Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Physics

Paper 1
Higher Tier

[G7604]

G7604

FRIDAy 15 JUNE, AFTERNOON

TIME

1 hour 45 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 125.
Quality of written communication will be assessed in Question **1(a)(iv)**.
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.

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On a cloudless summer day the solar energy shining on the panel **every second** is 6000 J. Of this amount 4800 J are reflected, the rest is converted to electricity.

(i) Calculate the output electrical energy every second from the solar panel.

Output electrical energy = _____ J [1]

(ii) Calculate the efficiency of the solar panel.
You are advised to show clearly how you get your answer.

Efficiency = _____ [2]

(iii) On a certain summer day the panel generated electricity for 10 hours. Using your answer to part **(a)(i)** calculate the number of kilowatt-hours (kWh) generated by the solar panel.
You are advised to show clearly how you get your answer.

Number of kWh = _____ [2]

A family of four would use on average 15 kWh per day.
The electricity generated is d.c. and is used to charge a battery.
Most electrical appliances in the home are powered by a.c.

(iv) Using your answer to part **(a)(iii)** and the information given above, write a paragraph to discuss whether the use of this solar panel is a practical solution to the energy needs of a family of four.
Suggest how they might improve the situation from the point of view of their energy needs. In your answer mention one advantage and one disadvantage of the use of the solar panel.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [4]

Quality of written communication [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

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

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(i) When using the equipment, John wants to do 300 J of work in each lift.
He can vary the weight from 100 N to 500 N in steps of 50 N.
He can also vary the distance he lifts the weights from 1.0 m to 2.0 m in steps of 0.5 m.
State **three** weights and the corresponding distances that John can use to achieve this.

1 weight = _____ N distance = _____ m

2 weight = _____ N distance = _____ m

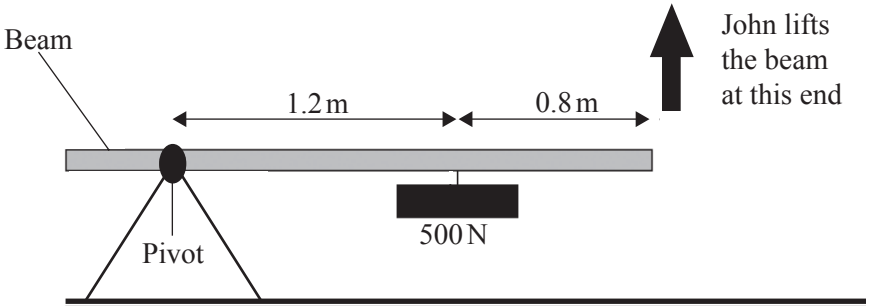
3 weight = _____ N distance = _____ m

[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]

(c) John builds a simple weightlifting device as shown below.



(i) For the arrangement of weight and distances shown above, calculate the force John needs to exert to raise the weight.
You are advised to show clearly how you get your answer.

Force = _____ N [4]

(ii) To reduce the force he needs to exert, John moves the 500 N weight. In what direction should he move it?
Explain your answer.

_____

_____

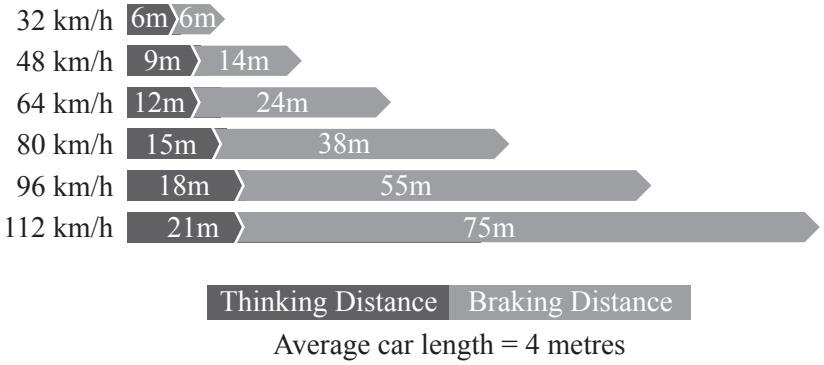
_____

_____ [3]

Examiner Only	
Marks	Remark

2 The **stopping distance** of a car is the **thinking distance** added to **the braking distance**.
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.
The braking distance is the distance the car travels from where the brakes were first applied to where the car stops.

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.



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

[3]

(ii) Using the data from the chart that applies to a speed of 80 km/h calculate the thinking time (reaction time) of the driver.
You are advised to show clearly how you get your answer.

Reaction time = _____ s [4]

Examiner Only
Marks | Remark

(iii) The speed of two cars following each other on a motorway is 112 km/h. Should the car in front 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]

(iv) A car is travelling at 112 km/h. This is equivalent to a speed of 31.1 m/s. Using the braking distance given in the chart, calculate the deceleration of the car.
You are advised to show clearly how you get your answer.

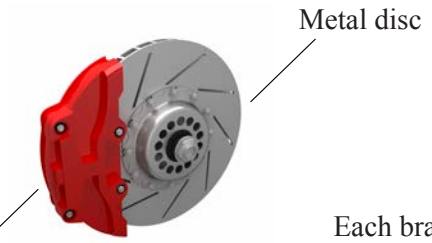
Deceleration = _____ m/s^2 [6]

(v) The car has a mass of 1500 kg.
Calculate the required braking force to produce this deceleration.
Remember to give the unit for force.
You are advised to show clearly how you get your answer.

Braking force = _____ [4]

Examiner Only	
Marks	Remark

(vi) This braking force is produced by the friction of brake pads rubbing against a metal disc. A car has **eight** such brake pads, 2 per wheel.



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Using the information given in the diagram above and your answer to part **(v)** calculate the pressure that each brake pad exerts on the metal disc as the car comes to rest.
You are advised to show clearly how you get your answer.

Pressure = _____ N/cm^2 [5]

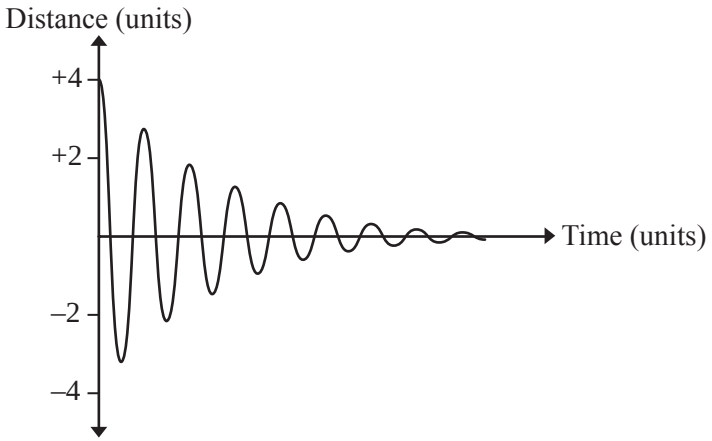
Examiner Only	
Marks	Remark

3 **(a)** Waves can be classified according to the direction of the vibrations they create. 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]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

The frequency of the shock wave was 50 Hz and it travelled with a speed of 4500 m/s.

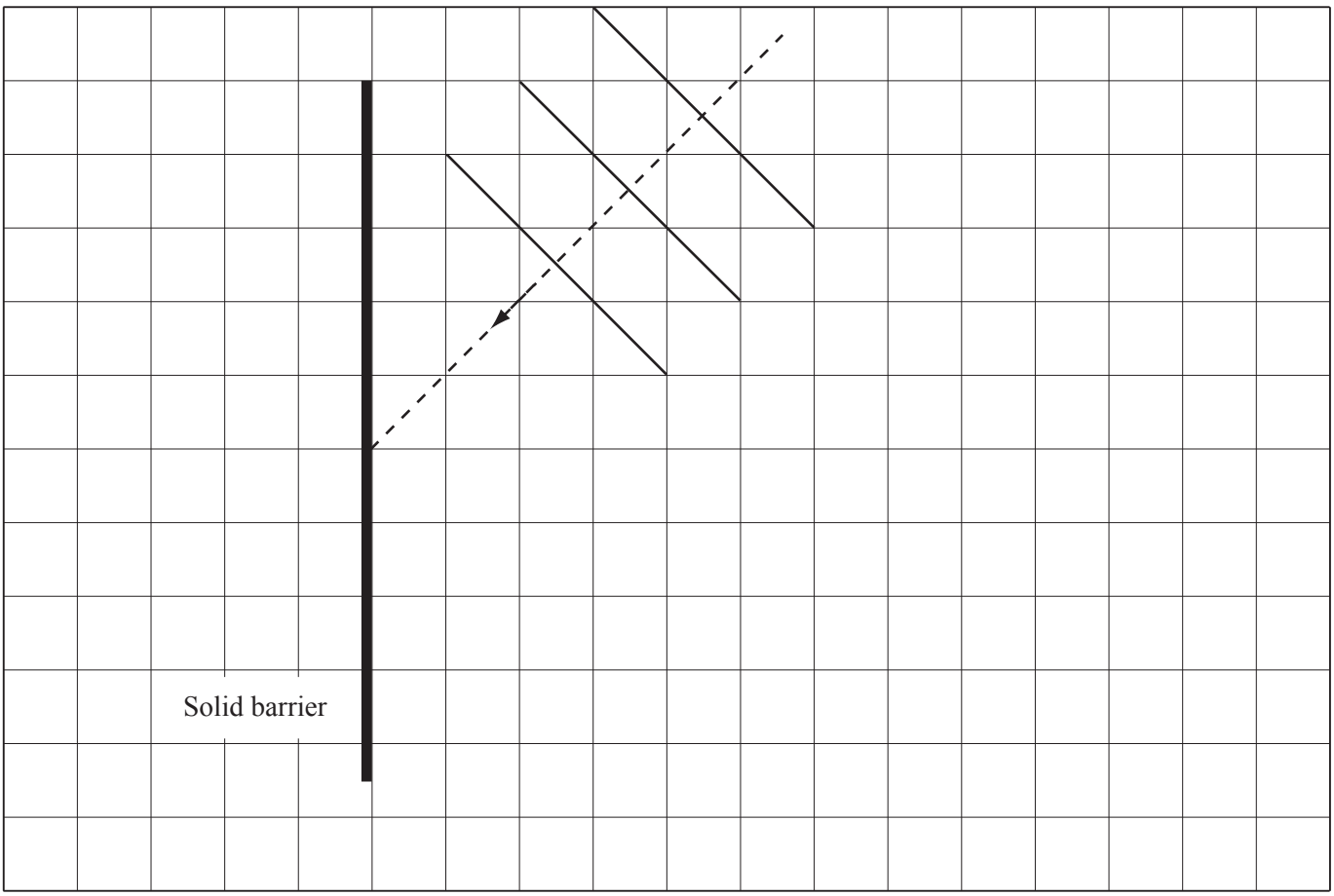
(iv) Explain what a frequency of 50 Hz means.

_____ [1]

(v) Calculate the wavelength of this shock wave.

Wavelength = _____ m [3]

(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]

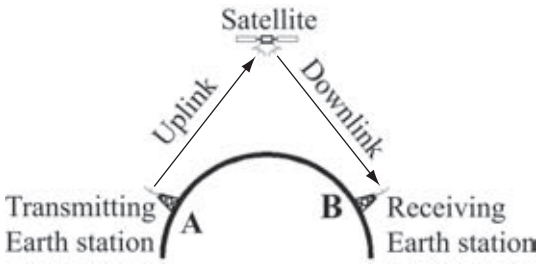
(iii) Using a ruler, carefully complete the diagram opposite to show the reflection of the water waves from the solid barrier.
Your diagram should show:

- 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) Long-distance communications between two points on the Earth's surface can be done using a satellite. Information is passed from **A** to **B** using a satellite above the Earth's surface.



© *Radio-Electronics.com*

(i) What property of microwaves allows them to travel from **A** to the satellite?

_____ [1]

Microwaves carry the information at a speed of 300 000 km/s from **A** to **B** via the satellite.

Examiner Only	
Marks	Remark

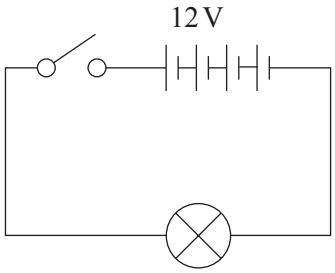
(ii) The points **A** and **B** are both 36 000 km from the satellite. Calculate the time taken for the information to travel from **A** to **B** by microwaves.

Time = _____ s [4]

(iii) The same information could also be sent from **A** to **B** along the surface of the Earth using infra-red waves. What type of connection between **A** and **B** would permit this type of communication link?

_____ [1]

4 **(a)** The diagram below represents a lamp which can be connected to the 12 V battery.



(i) Using the correct symbol show, on your diagram, how a voltmeter should be connected to measure the voltage across the lamp. [1]

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

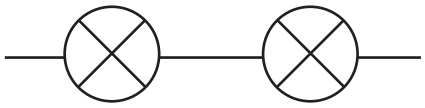
(iii) When the switch is closed a current of 2 A flows in the circuit.
Calculate the resistance of the lamp.
Remember to give the unit for resistance.
You are advised to show clearly how you get your answer.

Resistance = _____ [4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

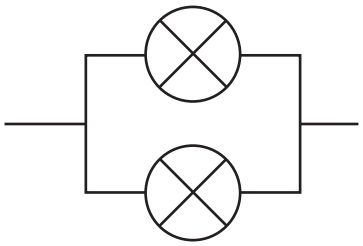
(iv) Calculate the combined resistance of two such lamps connected in **series**.



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

Combined resistance = _____ [2]

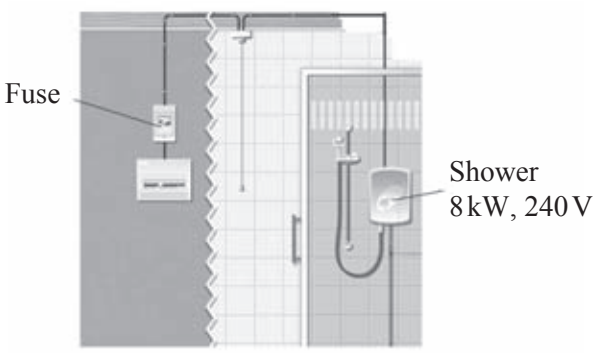
(v) Calculate the combined resistance when the two lamps are connected in **parallel**.



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

Combined resistance = _____ [2]

(b) An electric shower is rated at 8 kW when used on a 240 volt power supply.



(i) Calculate the size of the current flowing in the shower circuit when it is operating.
You are advised to show clearly how you get your answer.

Current = _____ A [4]

(ii) Calculate the cost of using this shower for 15 minutes.
The cost of a kWh is 13.5 pence.
You are advised to show clearly how you get your answer.

Cost = _____ pence [3]

Examiner Only	
Marks	Remark

(c) During a lightning strike the average current flowing is 40 000 A and the amount of electric charge delivered is 5 C.

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(i) Name the unit of electric charge. _____ [1]

(ii) Calculate the duration of the average strike.
You are advised to show clearly how you get your answer.

Duration = _____ s [4]

(iii) If the energy discharged is 700×10^6 J what is the voltage of the strike?

Voltage = _____ volts [3]

Examiner Only	
Marks	Remark

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

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

Particle	**Number in the nucleus**

[4]

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

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

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

_____ [1]

(ii) Explain your answer.

_____

_____ [1]

Examiner Only

Marks	Remark

(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]

Examiner Only	
Marks	Remark

(d) Fission and fusion are nuclear reactions which release large amounts of energy. The table below is intended to show a number of significant differences between the two reactions. Complete the table using the list of phrases/words below.

1. building of larger nuclei from small nuclei
2. the splitting up of large nuclei
3. nuclear power station
4. requires very high temperatures to start
5. the sun
6. hydrogen
7. uranium
8. will start at normal temperatures

Write the number corresponding to the statement in the appropriate box in the table below.

Nuclear Reaction	Fusion	Fission
Where the process can be found happening		
Fuel used		
Description of the reaction		
Conditions required to start		

[4]

(e) Cobalt-60 is a beta emitter, which decays to nickel.
The nickel produced decays by gamma (γ) emission.

(i) Complete the decay equations below.

$$^{60}_{27}\mathrm{Co} \rightarrow {}^{60}_{28}\mathrm{Ni}^{*} + {}^{\square}_{\square}\beta$$

$$\downarrow$$

$$^{\square}_{\square}\mathrm{Ni} + \gamma$$

[4]

Examiner Only

Marks	Remark

After 15 years the measured activity of a cobalt-60 source is found to have fallen from 120 counts per minute to 15 counts per minute.

Examiner Only	
Marks	Remark

(ii) What is the half-life of cobalt-60?
You are advised to show clearly how you get your answer.

Half-life = _____ years [3]

(iii) State **two** possible uses of gamma radiation.

1. _____

2. _____ [2]

Uranium is an alpha emitter.

(iv) Explain why wearing heavy gloves to handle uranium rods could be sufficient protection.

_____ [1]

(v) State **two** alternatives to shielding as ways of protecting people from the radiation from radioactive sources.

1. _____

2. _____ [2]

THIS IS THE END OF THE QUESTION PAPER

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