Rewarding Learning

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Physics

Paper 1
Foundation Tier

[G7602]

G7602

FRIDAY 15 JUNE, AFTERNOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Quality of written communication will be assessed in Question **5(b)(iii)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated with numerical answers where appropriate.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
Total Marks	

Examiner Only	
Marks	Remark

1 **(a)** The diagram shows one solar panel consisting of a number of sections.
The solar panel is made up of a number of photocells.
The photocells produce electricity directly from sunlight.
Solar panels are placed on the roof of a house.

© Zoonar / Thinkstock

On a cloudless summer day the solar power shining on the panel is 6000 W.

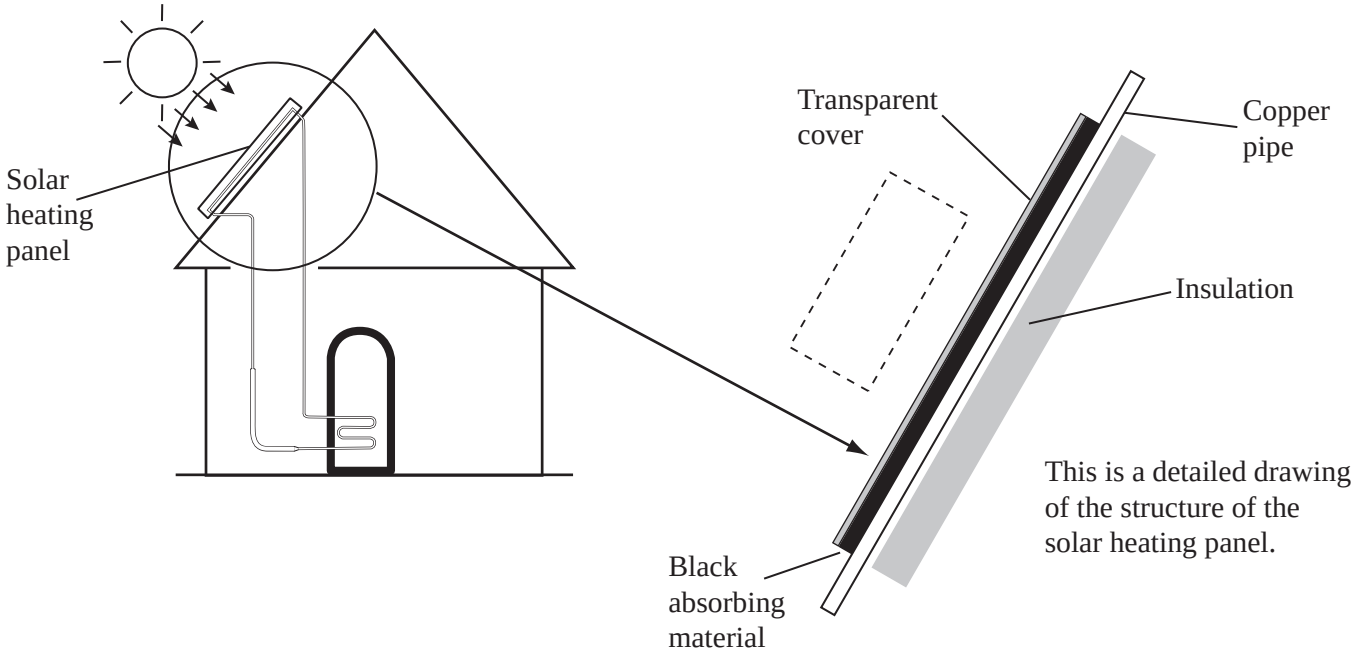
(i) How much energy per second is shining on the solar panel?

Energy per second = _____ J [1]

(ii) The efficiency of the solar panel is 0.2 or 20%.
Calculate the output electrical energy every second from the solar panel.
You are advised to show clearly how you get your answer.

Output electrical energy = _____ J [3]

(b) Sunlight can also be used to provide domestic hot water.
A typical solar heating panel is shown below.



Examiner Only	
Marks	Remark

(i) Why is the material used to absorb sunlight black?

_____ [1]

(ii) **Expanded** polystyrene is often used as the insulating material.
What property of **expanded** polystyrene makes it a good insulator?

_____ [1]

(iii) On the diagram of the enlarged view show, by placing an arrow in the dashed box, the direction of water flow through the solar heating panel. [1]

(iv) Name the type of electromagnetic wave in sunlight that is responsible for this heating effect.

_____ [1]

(c) The diagram shows weightlifting equipment found in most gyms.

© Polka Dot / Thinkstock

(i) When using the equipment John lifts a weight of 200 N through a distance of 1.5 m.
Calculate the amount of work that John does.
You are advised to show clearly how you get your answer.

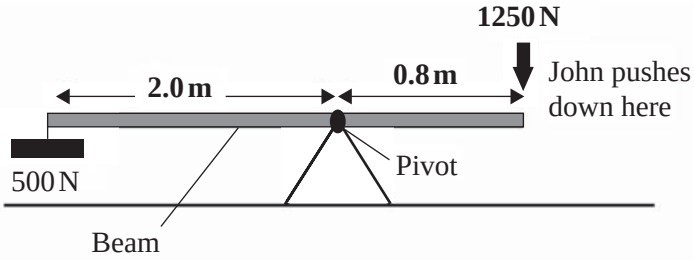
Work = _____ J [3]

(ii) John repeats the exercise. He does 10 complete lifts in a time of 30 seconds.
Calculate the power John produces during this time.
Remember to include the unit for power.
You are advised to show clearly how you get your answer.

Power = _____ [4]

Examiner Only	
Marks	Remark

(d) John builds a simple weightlifting device as shown below.
The pivot can be moved along the beam.



(i) For the arrangement of weight and distances shown above calculate the moment of the force that John exerts.
You are advised to show clearly how you get your answer.

Moment = _____ Nm [2]

(ii) To reduce the force that John exerts but keep the same moment, he moves the pivot.
In what direction should he move it?
Explain your answer.

_____

_____

_____

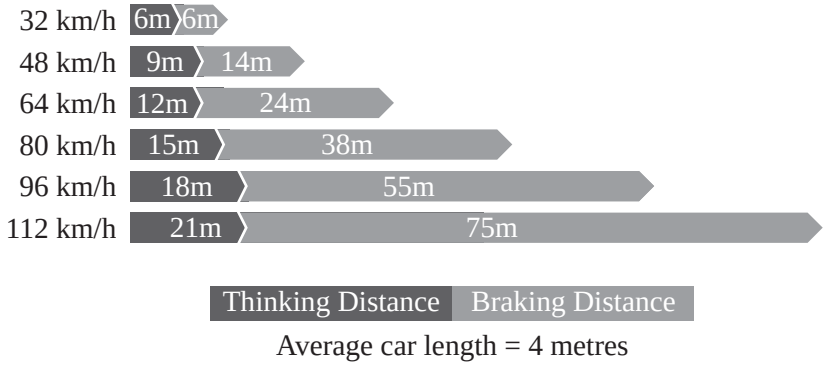
_____ [3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** The **stopping distance** of a car is the **thinking distance** added to the **braking distance**.
The chart below shows the results of a study of stopping distance by an alert driver, on a dry day using a car with good tyres and good brakes.



Average car length = 4 metres

(i) The **braking distance** is the distance the car travels from where the brakes were first applied to where the car stops.
For a car travelling along a level road, state **two** factors, not related to the driver, that would result in an increase in the braking distance.

_____

_____

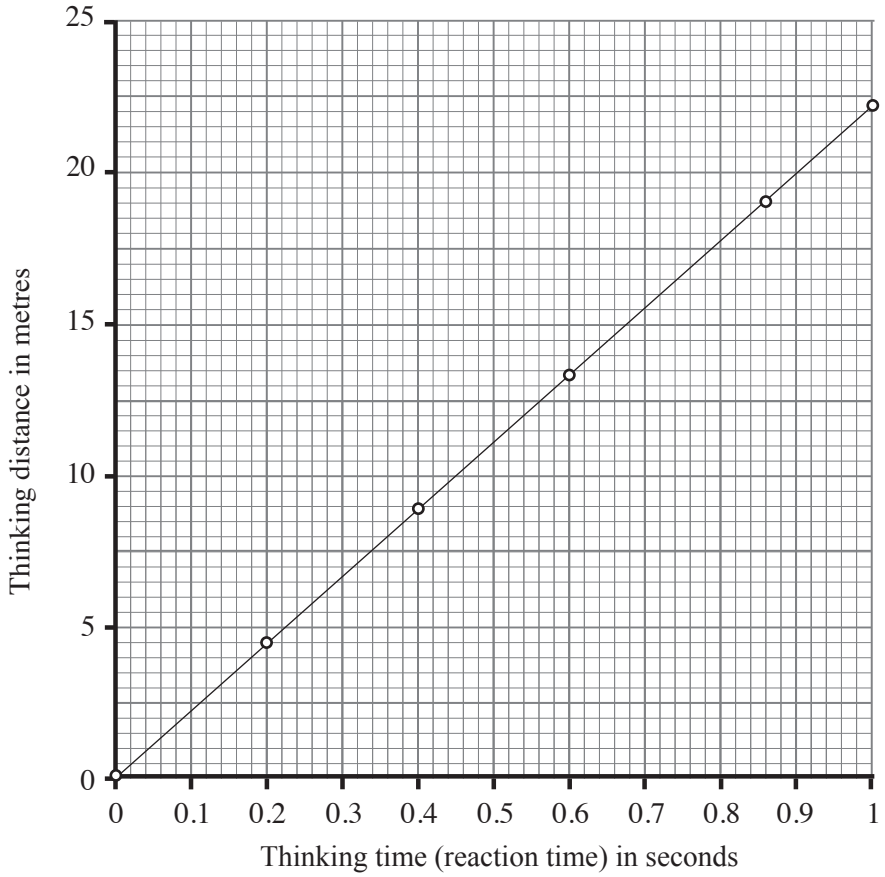
_____

_____ [2]

(ii) Show clearly that a speed of 80 km/h is equal to a speed of 22.2 m/s.

[3]

The graph below shows how thinking distance and thinking time (reaction time) are related for a car travelling at 80 km/h (22.2 m/s).



(iii) Using the graph above and the chart opposite, determine the thinking time (reaction time) for this driver.

Thinking time (reaction time) = _____ s [2]

(iv) On the graph above draw a straight line to show how the thinking distance and thinking time (reaction time) would be related for a car travelling **faster** than 80 km/h. [1]

Examiner Only

Marks	Remark

[Turn over

Examiner Only	
Marks	Remark

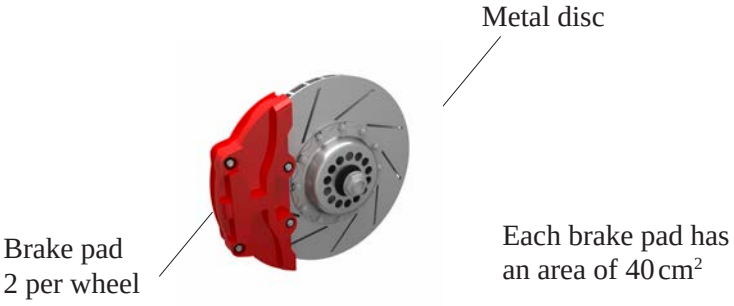
(v) The thinking distance is the distance the car travels at **constant speed** before the driver reacts (reaction time) to a hazard on the road and applies the brakes.
Research has shown that a driver who has taken alcohol and is on the legal limit to drive has a thinking time (reaction time) **twice** its normal value.
Using the information above and the chart on page 6 determine what this driver's thinking distance would be when travelling at 80 km/h.

Thinking distance = _____ m [1]

(vi) The speed of two cars following each other on a motorway is 112 km/h.
In case the car in front should suddenly brake it is advisable for the following car to leave a gap. The average length of a car is 4 m.
Use the data from the chart to calculate the size of the required gap.
Give your answer in complete car lengths.
You are advised to show clearly how you get your answer.

Required gap = _____ complete car lengths [3]

(b) The braking force needed to slow a car is provided by friction.
The brake pads are forced against rotating metal discs attached to the wheels.



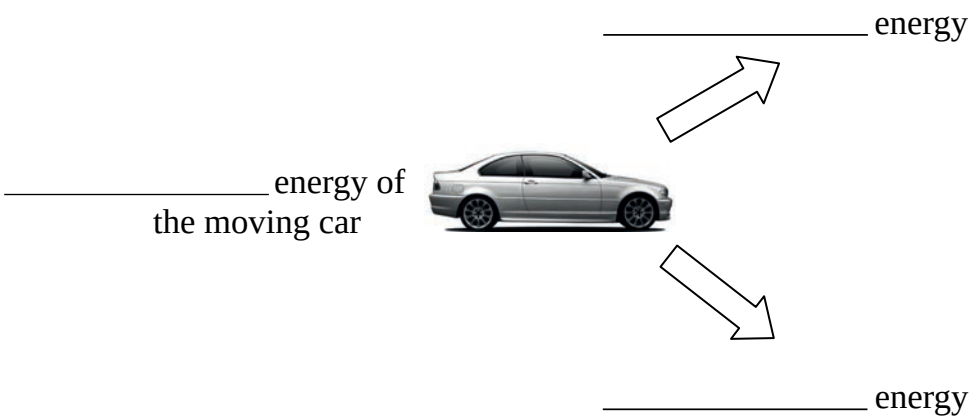
© iStockphoto / Thinkstock

Examiner Only	
Marks	Remark

(i) To slow the car down a braking force of 2000 N is applied to each wheel.
Calculate the pressure that each brake pad exerts on the metal disc.
Remember each wheel has two brake pads acting on the metal disc.
You are advised to show clearly how you get your answer.

Pressure = _____ N/cm^2 [5]

(ii) Complete the diagram below to show the energy changes that happen when the brakes are used to slow the car down.



[3]

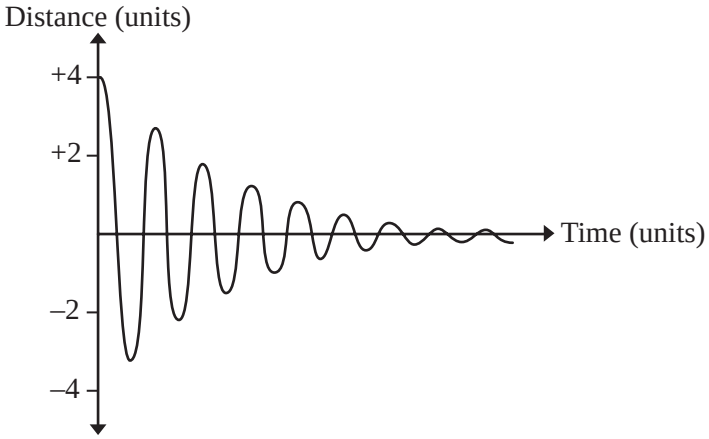
Examiner Only	
Marks	Remark

3 **(a)** Waves can be classified according to the direction of the vibrations. Complete the table below to illustrate this method of classification. Some entries in the table have already been completed for you.

Wave	Direction of vibrations	Type of wave
Light wave	Perpendicular to the direction of energy transfer	
Sound wave		
Water wave		Transverse

[4]

(b) The graph below shows an earthquake's shock wave.



(i) Write down the **maximum** amplitude of the wave.

Amplitude = _____ units [1]

(ii) How many **complete** waves are shown above?

_____ [1]

(iii) How can you tell **from the graph** that the frequency of the wave is constant?

_____ [1]

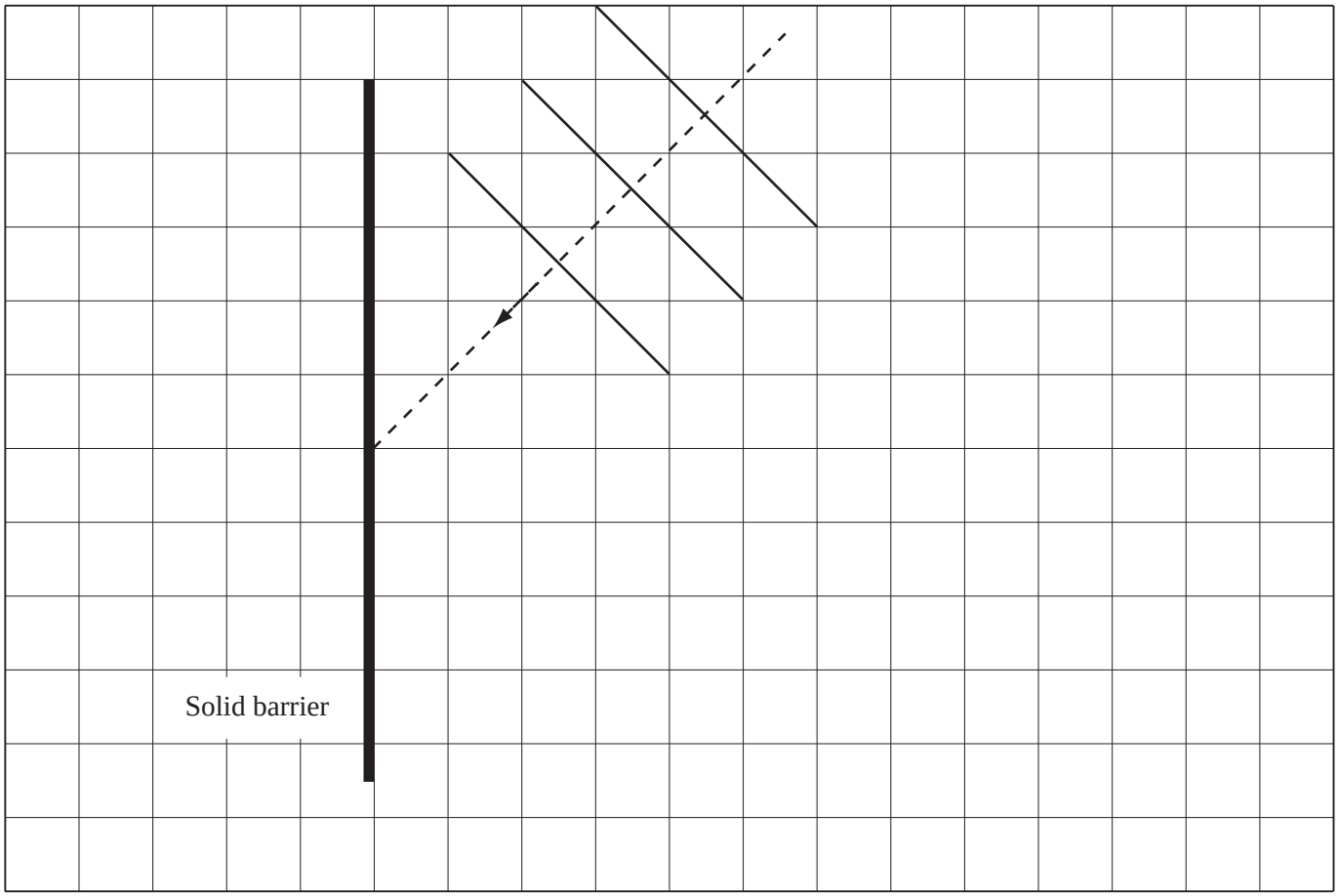
The frequency of the shock wave was 50 Hz.

