Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						5	0	4	9	/	0	1	Signature	

Paper Reference(s)

5049/01

Edexcel GCSE

Physics

P3 – Topics 5 and 6

Wednesday 10 June 2009 – Afternoon

Time: 1 hour

Examiner's use only

Team Leader's use only

Materials required for examination
Calculator

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Do not use pencil. Use blue or black ink.
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 (☒).
Show all stages in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 9 questions in this question paper. The total mark for this paper is 60.
There are 20 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Printer's Log. No.
N34063A
W850/R1536/57570 7/4/4/2/

N 3 4 0 6 3 A 0 1 2 0

Turn over

edexcel
advancing learning, changing lives

FORMULAE

You may find the following formulae useful.

$$\frac{\text{pressure}}{\text{temperature (Kelvin)}} = \text{constant} \qquad \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{\text{pressure} \times \text{volume}}{\text{temperature (Kelvin)}} = \text{constant} \qquad \frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$$

kinetic energy = electronic charge × accelerating voltage $\qquad KE = e \times V$

work done = force × distance moved in the direction of the force $\qquad W = F \times s$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{W}{t}$$

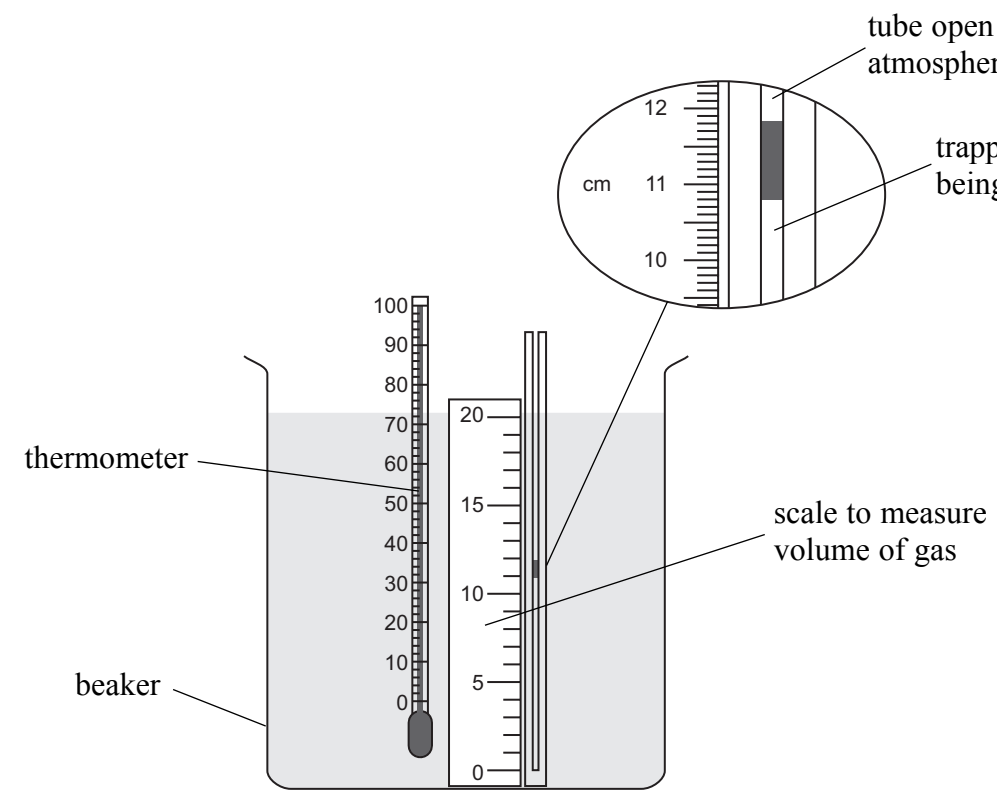
$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

$$\text{intensity} = \frac{\text{power of incident radiation}}{\text{area}} \qquad I = \frac{P}{A}$$

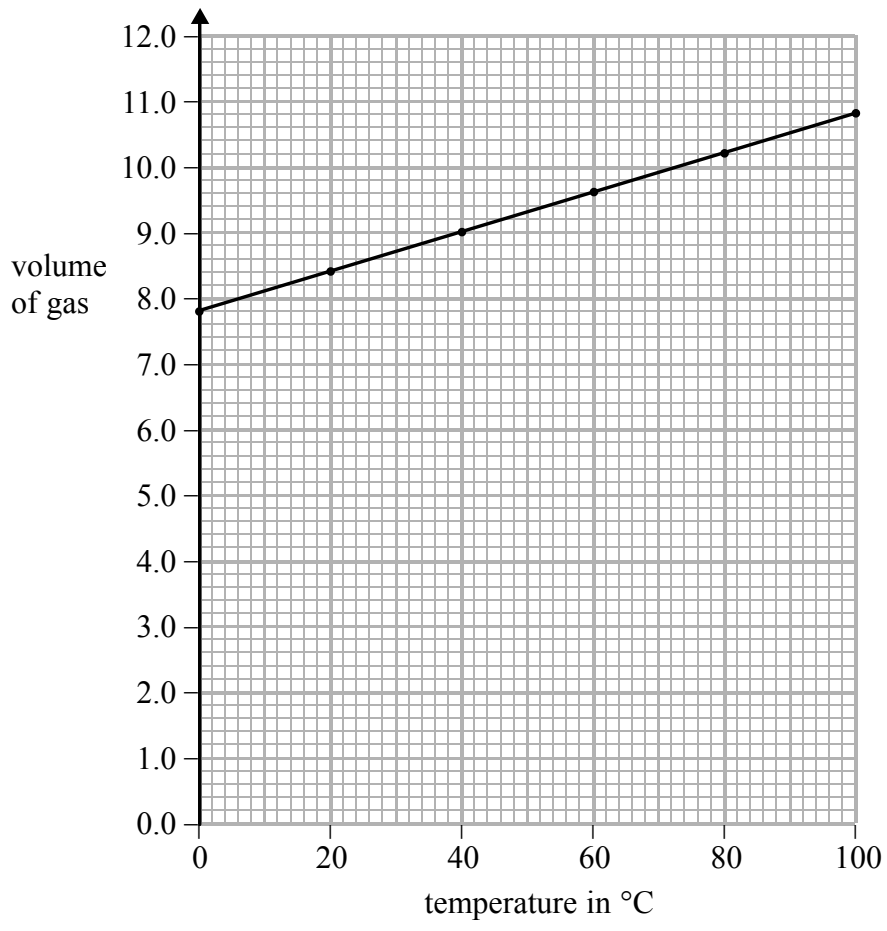
TURN OVER FOR QUESTION 1

Leave blank

1. Zoë is investigating what happens to the volume of a gas when its temperature is increased.
The diagrams show the equipment that she uses.



The graph shows her results.



Leave blank

(a) Tick (✓) the **three** statements that are true for Zoë's investigation.

statement	true?
as the temperature increases the volume increases	
as the temperature increases the pressure increases	
the mass of the gas is constant	
the pressure of the gas is constant	
when the temperature in °C doubles the volume doubles	

(3)

(b) Complete each sentence below by putting a cross (☒) in the correct box.

(i) When a gas is heated its particles
- **slow down.** ☒
- **speed up.** ☒
- **stay at constant speed.** ☒

(1)

(ii) When a gas is heated its particles hit the walls of the container
- **less frequently.** ☒
- **more frequently.** ☒
- **with less force.** ☒

(1)

(iii) The kinetic energy of the particles of a gas is directly proportional to
- **the temperature in °C.** ☒
- **the temperature in K.** ☒
- **the pressure in kPa.** ☒

(1)

(c) State the value of 100 °C in kelvin.

100 °C = ...K

(1)

(d) What happens to the movement of particles when the temperature is absolute zero?

.....

.....

(1)

Q1

(Total 8 marks)

Leave blank

2. Many people are confused by how CAT (computer aided tomography) and PET (positron emission tomography) scanners work.

In a CAT scanner

- many X-ray images are taken around a horizontal axis, each at a slightly different angle
- a computer puts all the images together
- a 3-D image is produced

The following sentences explain how a PET scanner works.
The sentences are in the wrong order.
Put them into the correct order by numbering the boxes.
Some have been done for you.

action	order
Two gamma rays are produced.	
The radioactive isotope emits positrons.	2
Gamma rays are detected.	
A computer puts the images together.	
Positrons annihilate electrons.	3
A 3-D image is produced.	7
The patient is injected with a radioactive isotope.	

Q2

(Total 3 marks)

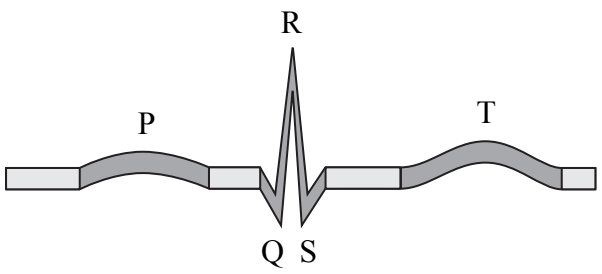
Leave blank

3. (a) What does an electrocardiogram (ECG) measure?

.....

(1)

(b) The diagram represents the ECG of a normal heart.



P, QRS and T are three sections of the ECG.
Identify the action of the heart muscles at each section.
Draw a line from each box at the top to the correct box at the bottom.

P	QRS	T
atria contract	recovery wave	ventricles contract

(2)

(c) The diagrams below show the ECGs of people with different heart conditions.
All these diagrams have the same scale.
The first one shows a normal heart beat.

Explain what each of the other ECGs show.

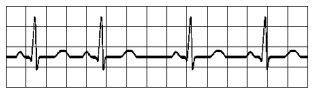
The heart is beating with a normal rhythm.

.....

.....

.....

.....



.....

.....

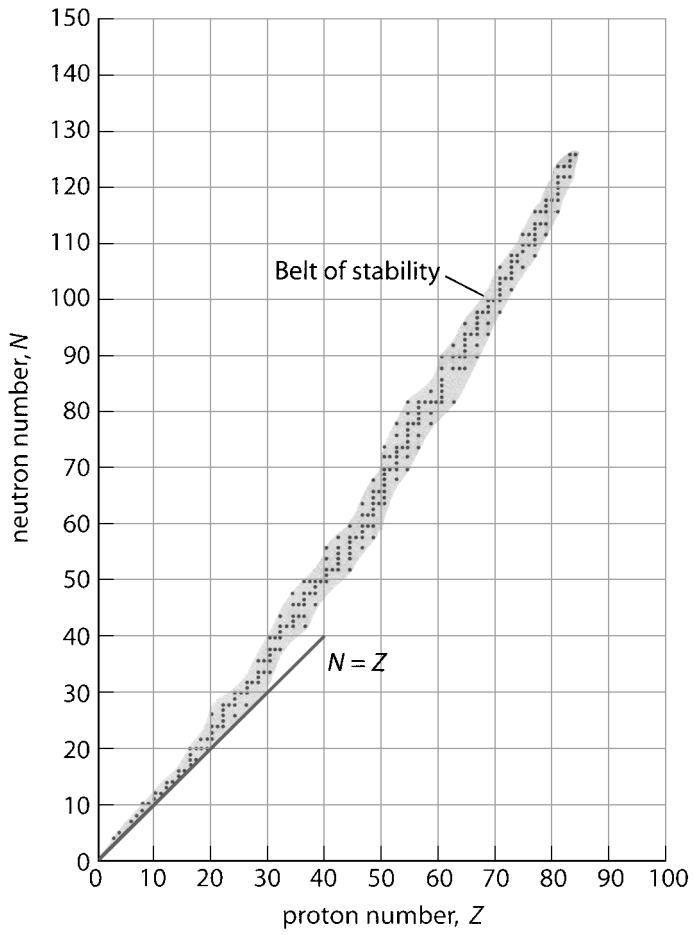
(3)

Q3

(Total 6 marks)

Leave blank

4. The graph shows the number of neutrons plotted against the number of protons for the nuclei of stable isotopes.



(a) Add letters to the graph to show the positions of unstable isotopes which emit the following radiations.

(i) alpha particles – use a letter A

(ii) β^- (beta-minus) particles – use a letter B

(iii) positrons – use a letter P

(3)

Leave blank

(b) Sulphur-38 decays by emitting a **beta-minus** particle and a gamma ray to form an isotope of chlorine.
Complete the nuclear equation for this decay, by filling in all the boxes.

$$^{38}_{16}\mathrm{S} \longrightarrow \square\ \mathrm{Cl} \quad + \quad \square\ \beta \quad + \quad \square\ \gamma$$

(2)

(c) Explain what is happening to

(i) a nucleus during gamma decay,

.....

.....

(ii) a nucleus during β^- (beta-minus) decay,

.....

.....

(iii) the quarks during β^- (beta-minus) decay.

.....

.....

(3)

(d) Name a fundamental particle involved in β^- (beta-minus) decay.

.....

.....

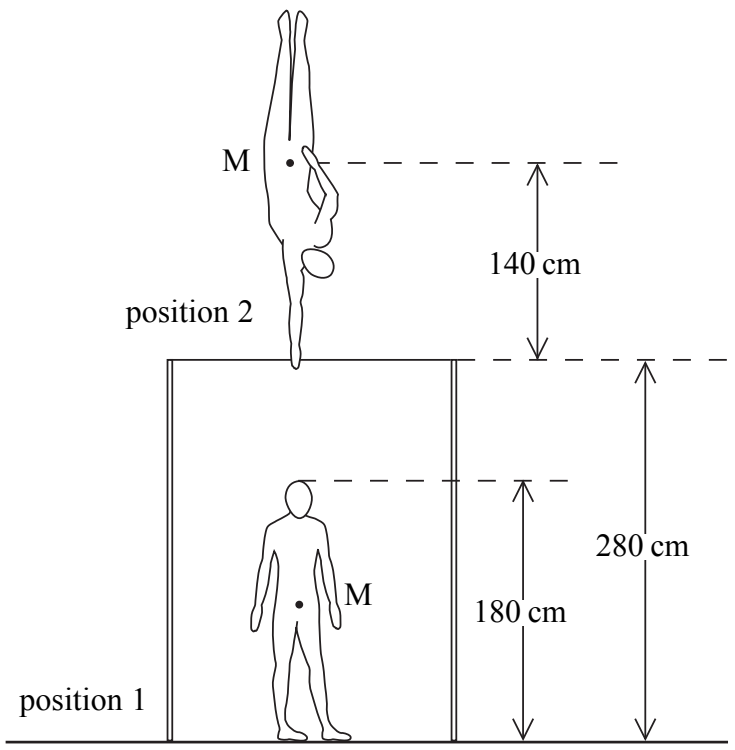
(1)

Q4

(Total 9 marks)

Leave blank

5. Adam Cox is a British gymnast.
His weight is 805 N.
The photograph shows him performing on the High Bar.



Using the information given in the diagram, calculate the work that Adam does to raise his weight from position 1 to position 2.
State the unit of your answer.
You should consider that his weight acts at point M.
In position 1, point M is 90 cm above the floor level.

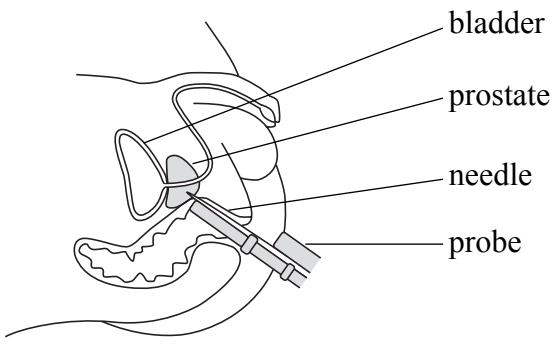
work done = ...

(Total 3 marks)

Q5

Leave blank

6. Cameron has prostate cancer. The diagram below shows the position of the prostate gland in a man.



(a) Cameron's consultant takes samples of the tumour.
He uses an ultrasound probe to guide his needle.

(i) What is ultrasound radiation?

.....

.....

(1)

(ii) Using ultrasound instead of X-rays to locate the tumour can be better for both Cameron and his consultant.

1. Suggest **one** advantage for Cameron.

.....

.....

2. Suggest **one** advantage for the consultant.

.....

.....

(2)

QUESTION 6 CONTINUES OVERLEAF

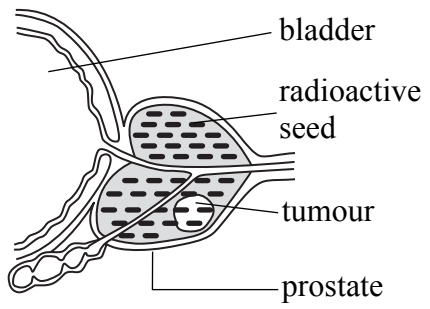
Leave blank

(b) The tests show that Cameron's tumour is small.
The consultant explains that there are two possible treatments.

Method 1

- Radioactive 'seeds', the size of rice grains are placed into the tumour and left there.
- The operation is done only once.
- This method has been in use for over 15 years.

Where the seeds go in the prostate



(i) Which of these radiation source types are suitable to use for the 'seeds'?
Tick (✓) all the correct answers.

source type	suitable for the 'seeds'?
alpha	
beta	
gamma	
neutron	
photon	

(1)

(ii) Explain the reason for your choice(s).

.....

.....

(1)

(iii) State and explain **two** other properties of the source that should be considered.

1 .....

.....

2 .....

.....

(3)

Leave blank

(iv)

Method 2

- Flexible tubes are placed into the tumour and the surrounding area.
- A computer then controls the movement of radioactive rods into and out of the tumour.
- This is repeated 3 times with 8 hour gaps.
- The tubes are then removed.
- This method has been in use for the last 5 years.

The radioactive rods are moved at different rates in each of the tubes.
As it nears the tumour, each radioactive rod moves more slowly.
Explain in terms of **intensity** of radiation reaching the tumour why this is done.

.....

.....

.....

.....

(3)

(c) Cameron decides on method 2.
This method requires a longer stay in hospital.
There is no data available about the long term success of this method.
State an advantage and a disadvantage of **newer** treatments.

Advantage .....

.....

.....

Disadvantage .....

.....

.....

(2)

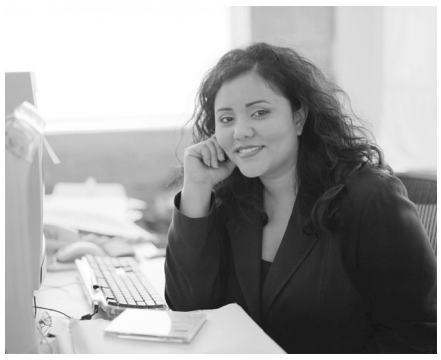
(Total 13 marks)

Q6

BLANK PAGE

Leave blank

7. Mei-li works on engine design in a specialist combustion laboratory.
Her job involves testing different fuel-air mixtures.
She has to



- mix a fuel gas with air
- measure its temperature, volume and pressure
- compress the mixture
- measure its temperature, volume and pressure just before ignition.

These are her results.

	before	**after**
pressure	1.01×10^5 Pa	23.8×10^5 Pa
volume	14 dl	2 dl
temperature	27 °C	

Calculate the temperature of the mixture just before it ignites and state its unit.

Temperature = ...

Q7

(Total 4 marks)

Leave blank

8. Radioactive isotopes can be used to trace the spread of bone tumours.
The patient is injected with an isotope that collects in areas where bone cells are active.
The patient is monitored over the next 8 hours.

(a) Explain why isotopes which emit gamma radiation are used as tracers.

.....

.....

(1)

(b) The table gives data on isotopes which emit gamma radiation.

isotope	half-life	energy of each gamma ray in keV
barium-137	2.55 min	662
iodine-125	59.4 days	35
iridium-192	73.8 days	704
technetium-99	6.01 hour	143

From the table, choose an isotope that can be used as a tracer for bone cancer.

Isotope = ...

Explain the reasons for your choice.

Reason 1 .....

.....

.....

Reason 2 .....

.....

.....

(2)

Leave blank

(c) When cancer has spread to the bone, it is often only possible to give palliative care.

(i) Explain what is meant by palliative care.

.....

.....

(1)

(ii) The normal palliative care consists of injections of strontium-89 into the bloodstream.
This isotope is made by bombarding strontium with neutrons.
Complete the nuclear reaction for this.

$$\square\!\square Sr + \square\!\square n \rightarrow {}^{89}_{38}Sr$$

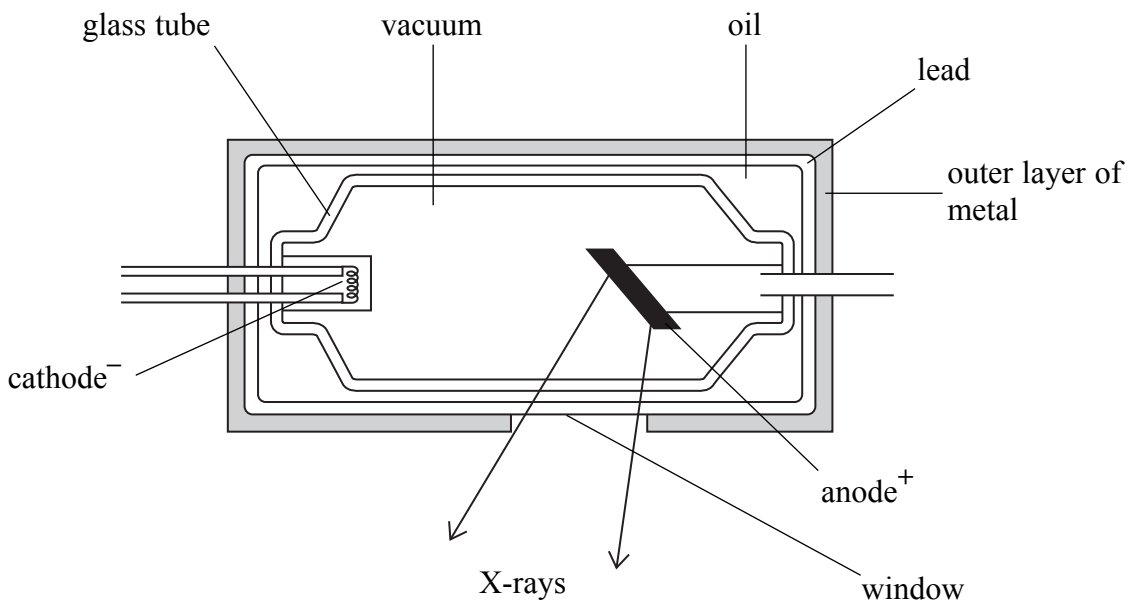
(2)

Q8

(Total 6 marks)

Leave blank

9. The diagram shows an X-ray tube.



(a) State the name of the process by which electrons are released from a hot cathode.

.....

(1)

(b) The voltage between the anode and the cathode is 10 000 V.

(i) State the effect this has on the electrons released at the cathode.

.....

.....

(1)

(ii) Calculate the kinetic energy of one of these electrons when it has reached the anode. The electronic charge, $e = 1.6 \times 10^{-19}$ C.
State its unit.

Answer .....

(3)

Leave blank

(c) 1.22×10^{18} electrons reach the anode in 10 s.
Show that this is equivalent to a current of about 20 mA.

(3) **Q9**

(Total 8 marks)

TOTAL FOR PAPER: 60 MARKS

END

BLANK PAGE