Write your name here

Surname	Other names

Centre Number | | | | | |

Candidate Number | | | | |

Edexcel GCSE

Physics

Unit P3: Applications of Physics

Higher Tier

Wednesday 5 June 2013 – Afternoon
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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P41947A

1/1/1/1/1/1/

P 4 1 9 4 7 A 0 1 1 6

PEARSON

FORMULAE

You may find the following formulae useful.

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

Answer ALL questions

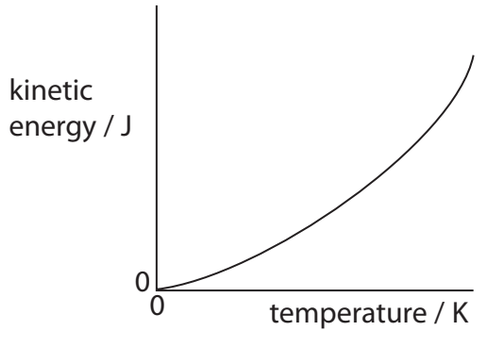
Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Gas cylinders

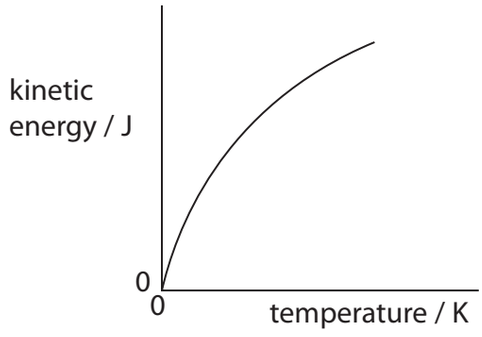
1 (a) Which graph shows the way in which the average kinetic energy of the molecules of a gas changes with temperature?

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

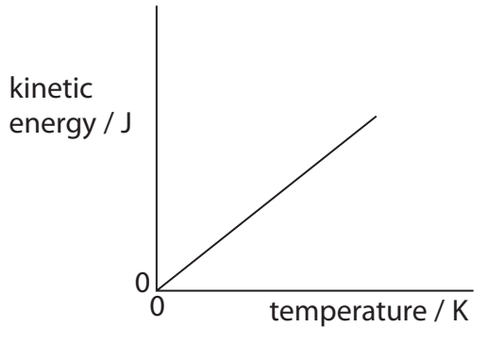
(1)



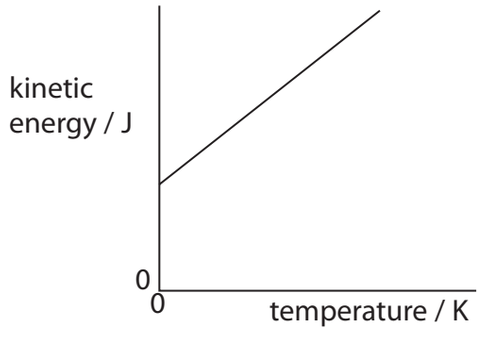
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(b) The photograph shows a scuba diver.
She can breathe under water because she carries a cylinder of air on her back.

(i) The air molecules in the cylinder move randomly.
Describe how these air molecules exert a pressure on the cylinder.

(2)

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(ii) The cylinder contains air at a pressure of 21 000 kPa.

The volume of air in the cylinder is 15.0 litres.
When the valve on the cylinder is opened, the air expands until its pressure is 100 kPa.
The temperature of the air does not change.

Show that the new volume of air is about 3 200 litres.

(2)

(iii) The cylinder is filled with air in a hot country and then taken to a cold country.

The temperature in the hot country is 305 K.
The temperature in the cold country is 278 K.
The pressure in the cylinder in the hot country is 21 000 kPa.

Calculate the pressure in the cylinder in the cold country.

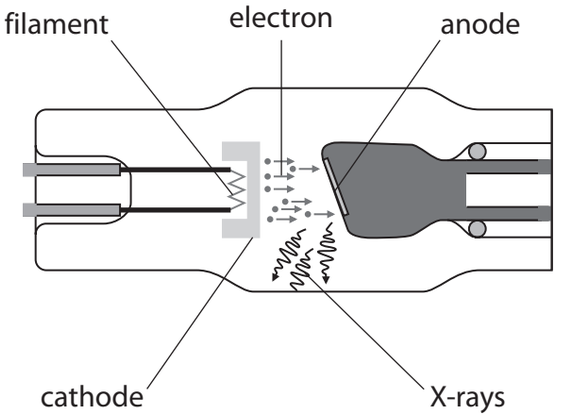
(3)

pressure in the cylinder in the cold country = ... kPa

(Total for Question 1 = 8 marks)

X-rays

2 (a) The diagram shows X-rays being produced when fast moving electrons hit a metal target.



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

The X-rays that have most energy have the

(1)

☒ **A** greatest mass

☒ **B** highest frequency

☒ **C** highest speed

☒ **D** longest wavelength

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

Electrons travel to the target because it is

(1)

☒ **A** magnetised

☒ **B** negatively charged

☒ **C** neutral

☒ **D** positively charged

(iii) Explain what is meant by **thermionic emission**.

(2)

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(iv) Suggest why there must be a vacuum in the glass tube.

(1)

.....

.....

(b) The potential difference between the filament and metal target in an X-ray tube is 40 kV.
The charge on an electron is 1.6×10^{-19} C and its mass is 9.1×10^{-31} kg.

Calculate the speed of an electron as it reaches the target.

(3)

speed of electron = ... m/s

(Total for Question 2 = 8 marks)

Ionising radiations

3 Ionising radiations are emitted by unstable nuclei.

(a) (i) Which particle has the same mass as but opposite charge to a β^+ particle?

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

(1)

☒ **A** electron

☒ **B** positron

☒ **C** proton

☒ **D** neutron

(ii) Suggest why a beta particle will travel further in air than an alpha particle.

(2)

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

Following the radioactive decay of a nucleus, the nucleus might undergo some rearrangement, losing energy as

(1)

☒ **A** gamma radiation

☒ **B** a proton

☒ **C** a neutron

☒ **D** an X-ray

(c) Some unstable nuclei decay by emitting β^- radiation.

(i) Describe the process of β^- emission.

(3)

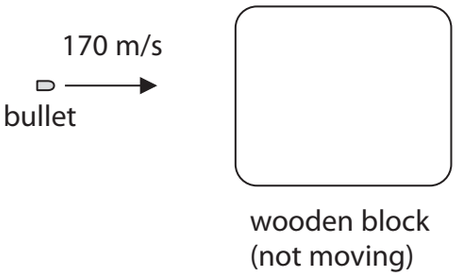
(ii) Explain what happens to the mass number and the atomic number of a nucleus when β^- emission occurs.

(3)

(Total for Question 3 = 10 marks)

Collisions

4 (a) The diagram shows a bullet moving towards a wooden block.



(i) The bullet is moving with a velocity of 170 m/s.
The mass of the bullet is 0.030 kg.

Show that the momentum of the bullet is about 5.0 kg m/s.

(1)

(ii) The bullet collides with the wooden block and sticks in it.
The bullet and the wooden block move off together.
The mass of the wooden block is 0.80 kg.

Calculate the velocity of the wooden block and bullet immediately after the collision.

(3)

velocity = ... m/s

(iii) The collision between the bullet and the wooden block is an inelastic collision.

State what is meant by an **inelastic collision**.

(2)

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(b) An electron and a positron collide and annihilate each other.
Two photons are produced.

(i) Explain why two photons must be produced, rather than just one.

(2)

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(ii) Calculate the minimum total energy of the photons produced when an electron and positron collide.

Use the equation

$$E = mc^2$$

mass of an electron = 9.1×10^{-31} kg
speed of light = 3.0×10^8 m/s

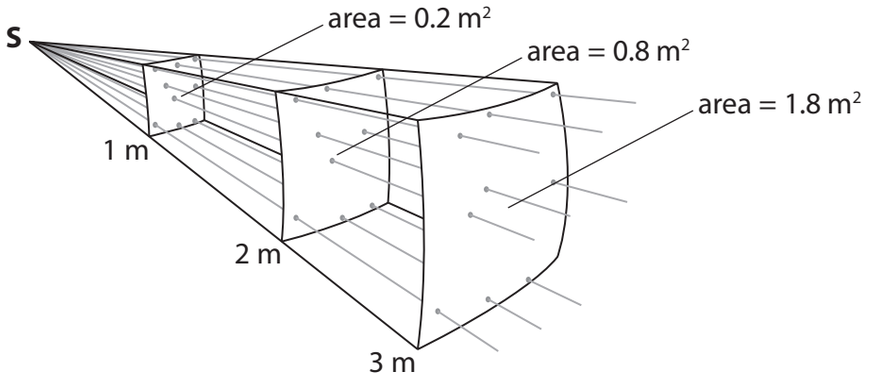
(2)

energy = ... J

(Total for Question 4 = 10 marks)

Uses of radiation

5 The diagram shows light from a point source, **S**, spreading out as it gets further from **S**.



(a) The intensity of light passing through the surface which is 1 m from **S** is 2.5 W/m².

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

The intensity of light, in W/m², passing through the surface which is 2 m from **S** is

(1)

☒ **A** $2.5 \div 2$

☒ **B** $2.5 \div 4$

☒ **C** 2.5×2

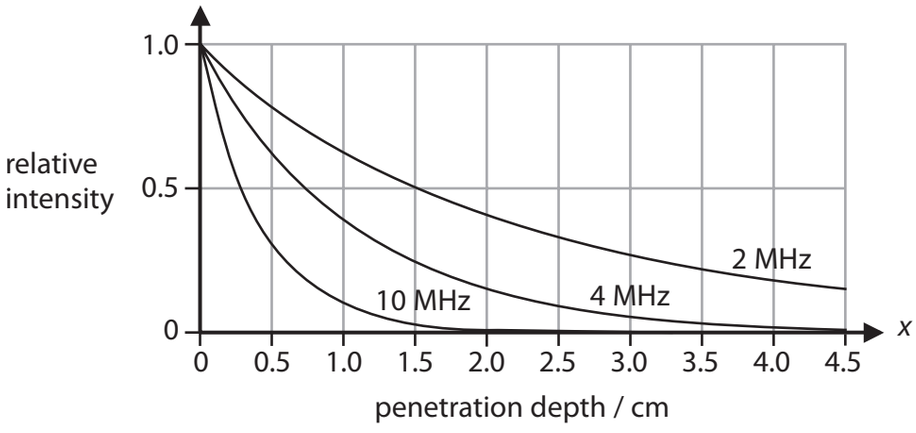
☒ **D** 2.5×4

(ii) Calculate the power of the light passing through the surface which is 1m from **S**.

(2)

power = ... W

(b) The graph shows how the intensity of ultrasound waves of different frequencies decreases as they penetrate soft tissue.



(i) Estimate how far a 2 MHz wave has penetrated into the soft tissue when its intensity is 25% of its original value.

(1)

penetration depth = ... cm

(ii) Explain which of these frequencies of ultrasound can be used to scan organs deep inside the body.

(2)

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.....

*(c) Medical physicists have developed endoscopes and many other devices to help doctors diagnose medical problems.

Compare the use of electromagnetic radiation in endoscopes and in one other diagnostic device.

(6)

(Total for Question 5 = 12 marks)

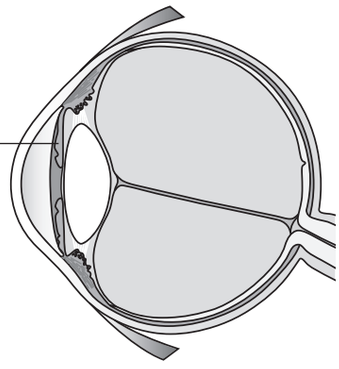
Defects of vision

6 (a) The diagram shows a human eye.

(i) Label part **X**.

(1)

X is .....



(ii) State the names of **two** parts of the eye that focus the light.

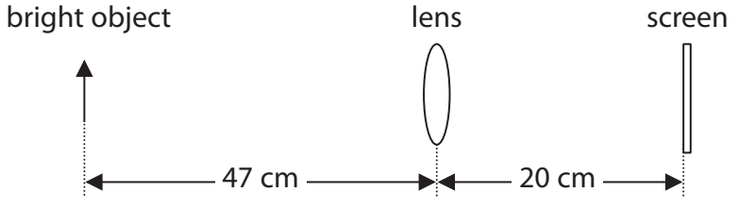
(2)

1 .....

2 .....

(b) A bright object is placed 47 cm away from a lens as shown in the diagram.

A real image of the bright object is seen on a screen which is 20 cm away from the lens as shown.



Not to scale

Calculate the focal length of the lens.

(3)

focal length = ... cm

*(c) Long sight and short sight are two defects of vision.

Explain how long sight and short sight are different from normal sight and how one of these defects can be corrected.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS