Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number	Candidate Number

Physics

Unit P3: Applications of Physics

Higher Tier

Friday 23 June 2017 – Morning
Time: 1 hour

Paper Reference
5PH3H/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 ▶

FORMULAE

You may find the following formulae useful.

energy = mass × (speed of light)^2	$E = mc^2$
intensity = $\frac{\text{power of incident radiation}}{\text{area}}$	$I = \frac{P}{A}$
power of lens = $\frac{1}{\text{focal length}}$	
The relationship between focal length, object and image distance	$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$
current = number of particles per second × charge on each particle	$I = Nq$
kinetic energy = electronic charge × accelerating potential difference	$KE = ½ mv^2 = e \times V$
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	$V_1 P_1 = V_2 P_2$
The relationship between the volume, pressure and temperature for a gas	$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

P 4 8 8 0 5 A 0 2 1 6

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BLANK PAGE

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 ☒.

Using a lens to aid vision

1 A coin collector looks at the detail of a pound coin through a converging lens (magnifying glass).

(a) The focal length of the lens is 10 cm.

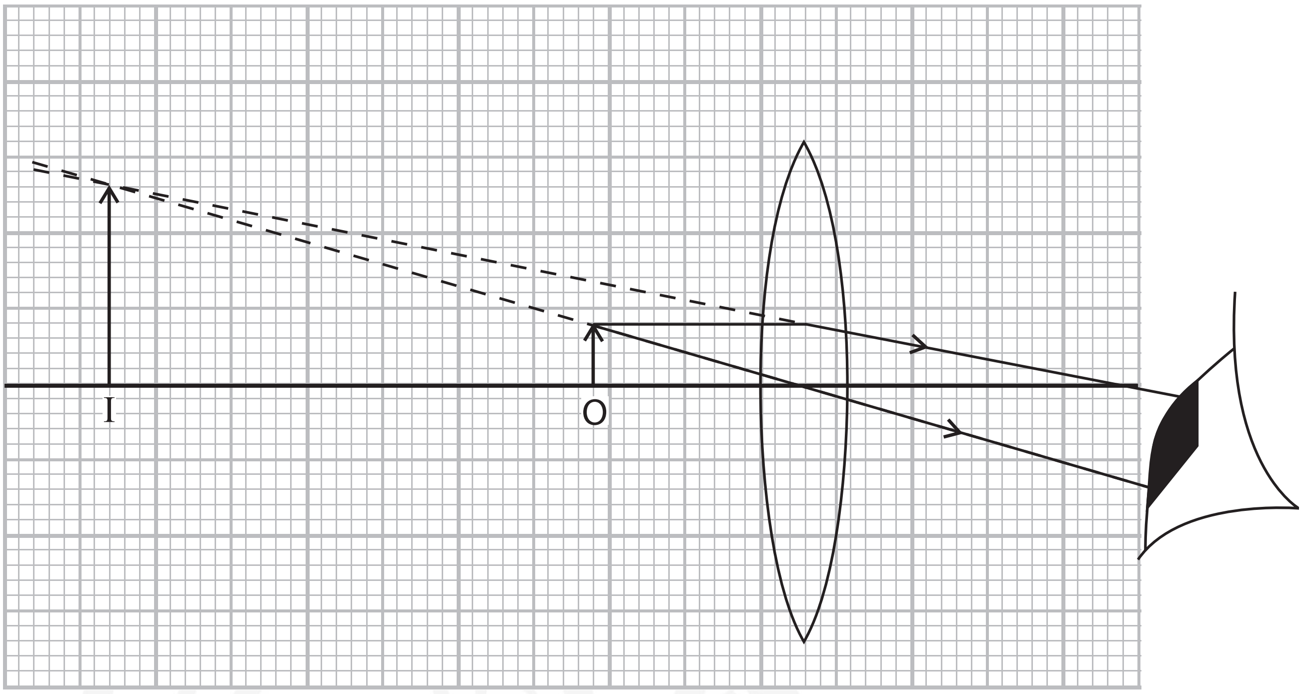
Calculate the power of the lens.

State the unit.

(4)

power = ... unit ....

(b) A scale ray diagram of how the collector uses the magnifying lens to see the coin is shown.



(i) Mark and label the focal length of the lens on the diagram.

(1)

(ii) Use the drawing to calculate the magnification produced by the lens.

(2)

magnification = ...

(iii) The image distance, in this case, should be negative.

What does this tell you about the image?

(1)

....

....

(Total for Question 1 = 8 marks)

Uses and dangers of ionising radiation

2 Radioactive sources are used in hospitals for both diagnosis and treatment of medical conditions.

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

(1)

Exposure of patients to ionising radiation will

☒ **A** decrease the probability of causing mutation of DNA in cells

☒ **B** always cause burns

☒ **C** never cause mutation of DNA in cells

☒ **D** increase the probability of causing mutation of DNA in cells

(b) Describe ways that medical staff can be protected from exposure to ionising radiation.