(iv) Explain what a frequency of 50 Hz means.

_____ [1]

Examiner Only	
Marks	Remark

(c) Water waves can be studied in a laboratory using a ripple tank.
Below is a **full-scale** diagram showing the movement of water waves in a ripple tank towards a solid barrier.



Examiner Only	
Marks	Remark

(i) Use a ruler to measure accurately the wavelength of the water waves.

Wavelength = _____ mm [1]

(ii) What is being transferred by the waves?

_____ [1]

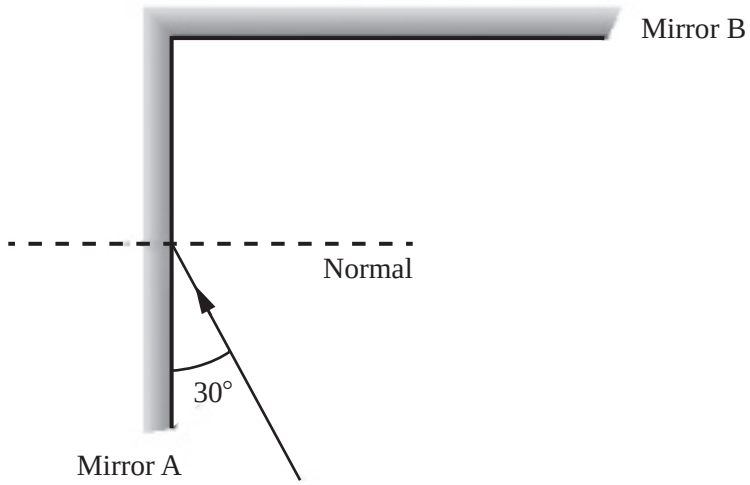
(iii) Using a ruler, carefully complete the diagram opposite to show the reflection of the water waves from the solid barrier.
Your diagram should show:

- an arrow showing the direction of the reflected waves and
- three reflected waves [5]

(iv) Is the frequency of the reflected waves greater than, smaller than or equal to the frequency of the incident waves? Ring the correct answer.

Greater than **Smaller than** **Equal to** [1]

(d) Two mirrors, A and B, are at right angles to each other.
A ray of light strikes Mirror A as shown below. The normal is drawn.



(i) What is the angle of incidence at Mirror A?

Angle = _____ ° [1]

(ii) What is the angle of reflection at Mirror A?

Angle = _____ ° [1]

(iii) Carefully continue the ray to show how it is reflected off **both** mirrors. [1]

(iv) Calculate the angle of incidence at Mirror B.

Angle = _____ ° [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

4 **(a)** **(i)** Using the correct symbols draw a circuit diagram of a series circuit showing a battery of three cells, two resistors, an ammeter and an open switch.

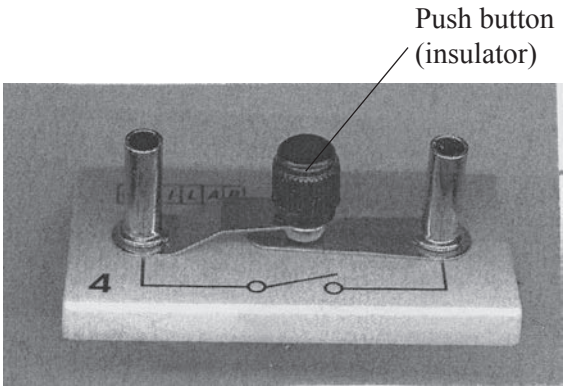
[5]

(ii) On your diagram, mark clearly, with an arrow the direction of the flow of electrons in your circuit when the switch is closed. [1]

(iii) What would be noticed if the current is measured at a number of points around the circuit?

_____ [1]

The picture below shows a simple electrical switch.



(iv) Label those parts of the switch that conduct electricity and the part of the switch that is an insulator, other than the push button. [2]

Currents flowing in electrical circuits produce heat.

(v) Where is the **most** heat produced in the circuit you have drawn?

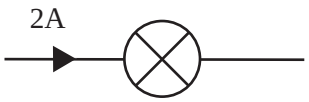
_____ [1]

Examiner Only	
Marks	Remark

(vi) Using the **correct symbol** show, on your diagram, how a voltmeter should be connected to measure the voltage across **one** of the resistors. [1]

(vii) Mark on the diagram the positive terminal of the voltmeter. [1]

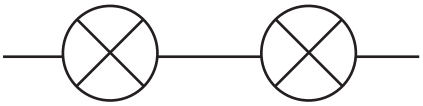
(b) The diagram below represents a lamp carrying a current of 2 A.
The voltage across the lamp is 12 volts.



(i) Calculate the resistance of the lamp.
Remember to give the unit for resistance.
You are advised to show clearly how you get your answer.

Resistance = _____ [4]

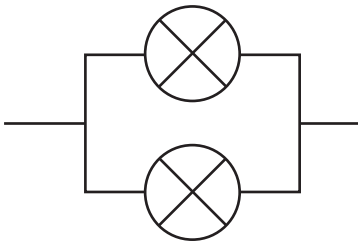
(ii) Calculate the combined resistance of two such lamps connected in **series**.



You are advised to show clearly how you get your answer.

Combined resistance = _____ [2]

(iii) Calculate the combined resistance when the two lamps are connected in **parallel**.



You are advised to show clearly how you get your answer.

Combined resistance = _____ [2]

Examiner Only	
Marks	Remark

5 **(a)** Complete the table below, naming the three different radiations emitted by radioactive substances and stating the nature of each.

Name of radiation emitted	Nature of radiation (electromagnetic wave or particle)

[6]

(b) Even out in the open, away from any man-made radioactive sources, radioactivity can be detected.

(i) What is this kind of radioactivity called?

_____ [1]

(ii) Where does such radioactivity come from?

_____ [1]

(iii) Describe how you would measure the radioactivity that you would find out in the open.

_____

_____

_____

_____

_____

_____ [2]

Quality of written communication [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(c) A radioactive substance has a half-life of **12 years**.
Which of the following statements is/are true?
Write your answer in the space provided.

For a sample of this substance **after 12 years**:

Statement	True or False
Its activity will be half of what it was at the start.	
Its activity will be double what it was at the start.	
Its activity will be zero.	

For a sample of this substance **after 24 years**:

Statement	True or False
All of the radioactive nuclei will have decayed.	
Its activity will be zero.	
Its activity will be $\frac{1}{4}$ of what it was at the start.	

[3]

(d) The full symbol for a nucleus of carbon-14 is $^{14}_{6}\mathrm{C}$

Complete the table below by naming the particles in a nucleus of carbon-14 and give the number of each in a nucleus of carbon-14.

Particle	Number in the nucleus

[4]

(e) Four unknown nuclei are labelled *W*, *X*, *Y* and *Z*.
Their full symbols are given below.

$$^{30}_{15}W \qquad ^{30}_{16}X \qquad ^{32}_{17}Y \qquad ^{33}_{16}Z$$

(i) Which, if any, of these nuclei are isotopes of the same element?

_____ [1]

(ii) Explain your answer.

_____

_____ [1]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER