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

Friday 28 May 2010 – Morning

Time: 1 hour

Materials required for examination
Calculator

Items included with question papers
Nil

Examiner's use only

Team Leader's use only

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

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.
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 8 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.

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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 $\qquad W = F \times s$

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

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

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

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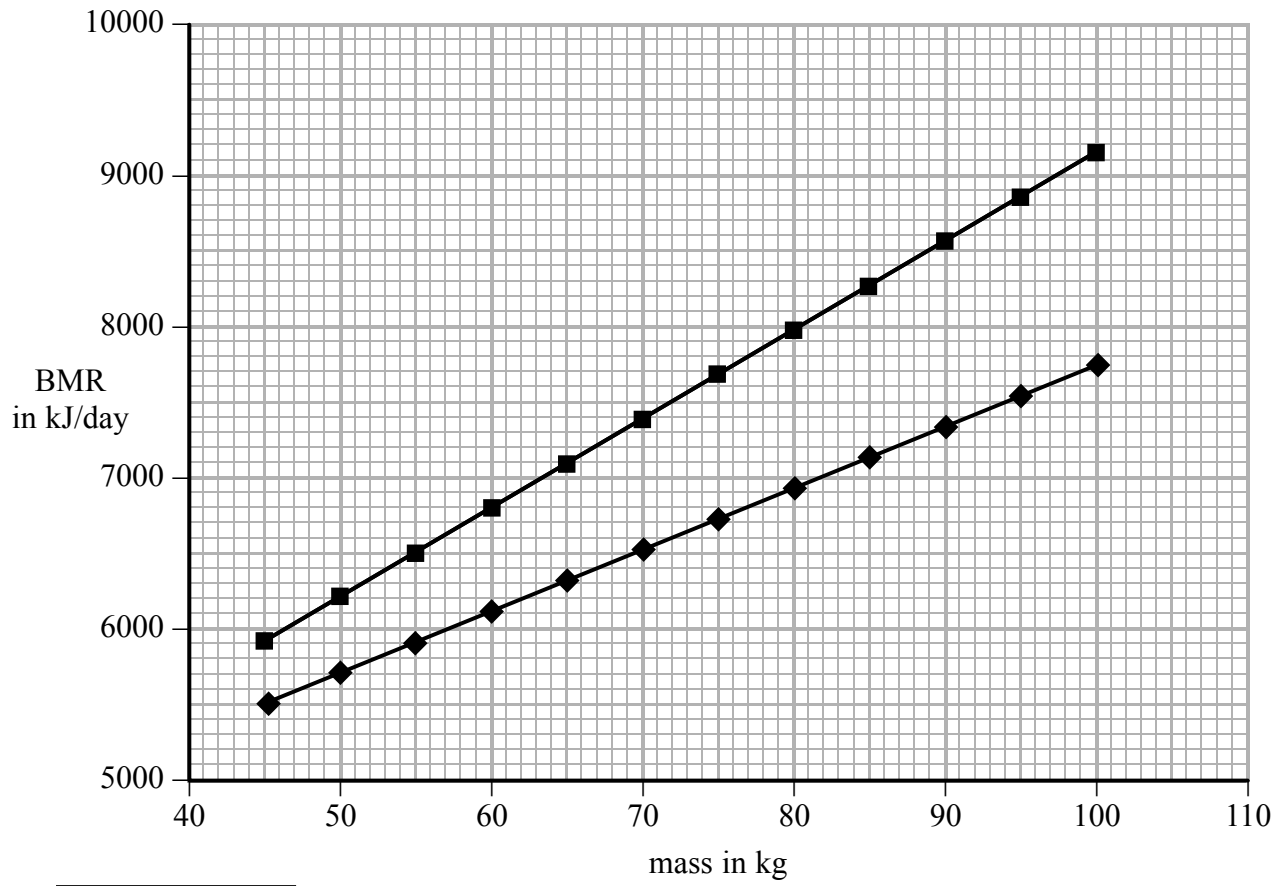
1. Tyron investigates his personal energy.
He finds this graph of BMR (basal metabolic rate) for students aged 16 years.



(a) (i) Explain what is meant by **BMR**.

.....

.....

(1)

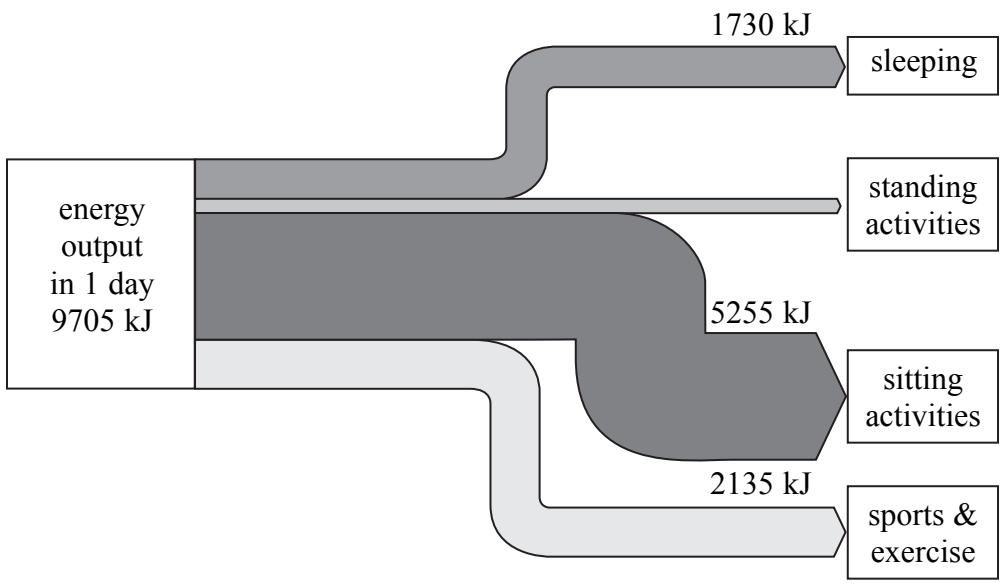
(ii) Tyron's mass is 55 kg.
Use the graph to find his BMR.

BMR = ...

(1)

Leave blank

(b) Tyron draws the following flow diagram showing his daily energy usage.

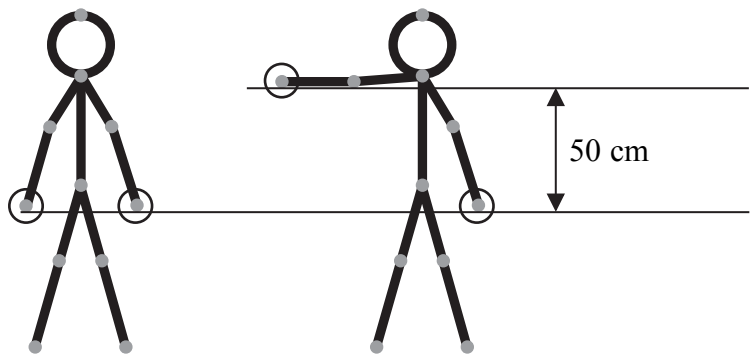


Calculate the energy he transfers into standing activities in one day.

Energy = ... kJ

(1)

(c) One exercise that Tyron does is called a ‘lateral raise’.
He lifts a 20 N dumb-bell up to shoulder height as shown.



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(i) Calculate the work done on the dumb-bell in one lateral raise.

Work done =..... J
(2)

(ii) The dumb-bell is lifted 15 times in 1 minute.
Calculate the power.
State the unit.

Power =.....
(3)

(d) Tyron's friend realises that he takes in more energy each day than his energy output.

(i) Suggest how this will affect him.

.....

.....
(1)

(ii) What **two** things can he do to avoid this happening?

Put only **one** tick (✓) to show what activity he should do more of.
Put only **one** tick (✓) to show what activity he should do less of.

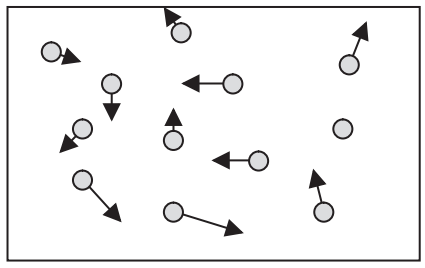
activity	do more of	do less of
eating		
sleeping		
standing activities		
sitting activities		
sports and exercise		

(2) **Q1**

(Total 11 marks)

Leave blank

2. This diagram shows a model of the particles in a gas.



Use words from the box to complete the following sentences.

absolute zero	backwards	colliding	faster
freezing point	kinetic	potential	reacting

Pressure is caused by the particles ..... with the walls of the container.

When a gas is heated, the particles move ..... .

Kelvin temperature is a measure of the average ..... energy of the particles.

The temperature at which the particles stop moving is called ..... .

(4) **Q2**

(Total 4 marks)

Leave blank

3. Scientists use many types of radiation.
Some radiations are particles, others are waves.

Draw one straight line from each of the following radiations to its description.

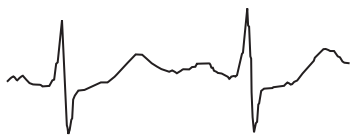
radiation	description
gamma	high frequency electromagnetic wave
neutron	particles with the same mass as an electron and the same charge
positron	particles with the same mass as an electron but the opposite charge
	particles with nearly the same mass as a proton but no charge

Q3

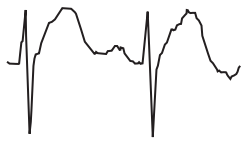
(Total 3 marks)

Leave blank

4. Marie complains of chest pains when exercising.
At the hospital, they monitor her heart before and during exercise.
The following graphs show her ECGs (electrocardiograms).



ECG before exercise



ECG during exercise

(a) Describe how these two ECGs show that Marie may have a problem during exercise.
You may add to the diagram if it helps your answer.

.....

.....

(1)

(b) Marie's doctor suspects that she has angina caused by narrowing of her arteries.
He sends her for an ultrasound scan.

(i) What is **ultrasound radiation**?

.....

.....

(1)

(ii) Explain the principle of an ultrasound scan.
You may draw a diagram if this helps your answer.

.....

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.....

.....

.....

(2)

Leave blank

(iii) Over exposure to X-rays is dangerous.
State another reason why an ultrasound scan is preferred to an X-ray photograph.

.....

.....

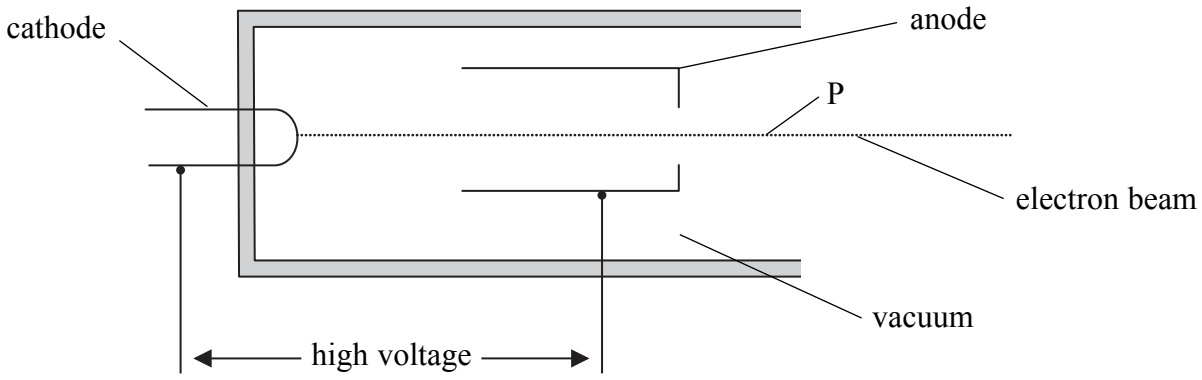
(1)

Q4

(Total 5 marks)

Leave blank

5. The diagram shows an arrangement for producing a beam of electrons.



(a) State one use for such a beam.

.....

(1)

(b) Why is the vacuum needed?

.....

.....

(1)

(c) Electrons come out of the cathode by a process called thermionic emission.

Explain what is meant by **thermionic emission**.

.....

.....

(1)

Leave blank

(d) Electronic charge, $e = 1.6 \times 10^{-19}$C.

(i) The voltage between the cathode and anode accelerates the electrons.
The kinetic energy of an electron as it leaves the anode is 3.2×10^{-15}J.

Calculate the voltage needed to accelerate an electron from rest to this energy.

Voltage = ... V
(3)

(ii) The number of electrons passing point P in 5.0 seconds is 6.3×10^{18}.

Calculate the current in the beam.

Current = ... A
(3)

Q5

(Total 9 marks)

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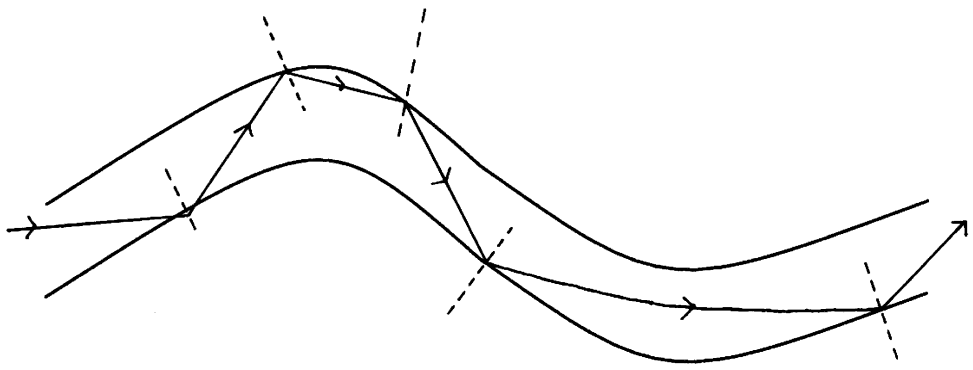
6. (a) Tyron was asked to draw a diagram to show a ray of light passing through an optical fibre.
He drew this diagram and it has several mistakes.



Circle **two** mistakes on Tyron's diagram.
Explain below what is wrong in each case.

Mistake 1 .....

.....

.....

Mistake 2 .....

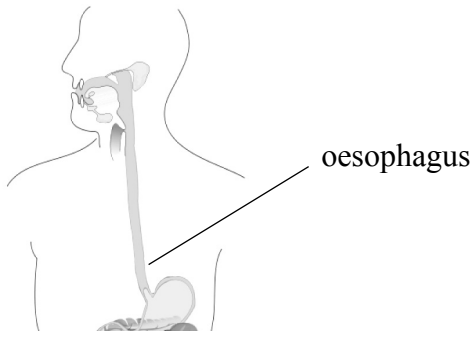
.....

.....

(2)

Leave blank

(b) Jack has a condition called 'Barrett's oesophagus'.
He has pre-cancerous cells at the bottom of his oesophagus.
His doctor wants to treat him using photodynamic therapy (PDT).



(i) In PDT, the patient is given a chemical called ALA which makes his cells very sensitive to light.
ALA is given either as a cream on the affected area or as an injection which affects the whole body.

Explain why, in Jack's case, the doctor gives him an injection of ALA and does not apply a cream.

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.....

(1)

(ii) ALA is absorbed more by pre-cancerous cells than by healthy cells.
When ALA is exposed to high-intensity long wavelength light, it releases oxygen as single atoms.
Single oxygen atoms are highly chemically reactive and destroy nearby cells.

The doctor gives the injection of ALA.

Use the information above to suggest how the doctor can use fibre optics to treat Jack's condition.
You could consider how to find and destroy the pre-cancerous cells and details of the light used in each stage.

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(3)

Leave blank

(iii) Suggest a precaution that Jack should take in the weeks following the ALA injection.
Explain your answer.

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(2)

Q6

(Total 8 marks)

Leave blank

7. (a) The symbol for a nucleus of radium-226 is

$$^{226}_{88}\mathrm{Ra}$$

Radium-226 is unstable.

What feature of the nucleus makes it likely to decay by alpha emission?

.....

.....

(2)

(b) Carbon-14 and carbon-12 are isotopes of carbon.

(i) Explain what is meant by **isotopes**.

.....

.....

(1)

(ii) The following nuclear equation shows that carbon-14 decays into nitrogen by emitting a beta particle (β).

1. What is a **beta particle**?

.....

(1)

$$^{14}_{6}\mathrm{C} \rightarrow {}^{14}_{7}\mathrm{N} + {}^{0}_{-1}\beta$$

2. Use this equation to help you explain why a neutron is not a fundamental particle.

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(3) **Q7**

(Total 7 marks)

Leave blank

8. Medical physicists try to find suitable radioactive isotopes for use in the diagnosis and treatment of cancer.

(a) A new treatment for cancer uses certain proteins that target cancer cells.
A radioactive isotope is attached onto these proteins.
The proteins are then injected into patients.

Suggest a benefit of this method compared to other methods of cancer treatment.

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.....

.....

(1)

(b) Lead-201(Pb-201) is made by bombarding thallium-203 (Tl-203) with protons.

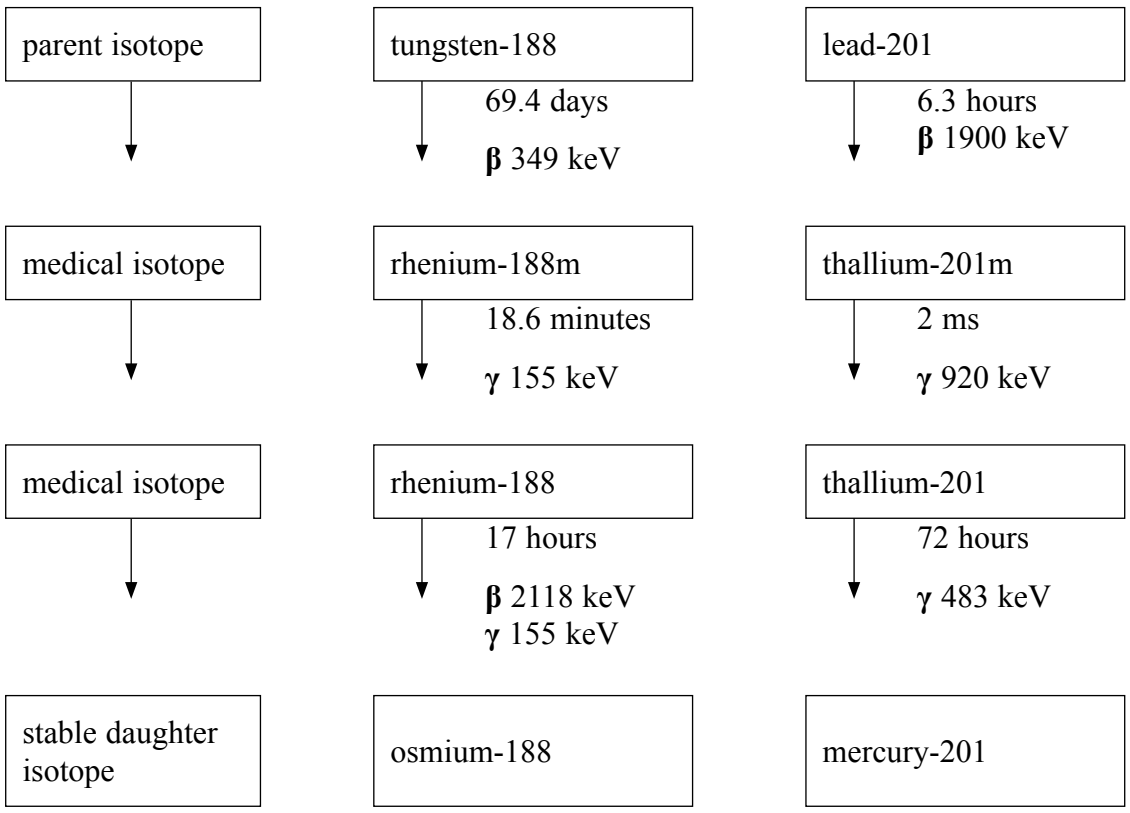
Complete the following nuclear equation for its formation.

$$^{203}_{\square}\mathrm{Tl} + ^{\square}_{\square}\mathrm{p} \longrightarrow ^{\square}_{82}\mathrm{Pb} \longrightarrow ^{201}_{82}\mathrm{Pb} + 3\,^{\square}_{\square}\mathrm{n}$$

(4)

Leave blank

(c) Two of the commonly used isotopes are rhenium-188 and thallium-201.
Their positions in the decay chains are shown below.



(i) Tungsten-188 is formed by irradiation with thermal neutrons.
Explain what is meant by **thermal neutrons**.

.....

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(1)

(ii) Rhenium-188m decays to rhenium-188 by gamma emission.
Explain what happens to the particles in the nucleus during this decay.

.....

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(1)

Leave blank

(iii) Compare the suitability of rhenium-188 and thallium-201 for diagnosis and treatment of cancer in terms of

1. their production, transport and storage

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2. their effectiveness for both diagnosis (location) and treatment

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(4)

(d) What precautions are needed to ensure the safety of medical personnel when using radioactive isotopes?

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(2)

Q8

(Total 13 marks)

TOTAL FOR PAPER: 60 MARKS

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