(3)

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(c) Explain how cancer tumours can be treated using a radiation source placed inside the patient.

(3)

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(d) The isotope Tc-99m has these properties

- it is a gamma emitter
- it has a half-life of 6.03 hours

Doctors sometimes inject patients with this isotope to diagnose kidney problems.

Explain why the properties of the isotope make it suitable as a tracer.

(2)

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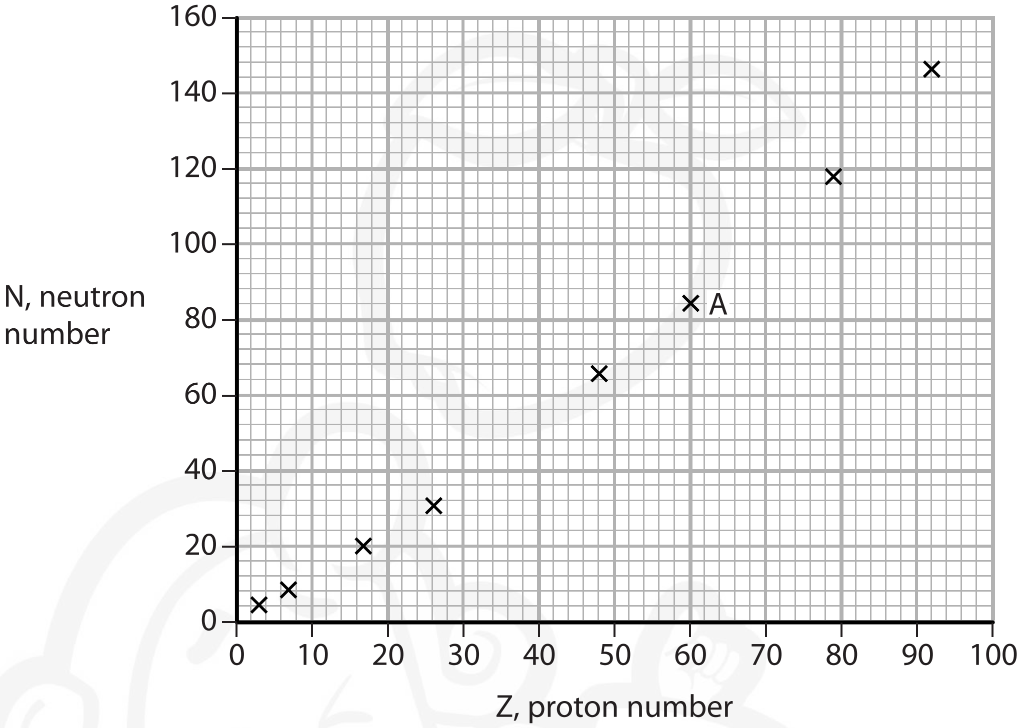
(Total for Question 2 = 9 marks)

Radioactivity

3 (a) The graph shows a plot of N, neutron number, against Z, proton number, for 8 **stable** nuclei.



(i) One of the nuclei is marked A on the graph.
Complete the symbol for the nucleus A.

(2)

$$\frac{\underline{\quad\quad}}{\underline{\quad\quad}}\text{A}$$

(ii) Two other stable nuclei have the following properties.

Nucleus	Proton number	Neutron number
Hafnium	72	108
Yttrium	39	50

Plot the points on the graph that represent these two nuclei.

(2)

(iii) Draw a best fit curve.

(1)

P 4 8 8 0 5 A 0 8 1 6

(b) State where a beta-minus particle emitter lies in relation to the curve.

(1)

....

....

(c) Which of the following statements is correct about β^+ decay?

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

(1)

β^+ decay involves a

☐ **A** neutron becoming a proton and an electron

☐ **B** neutron becoming a proton and a positron

☐ **C** proton becoming a neutron and an electron

☐ **D** proton becoming a neutron and a positron

(d) Protons and neutrons are made of quarks.

Draw the arrangement of quarks in a proton and a neutron using 'u' for up quarks and 'd' for down quarks.

(2)

NEUTRON

PROTON

(Total for Question 3 = 9 marks)

Kinetic theory and the gas laws

4 Kinetic theory describes the behaviour of particles in solids, liquids and gases.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer. **(1)**

In the liquid state, particles are

☐ **A** a long way apart

☐ **B** can move past each other

☐ **C** in a regular pattern

☐ **D** stationary

(b) Gases are stored in cylinders at high pressure for use in hospitals.

(i) Explain how the gas in the cylinder exerts pressure. **(3)**

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(ii) Explain why the pressure of the gas inside the cylinder increases if the cylinder gets hot. **(2)**

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(c) The diagram shows a diver using a gas bottle to provide air for a dive 50 m below the surface of the sea.

When the diver breathes out, small bubbles of air are produced that rise to the surface.

Every 10 m increase in the depth of seawater gives an increase of pressure of 101 kPa.

Normal atmospheric pressure at the surface is 101 kPa.

(i) Show that the pressure at a depth of 50 m is about 6×10^5 Pa.

(1)

(ii) As the diver breathes out, bubbles are produced.
At a depth of 50 m, one particular bubble has a volume of 1.25×10^{-6} m^3.

Calculate the volume of this bubble when it reaches the surface.
Assume that the temperature of the bubble remains constant and that it doesn't lose or gain any molecules in the process.

(3)

volume of bubble at the surface = ... m^3

(Total for Question 4 = 10 marks)

Optical fibres and ultrasound

5 (a) State one medical use for optical fibres.

(1)

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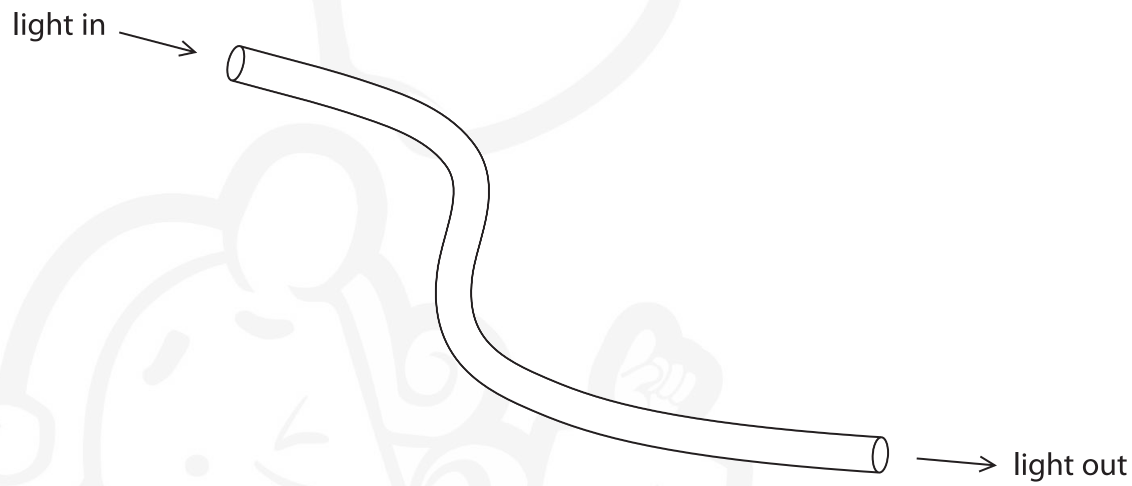
(b) Light is shone down an optical fibre as shown.



The intensity of the light coming out of the fibre is 5.0 W/m^2.

(i) 1% of the intensity is lost as it travels through the fibre.

Calculate the intensity of the light as it enters the fibre.

(1)

intensity = ... W/m^2

(ii) The cross-sectional area of the fibre is $6.2 \times 10^{-7} m^2$.

Calculate the power of the light as it comes out of the fibre.

(3)

power = ... W

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

(1)

Intensity of light decreases as it travels down an optical fibre cable because

☒ **A** light obeys an inverse square law

☒ **B** light obeys Snell's law about refraction

☒ **C** light slows down as it travels through the fibre

☒ **D** light scatters off impurity atoms at a wide range of angles *(c) Ultrasound is used in hospitals.

Describe how ultrasound is used to produce scans for diagnosis and also to treat some medical conditions.

(6)

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(Total for Question 5 = 12 marks)

Cyclotrons and PET scanners

6 Cyclotrons produce fast-moving charged particles.

(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer. **(1)**

A cyclotron makes protons move in a spiral because there is a

☐ **A** force away from the centre of the circle due to an electric field

☐ **B** force away from the centre of the circle due to a magnetic field

☐ **C** force towards the centre of the circle due to an electric field

☐ **D** force towards the centre of the circle due to a magnetic field

(ii) State what is used to accelerate the protons across the gap in the cyclotron. **(1)**

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(iii) Suggest why a neutron cannot be accelerated in a cyclotron. **(1)**

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(iv) Describe how the fast-moving protons are used to produce radioactive nuclei. **(3)**

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P 4 8 8 0 5 A 0 1 5 1 6

*(b) The radioactive isotope fluorine-18 emits beta-plus particles.

This isotope is used in PET (Positron Emission Tomography) scans.

Fluorine-18 is attached to a glucose molecule, injected into a patient and gets to the site of a tumour.

Explain how gamma rays are then produced and detected to enable the position of a tumour to be located.

You may draw a diagram if it helps your answer.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS