

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	



General Certificate of Secondary Education
Higher Tier
January 2011

Additional Science
Unit Physics P2

PHY2H
H

Physics
Unit Physics P2

Wednesday 19 January 2011 9.00 am to 9.45 am

For this paper you must have:

- a ruler.

You may use a calculator.

Time allowed

- 45 minutes

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice

- In all calculations, show clearly how you work out your answer.



J A N 1 1 P H Y 2 H 0 1

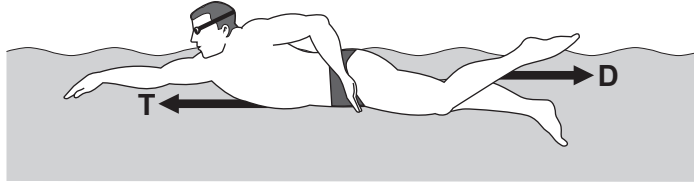
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ANSWER IN THE SPACES PROVIDED**



Answer **all** questions in the spaces provided.

1 (a) The diagram shows the horizontal forces acting on a swimmer.



1 (a) (i) The swimmer is moving at constant speed.
Force **T** is 120 N.

What is the size of force **D**?

..... N
(1 mark)

1 (a) (ii) By increasing force **T** to 140 N, the swimmer accelerates to a higher speed.

Calculate the size of the initial resultant force acting on the swimmer.

.....
.....

Initial resultant force = N
(1 mark)

1 (a) (iii) Even though the swimmer keeps the force **T** constant at 140 N, the resultant force on the swimmer decreases to zero.

Explain why.

.....
.....
.....
.....
.....
.....

(3 marks)

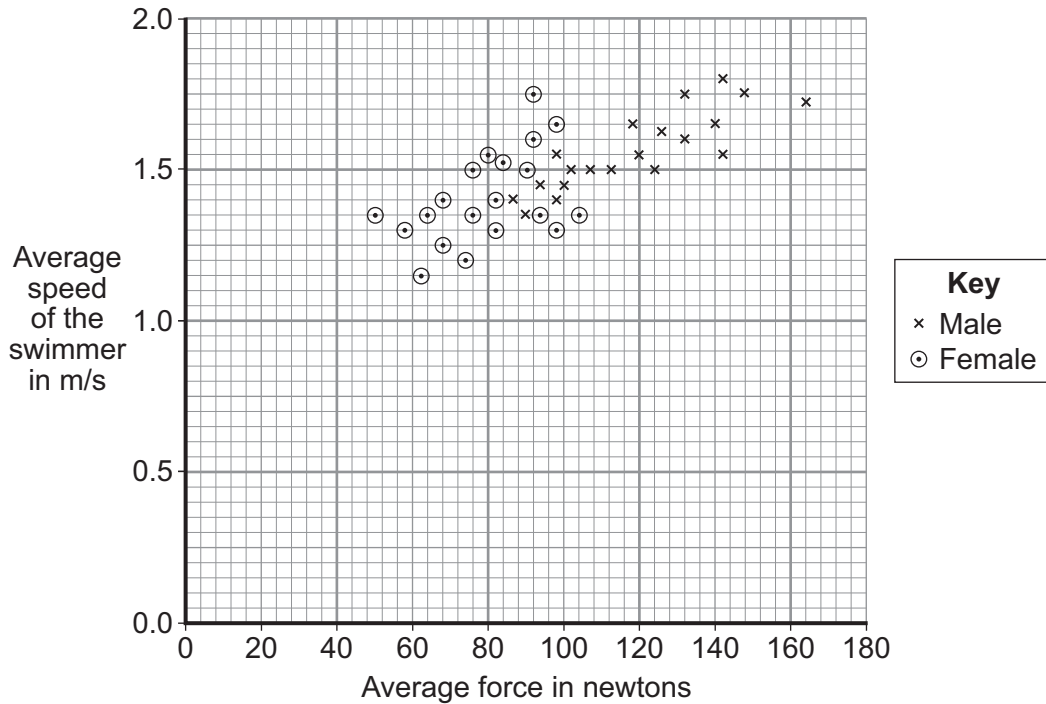
Question 1 continues on the next page

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1 (b) A sports scientist investigated how the force exerted by a swimmer's hands against the water affects the swimmer's speed. The investigation involved 20 males and 20 females swimming a fixed distance. Sensors placed on each swimmer's hands measured the force 85 times every second over the last 10 metres of the swim. The measurements were used to calculate an average force. The average speed of each swimmer over the last 10 metres of the swim was also measured.

The data from the investigation is displayed in the graph.



1 (b) (i) What was the dependent variable in this investigation?

.....
(1 mark)

1 (b) (ii) Explain **one** advantage of measuring the force 85 times every second rather than just once or twice every second.

.....

 (2 marks)



1 (b) (iii) Give **one** way in which the data for the male swimmers is different from the data for the female swimmers.

.....
.....

(1 mark)

1 (b) (iv) Considering only the data from this investigation, what advice should a swimming coach give to swimmers who want to increase their average speed?

.....
.....

(1 mark)

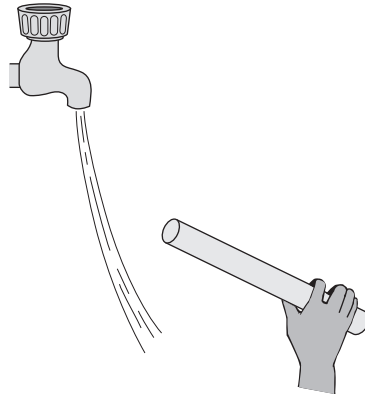
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Turn over for the next question

Turn over ►



- 2 (a) The diagram shows a negatively charged plastic rod held close to a thin stream of water. The water is attracted towards the rod.



Which **one** of the following statements explains what is happening to the charge in the water?

Tick (✓) **one** box.

The positive and the negative charges in the water are attracted to the rod.

The positive and the negative charges in the water are repelled by the rod.

The negative charge in the water is repelled by the rod and the positive charge is attracted.

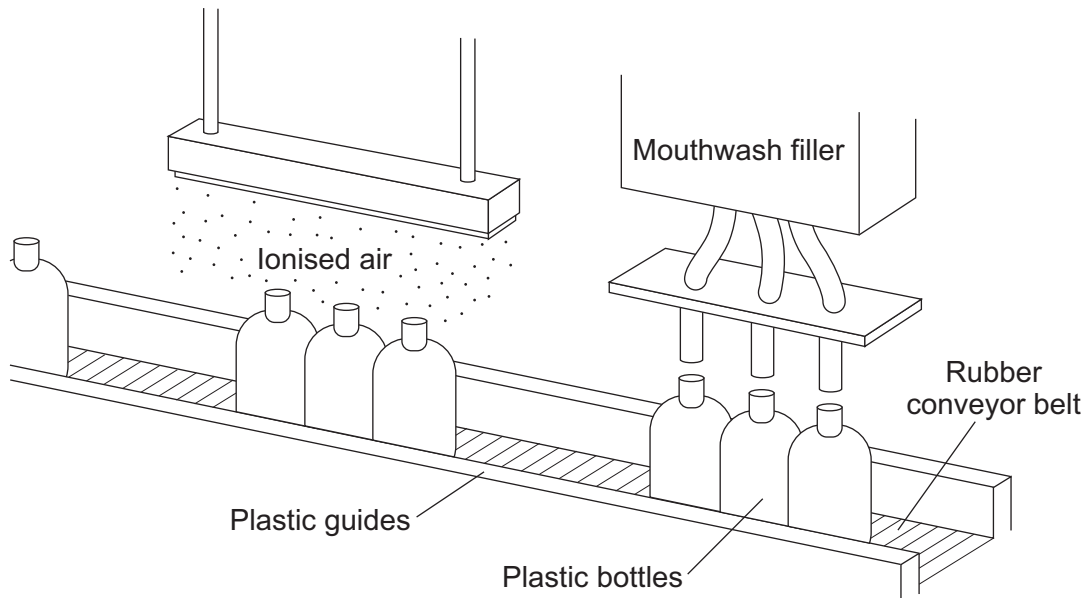
The negative charge in the water is attracted by the rod and the positive charge is repelled.

(1 mark)



- 2 (b)** A company that produces bottles of mouthwash found a problem with the automatic filling system.

As the bottles go towards the filler, they move around on the conveyer belt and become electrostatically charged. This causes the stream of mouthwash to move sideways, missing the open top of the bottle.



The company came up with a solution to the problem. Before the bottles reach the filler, they pass through a stream of ionised air. The ions in the air neutralise the charge on the bottles.

- 2 (b) (i)** Explain why the plastic bottles become charged.

.....

.....

.....

.....

(2 marks)

Question 2 continues on the next page

Turn over ►



2 (b) (ii) What is an ion?

.....
.....

(1 mark)

2 (b) (iii) Earthing the conveyor belt with a conducting wire would not have solved this problem.

Give a reason why.

.....
.....

(1 mark)

5



3 (a) Background radiation is all around us all the time.

3 (a) (i) Radon is a natural source of background radiation.

Name another natural source of background radiation.

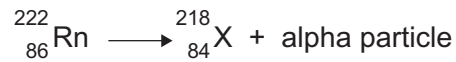
.....
(1 mark)

3 (a) (ii) X-rays are an artificial source of background radiation.

Name another artificial source of background radiation.

.....
(1 mark)

3 (a) (iii) An atom of radon-222 decays by emitting an alpha particle.
The equation representing the decay is shown below.



How can you tell from the equation that 'X' is not an atom of radon?

.....
.....
(1 mark)

Question 3 continues on the next page

Turn over ►



3 (b) Having an X-ray taken increases your exposure to radiation.

The table gives:

- the radiation doses received for 6 different medical X-rays;
- the number of days' of exposure to natural background radiation each dose is equivalent to.

Medical X-ray	Radiation dose received (in arbitrary units)	Equivalent number of days of exposure to natural background radiation
Chest	2	2.4
Skull	7	8.4
Pelvis	22	26.4
Hip	44	52.8
Spine	140	
CT head scan	200	240

A hospital patient has an X-ray of the spine taken.

Calculate the number of days of exposure to natural background radiation that an X-ray of the spine is equivalent to.

Show how you work out your answer.

.....

.....







.....

Equivalent number of days =
(2 marks)



3 (c) Scientists have shown that X-rays increase the risk of developing cancer. The scientists came to this conclusion by studying the medical history of people placed in one of two groups, **A** or **B**. The group into which people were put depended on their X-ray record.

3 (c) (i) Person **J** has been placed into group **A**. Place each of the people, **K**, **L**, **M**, **N** and **O**, into the appropriate group, **A** or **B**.

	J	K	L	M	N	O
Person						
Medical X-ray record	3 arm	None	None	2 skull	None	4 leg

Group A	Group B
J	

(1 mark)

3 (c) (ii) To be able to make a fair comparison, what is important about the number of people in each of the two groups studied by the scientists?

.....

.....

(1 mark)

3 (c) (iii) What data would the scientists have compared in order to come to the conclusion that X-rays increase the risk of developing cancer?

.....

.....

(1 mark)

Question 3 continues on the next page

Turn over ▶



3 (c) (iv) The chance of developing cancer due to a CT head scan is about 1 in 10000.
The chance of developing cancer naturally is about 1 in 4.

A hospital patient is advised by a doctor that she needs to have a CT head scan.
The doctor explains to the patient the risks involved.

Do you think that the patient should give her permission for the CT scan to be taken?

Draw a ring around your answer.

Yes

No

Give a reason for your answer.

.....

.....

(1 mark)

9



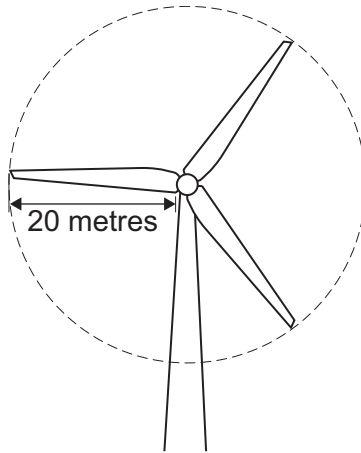
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ANSWER IN THE SPACES PROVIDED**

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- 4 The diagram shows a wind turbine.



- 4 (a) The blades of the turbine are 20 metres long. On average, 15000 kg of air, moving at a speed of 12 m/s, hit the blades every second.

Use the equation in the box to calculate the kinetic energy of the air hitting the blades every second.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

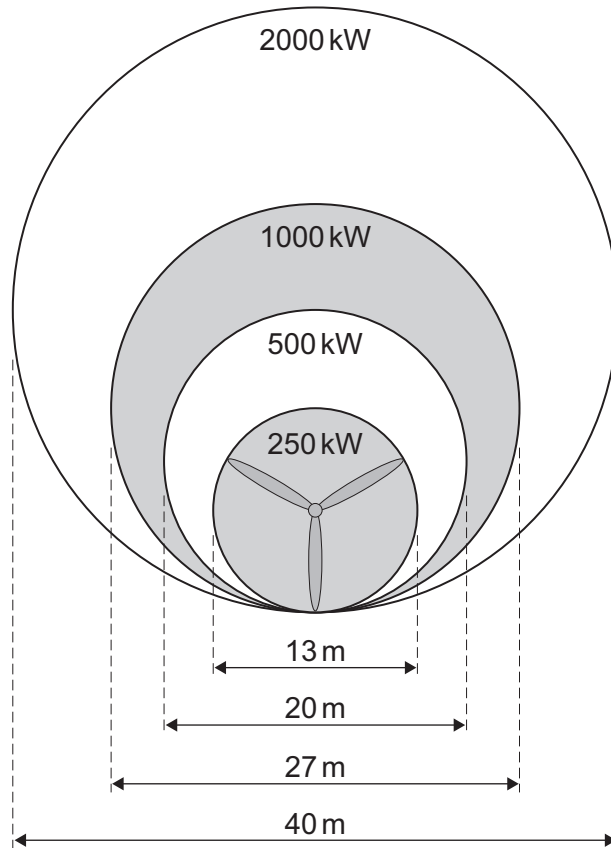
Show clearly how you work out your answer.

.....

Kinetic energy = J
 (2 marks)



- 4 (b)** Part of the kinetic energy of the wind is transformed into electrical energy. The diagram shows that, for the same wind speed, the power output of a turbine, in kilowatts, depends on the length of the turbine blades.



Give a reason why doubling the diameter of the blades more than doubles the power output of a turbine.

.....

.....

(1 mark)

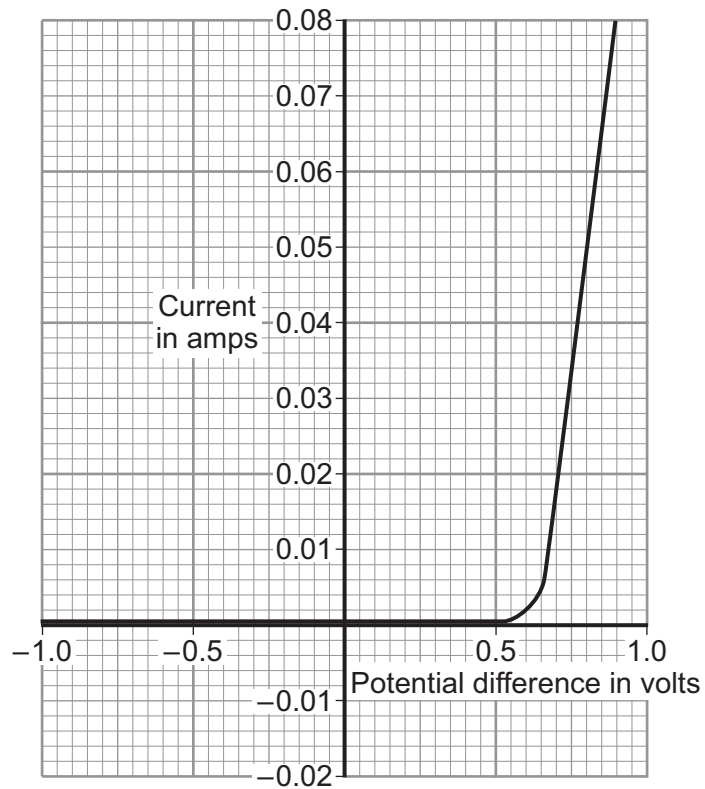
3

Turn over for the next question

Turn over ►



- 5 The current–potential difference graph for one type of electrical component is drawn below.



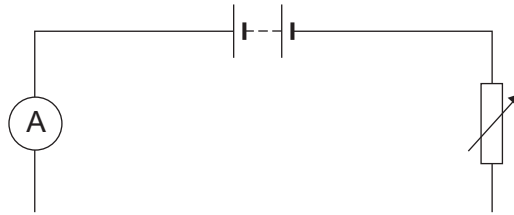
- 5 (a) What is the component?

.....

(1 mark)



- 5 (b) Complete the diagram to show a circuit that can be used to obtain the data needed to plot the graph. Use the correct circuit symbol for each component that you add to the diagram.



(2 marks)

- 5 (c) (i) What is the current through the component when the potential difference across the component is 0.8 volts?

Current amps
(1 mark)

- 5 (c) (ii) Use the equation in the box to calculate the resistance of the component when the potential difference across it is 0.8 volts.

potential difference = current × resistance

Show clearly how you work out your answer.

.....
.....

Resistance = Ω
(2 marks)

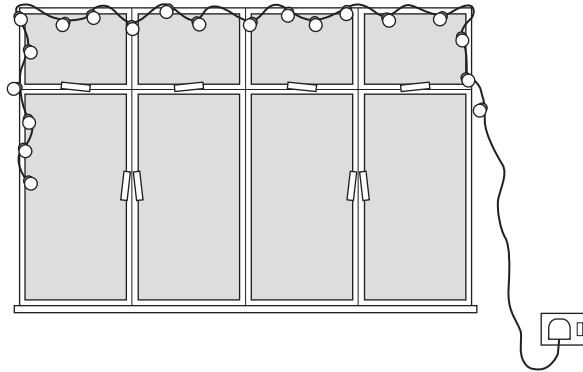
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Turn over for the next question

Turn over ►



6 A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.



6 (a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.

6 (a) (i) What is the total current drawn from the mains supply?

.....
(1 mark)

6 (a) (ii) Use the equation in the box to calculate the charge passing through **one** of the lamps in 5 minutes.

$$\text{charge} = \text{current} \times \text{time}$$

Show clearly how you work out your answer and give the unit.

.....
.....
.....
.....

Total charge =
(3 marks)



6 (b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a fault occurs. A short time after the lights are switched on, a fault causes the filament inside the fuse lamp to melt and all the lamps go out.

The householder cannot find another fuse lamp so connects a piece of aluminium foil across the contacts inside the fuse lamp holder. When switched on, the nineteen remaining lamps work. What the householder has done is dangerous.

Explain why.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Turn over ►



7 (a) Complete the following sentence.

The momentum of a moving object has a magnitude, in kg m/s,

and a (1 mark)

7 (b) A car being driven at 9.0 m/s collides with the back of a stationary lorry. The car slows down and stops in 0.20 seconds. The total mass of the car and driver is 1200 kg.

Use the equations in the box to calculate the average force exerted by the lorry on the car during the collision.

$\text{momentum} = \text{mass} \times \text{velocity}$ $\text{force} = \frac{\text{change in momentum}}{\text{time take for the change}}$

Show clearly how you work out your answer.

.....
.....

Force = N
(2 marks)

7 (c) Within 0.04 s of the car hitting the back of the lorry, the car driver's airbag inflates. The airbag deflates when it is hit by the driver's head.



Use the idea of momentum to explain why the airbag reduces the risk of the driver sustaining a serious head injury.

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(3 marks)

6

END OF QUESTIONS

