}_{88}Ra$ the mass number becomes .....

**(1)**

(ii) When an alpha particle is emitted by $^{226}_{88}Ra$ the atomic number becomes .....

**(1)**

(c) Describe how the emissions from radioactive substances can be dangerous to living things.

**(2)**

.....

.....

.....

.....

(d) Explain **one** precaution that is taken in hospitals to limit the risks of exposure to radiation.

**(2)**

.....

.....

.....

.....

**(Total for Question 1 = 8 marks)**



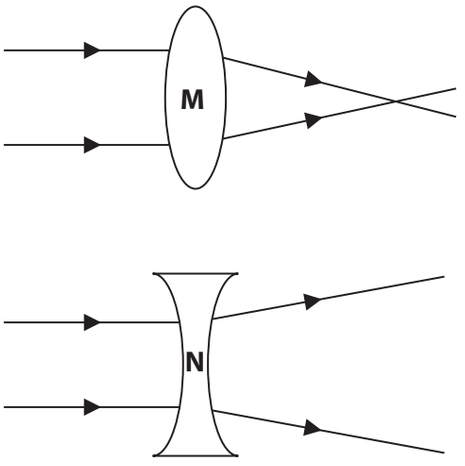




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## Lenses

**2** (a) The diagrams show rays of light passing through two lenses labelled **M** and **N**.




(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The light changes direction as it leaves the lenses.
This is called

**(1)**

☒ **A** contraction

☒ **B** diffraction

☒ **C** reflection

☒ **D** refraction

(ii) The focal length of lens **M** is 2 m.

Calculate the power of lens **M**.

**(2)**

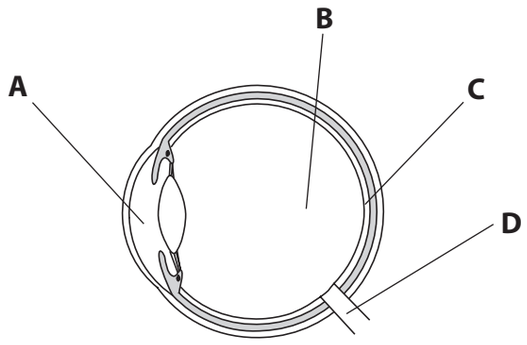
power = ..... D



P 4 1 9 4 6 A 0 6 2 0

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(b) The diagram shows an eye of a short sighted person.
A diverging lens is used to correct short sight.




(i) The eye will form an image of a distant object.

Which letter shows where the image will form for the short sighted eye?

Put a cross (☒) in the box next to your answer.

**(1)**

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) Draw on the diagram a diverging lens in a position which would correct the short sightedness.

**(1)**

(iii) Describe how the diverging lens corrects this defect of vision.

**(2)**

.....

.....

.....

.....

(iv) Suggest one way of correcting short sight other than wearing glasses.

**(1)**

.....

.....

**(Total for Question 2 = 8 marks)**

## Applications of light and sound

**3** Diagram 1 shows a glass prism which can be used to turn an image the right way up.

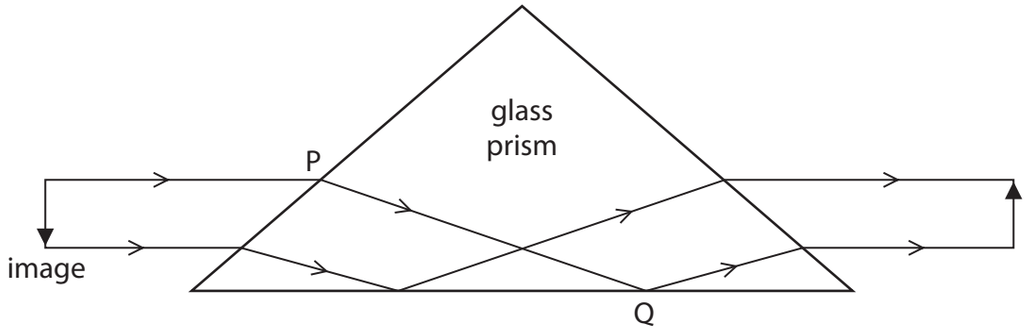



Diagram 1

(a) (i) In diagram 1, total internal reflection occurs at Q.
Explain why total internal reflection occurs at Q.

**(2)**

.....

.....

.....

.....



P 4 1 9 4 6 A 0 8 2 0

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(ii) The way in which the light changes direction at P is shown in diagram 2.

Mark on the diagram (*i*) for the angle of incidence and (*r*) for the angle of refraction for the ray of light shown.

**(2)**

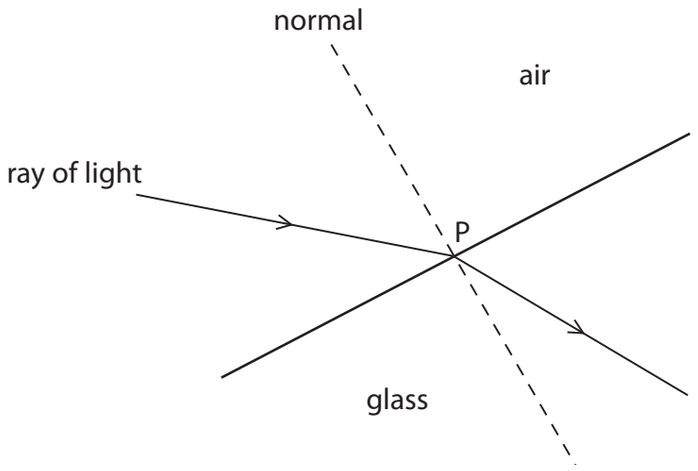



Diagram 2

(iii) Which of these is correct for the light as it enters the prism at P?

Put a cross (☒) in the box next to your answer.

**(1)**

☒ **A** frequency decreases

☒ **B** frequency increases

☒ **C** speed decreases

☒ **D** speed increases







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(b) Light waves and sound waves are both used in the diagnosis and treatment of medical conditions

(i) A doctor uses an endoscope to look inside the body of a patient.

Explain how optical fibres are used in endoscopes.
You may draw a labelled diagram to help with your answer.

**(3)**

(ii) Describe how ultrasound can be used as a medical treatment for illness or injury.

**(2)**

**(Total for Question 3 = 10 marks)**





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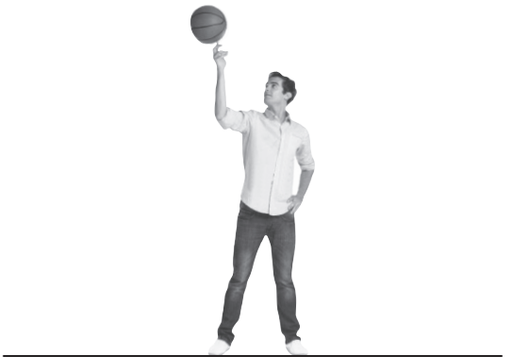




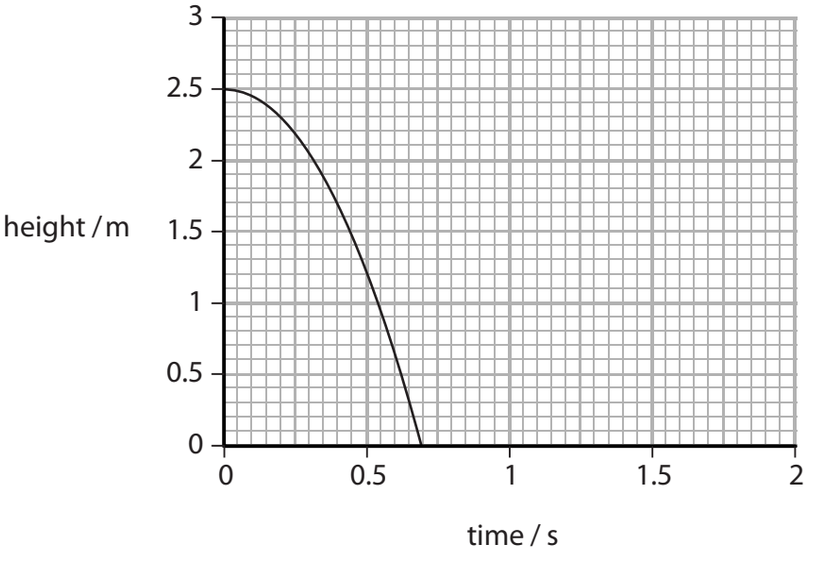
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## Collision

**4** (a) The man in the photograph balances a ball above the ground.



He lets the ball fall.
He starts a timer at the same time.
The graph shows how the height of the ball above the ground changes with time.




(i) From the graph, state the height of the ball above the ground when the timer was started.

**(1)**

height above ground = ..... m



P 4 1 9 4 6 A 0 1 2 2 0

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(ii) From the graph, state the time taken for the ball to reach the ground.

**(1)**

time = ..... s

(iii) The ball bounces back to a height of 1.9 m.
Continue the line on the graph to show this.

**(3)**

(iv) Explain why the ball does not bounce back to its original height.

**(2)**

.....

.....

.....

.....

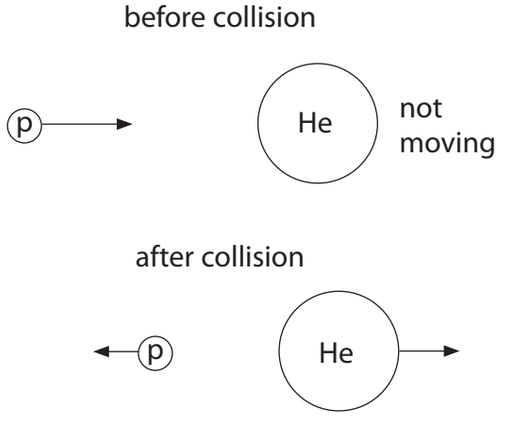






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(b) The diagram shows a collision between a proton (p) and a helium nucleus (He).




(i) The table gives some information about the collision.

| | | before collision | after collision |
|---|---|---|---|
| proton | kinetic energy (arbitrary units) | 12.5 | 4.5 |
| helium nucleus | kinetic energy (arbitrary units) | 0 | 8 |

Use information from the table to show that the collision is elastic.

**(2)**

.....

.....

.....

.....

(ii) State the name of **one** device that can be used to accelerate protons to very high speeds.

**(1)**

.....

.....

**(Total for Question 4 = 10 marks)**





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## Monitoring heart action and pulse

**5** The photograph shows a pulse oximeter. This is used to show the heart rate and the amount of oxygen in the blood.




(a) (i) Where is the oximeter usually placed to take measurements?

Put a cross (☒) in the box next to your answer.

**(1)**

☒ **A** on the finger

☒ **B** over the heart

☒ **C** on the neck

☒ **D** on the wrist

(ii) There are two LEDs used in an oximeter.
One emits visible light.
State what type of radiation the other LED emits.

**(1)**

.....

.....







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(iii) The oximeter shows a heart rate of 89 beats per minute.
Calculate the frequency in beats per second.

**(2)**

frequency = ..... beats/second

(iv) Calculate the time between each heartbeat.

Use the equation

$$\text{time between heartbeats} = \frac{1}{\text{frequency}}$$

**(2)**

time between heartbeats = ..... s



P 4 1 9 4 6 A 0 1 6 2 0

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*(b) Doctors use an electrocardiogram (ECG) machine to monitor the action of a person's heart.

Describe how a doctor can use an ECG machine to collect and display information from a person's beating heart in order to check heart action.

You may draw a labelled diagram to help with your answer.

**(6)**

**(Total for Question 5 = 12 marks)**





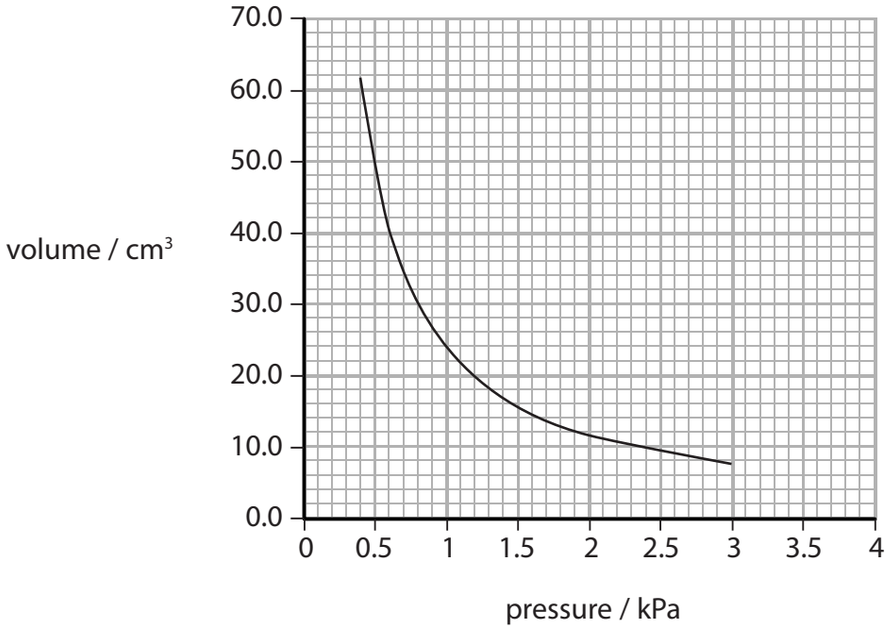


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## Gases

**6** (a) A student investigated how the volume and pressure of a gas were related.

The graph shows how the volume of a gas changes with pressure.




The table shows the results used to plot the graph.

| pressure / kPa | volume / $cm^3$ |
|---|---|
| 2.5 | ..... |
| 2.0 | 11.9 |
| ..... | 14.0 |
| 1.4 | 17.0 |
| 1.0 | 24.0 |
| 0.4 | 61.5 |

(i) Use the graph to complete the table.

**(2)**





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(ii) The results were taken at a constant temperature of 23 °C.

Complete the sentence by putting a cross (☒) in the box next to your answer.

A temperature of 23 °C can be written in kelvin as

**(1)**

☒ **A** –273 K

☒ **B** 250 K

☒ **C** 273 K

☒ **D** 296 K

(iii) Estimate a value for the volume when the pressure becomes 4 kPa.

**(1)**

volume = ..... $cm^3$

(iv) When the pressure of the gas is 2.2 kPa, the volume of the gas is 10.8 $cm^3$.

Use the equation

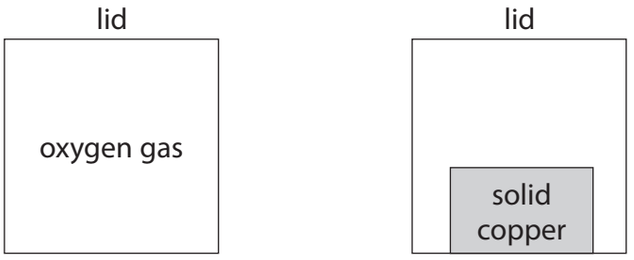
$$V_2 = \frac{P_1 V_1}{P_2}$$

to calculate the volume of the gas when the pressure of the gas is 0.2 kPa.

**(2)**

volume = ..... $cm^3$

*(b) The diagrams show a block of solid copper and some oxygen gas in two closed containers.




The oxygen exerts a pressure on the lid of its container.

The copper does not exert a pressure on the lid of its container.

Explain, using kinetic theory, why the oxygen exerts a pressure on the lid but the copper does not.

**(6)**

**(Total for Question 6 = 12 marks)**

**TOTAL FOR PAPER = 60 MARKS**





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# Mark Scheme (Results)

## Summer 2013

GCSE Physics (5PH3F)
Paper 01

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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.

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(a)(i)** | ☒ **C** the same as the charge on the proton | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(a)(ii)** | ☒ **A** electrons | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(b)(i)** | 222 | 4 less/4fewer | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(b)(ii)** | 86 | 2 less/2fewer | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(c)** | A description including **two** of:<br>• Kill/damage cells(1)<br>• affecting DNA (1)<br>• (causing) mutation (1)<br>• by ionisation (1)<br>• make cell reproduce rapidly (1)<br>• cause cancer (1)<br>• (radiation) burns (1)<br>• (radiation) sickness (1) | | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(d)** | An explanation linking any suitable precaution to a sensible reason:<br>Eg lead/shielding (1)<br>(because it)<br>stops/absorbs radiation (1)<br><br>Use of radiation meters (1)<br>{measure/warn of} radiation received (1)<br><br>put up signs (1)<br>(to )keep people away from radiation (1)<br><br>increasing distance (1)<br>(to)reduce intensity (1)<br><br>to reduce dose(1)<br>by limiting the number of X-rays taken (1) | source locked away for shielding<br><br>(worker) leaves room<br>inverse square law | **(2)** |

Total mark question 1= 8

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(i)** | ☒ **D** refraction | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(ii)** | substitution: (1)<br><br>power = 1/ 2<br><br>evaluation: (1)<br><br>0.5 (D) | <br><br><br><br>Award 2 marks for correct answer no working | <br><br><br><br>**(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(i)** | ☒ **B** | | **(1)** |

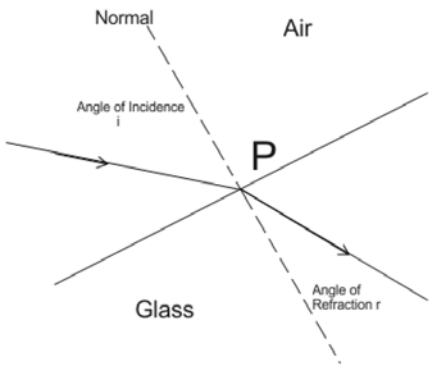
| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)( ii)** |  in front of eye (1) | any other diverging lens<br>(lens which is narrower at the centre than at the ends)<br><br>Reject lens inside the eye | <br><br>**(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(iii)** | a description including any **two** from:<br><br>• to spread out the light/ rays (1)<br>• to produce focused image (1)<br>• (focused image) on the retina (1) | <br><br>make image distance longer<br><br>sharp/clear image<br>back of eye | <br><br><br><br>**(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(iv)** | contact lenses (1) | <u>laser</u> surgery/ eye lens replacement | **(1)** |

Total mark for question 2 = 8

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(a)(i)** | An explanation linking:<br>Angle (of incidence) in glass (1)<br>greater than critical angle / 42° (1) | Angle in air cannot be greater than 90° for 1 mark<br><br>Glass has a higher refractive index than air for 1 mark | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3 (a)(ii)** | <br>angle i from normal in air (1)<br>angle r from normal in glass (1) | accept for 1 mark<br><br>angle i in air <u>and</u> angle r in glass/ <u>both</u> angles measured from normal | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3 (a)(iii)** | ☒ **C** speed decreases | | **(1)** |

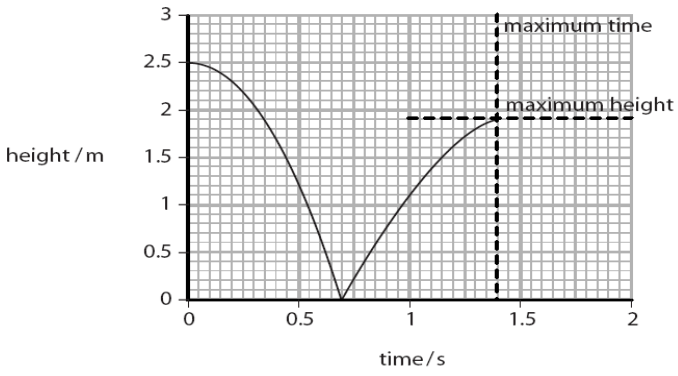
| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(b)(i)** | An explanation linking any three of the following:<br><br>(Optical fibres) bend (1)<br>some fibres carry light to the inside of the patient (1)<br>some fibres transmit the reflected light (1)<br>light passes up/down fibres by TIR (1)<br>light is reflected inside the patient (1)<br>image is analysed by computer (1) | Accept suitable labelling on a Diagram<br><br>Image projected on a screen | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(b)(ii)** | Either<br>Breaks/blasts/smashes (1)<br>Kidney stones (1)<br>or<br>Energy absorbed (1)<br>to help repair muscle tissue (1)<br>or<br>Use of gel (1)<br>to prevent loss of intensity (1)<br>or | bruising/clots<br>increases blood flow<br><br>Allow (1) mark for suitable diagnosis e.g. prenatal scan | **(2)** |

Total mark for question 3 = 10

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4 (a)(i)** | 2.5 (m) | Allow answers between (and including) 2.45 & 2.55 | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4 (a)(ii)** | 0.7 (s) | Allow answers between (and including) 0.68 & 0.72 | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4 (a)(iii)** | <br>line:<br>same shape as original (1)<br>peak at 1.9 m (1)<br>time taken < 0.7 s (1) | Ignore any part of the graph after the peak | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4 (a)(iv)** | An explanation linking:<br>energy lost (1)<br>in collision with ground / air resistance (1) | Inelastic collision worth (2)<br>as sound or heat | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4 (b)(i)** | shown using data<br>Any two from<br>kinetic energy before = 12.5 + 0 (=12.5) (1)<br>kinetic energy after = 4.5 + 8 (=12.5)<br>(1)<br><br>Kinetic energy is the same before and after the collision (1) | <br><br><br><br><br><br>Kinetic energy is conserved/no energy lost | <br><br><br><br><br><br>**(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4 (b)(ii)** | cyclotron (1) | named particle accelerator<br>accept CERN | **(1)** |

Total mark for question 4 = 10

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5 (a)(i)** | ☒ **A** on the finger | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5 (a)(ii)** | infrared (1) | red light | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5 (a)(iii)** | 89/60 (1)<br><br>1.5 (beats/second) (1) | <br><br>1.48 (beats/second)<br>Allow 1.49<br>1.483333etc<br>Accept correct answer no working for 2 marks | <br><br>**(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5 (a)(iv)** | 1/1.5 (1)<br><br>0.67(s) (1) | ecf<br><br>1/ 89 one mark only<br>Accept correct answer no working for 2 marks | <br><br>**(2)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | ***5(b)** | A description including some of the following points:<br><br>what the information / signal is<br>• electrical signals<br>• small difference in potential (mV) between one part of the body and another<br>• signal changes as the heart beats<br>• are started in the heart (right atria)<br>• caused by nervous impulse<br>• action potentials<br><br>signal in<br>• electrodes attached to the skin<br>• water in the body conducts electricity / signal<br>• at least two electrodes used<br>• electrodes conduct electricity / contain gel<br><br>signal out<br>• shows heart rate on a screen / paper<br>• shows a waveform on a screen / paper<br>• receives small signals which have to be amplified | **(6)** |
| **Level** | **0** | No rewardable content | |
| **1** | **1 - 2** | • a limited explanation e.g. it shows your heart beat on a screen<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy | |
| **2** | **3 - 4** | • a simple explanation e.g. it shows if your heart is working properly by measuring heart beat which you can see on a screen<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy | |
| **3** | **5 - 6** | • a detailed explanation e.g. connects electrodes/wires on the skin to measure (electrical) signals of the heart in order to assess the heart beat/heart performance/heart condition<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors | |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6 (a)(i)** | volume in range 9.0 – 10.5 ($cm^3$) (1)<br>pressure in range 1.5 – 1.7 (kPa) (1) | | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6 (a)(ii)** | ☒ **D** 296 K | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6 (a)(iii)** | Volume in range 4 – 8 ($cm^3$) | Any value between 4 ($cm^3$) and 8 ($cm^3$) | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **6 (a)(iv)** | Substitution (1)<br>2.2 x 10.8 ÷ 0.2<br><br>Evaluation (1)<br>119 ($cm^3$) | <br><br><br>118.8 ($cm^3$)<br><br>give full marks for the correct answer, no working | **(2)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | ***6(b)** | An explanation including some of the following points:<br><br>particles in gas<br>• move rapidly<br>• throughout container<br>• collide with each other<br>• collide with walls/lid of container<br>• exerting a force<br><br>particles in solid<br>• in fixed positions<br>• vibrate<br>• do not reach lid | **(6)** |
| **Level** | **0** | No rewardable content | |
| **1** | **1 - 2** | • a limited explanation e.g. particles in the copper do not touch the lid / particles in the oxygen do touch the lid<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy | |
| **2** | **3 - 4** | • a simple explanation e.g. particles in a gas can move freely and collide with the lid<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy | |
| **3** | **5 - 6** | • a detailed explanation e.g. particles in a gas can move freely and collide with the lid but particles in a solid vibrate about fixed positions so cannot reach the lid<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors | |

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