THIS IS A NEW SPECIFICATION

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RECOGNISING ACHIEVEMENT

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Thursday 13 June 2013 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A

A182/02 Modules P4 P5 P6 (Higher Tier)

A137290613

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

A182O2

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of useful relationships is printed on page 2.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **16** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

Explaining motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric circuits

power = voltage × current

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

energy = mass × [speed of light in a vacuum]^2

Answer **all** the questions.

1 Read the following article.

> Some cancers are treated with a form of radiation therapy called permanent brachytherapy. A small radioactive source is placed inside a tumour. The source then decays over time, releasing ionising radiation that breaks down the tumour.

(a) (i) Link each **phrase** from the article to its correct **meaning**.

phrase	meaning
	particles or waves that can break apart atoms
radioactive source	a substance that produces alpha, beta or gamma radiation
ionising radiation	the time taken for half of a radioactive substance to turn into another substance
decay	the particles in a sample naturally change from one element to another
	energy is released by a chain reaction

[3]

(ii) The radioactive source in the tumour gives out one type of ionising radiation.

A small amount of the radiation can be detected outside the body.

This shows that one type of radiation is definitely **not** produced by the source.

Put a (ring) around the correct choice to complete each sentence.

The source does not produce **alpha / beta / gamma** radiation.

This is the least **penetrating / evaporating / decaying** type of radiation,

so it **would / would not** pass out of the body.

[2]

(b) Which two statements, when taken together, explain why the ionising radiation "breaks down the tumour"?

Put ticks (✓) in the boxes next to the **two** correct statements.

Ionising radiation…

… can cause chemical reactions to take place. ☐

… is not affected by chemical processes. ☐

… can cause cells to become cancerous. ☐

… is produced from the nuclei of atoms. ☐

… decays over time. ☐

… kills living cells. ☐

[2]

(c) For brachytherapy to be effective, the source implanted into the tumour must have an activity that is high enough to kill the tumour, but drops to background levels soon after.

A doctor has a choice of four different sources to treat a tumour.

- Each source produces the same type of radiation.
- He knows that the source he chooses must have an activity of not more than 4 decays per second at the end of the treatment.
- The treatment lasts one year.
- Each source starts with an activity of 32 decays per second.

source	**A**	**B**	**C**	**D**
half life	2 months	3 months	6 months	2 years

Which source should the doctor use to treat this tumour?

Justify your answer.

source .....

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..... **[3]**

(d) (i) Denis wants to know if he should have brachytherapy for a cancer in his prostate gland.

He finds the following information:

- the therapy is successful in most cases
- 2 out of 125 patients in a study who had brachytherapy for prostate cancer went on to develop a cancer in a nearby organ as well.

Denis decides to go ahead with the therapy.

Suggest why he came to this conclusion, using this information.

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..... **[3]**

(ii) When doing his research, Denis finds information about the dose from different treatments.

Explain what **dose** means.

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..... **[1]**

[Total: 14]

2 Some scientists believe that nuclear fusion will be a major source of energy.

Currently, nuclear power stations use nuclear **fission** to generate electricity.

- Fission of uranium-235 releases 3.2×10^{-11} J per event.
- Fusion of hydrogen-1 releases 2.8×10^{-12} J per event.

Compare how nuclear fusion and nuclear fission release energy.

The quality of written communication will be assessed in your answer.

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..... **[6]**

[Total: 6]

3 Judy is investigating three different electrical components, **A**, **B** and **C**.

She changes the temperature of each component and measures the resistance.

She then changes the amount of light on each component and measures the resistance.

Temperature in °C	Resistance in Ω		
	component A	component B	component C
0	403	52	101
10	199	50	98
20	100	49	102
30	53	51	100
40	26	51	99
50	13	50	98
60	6	48	100

Light intensity in lux	Resistance in Ω		
	component A	component B	component C
0	101	76	102
100	100	50	101
200	102	32	99
300	98	21	98
400	99	14	101
500	101	19	102
600	102	8	101

(a) Use the data to decide what type of component **A**, **B** and **C** are.

component **A** .....

component **B** .....

component **C** .....

[3]

(b) Complete the following table to show whether each statement about Judy's experiment is **true**, **false** or you **cannot tell**.

Put ticks (✓) in the correct boxes.

	True	False	Cannot tell
Judy repeated her tests three times.			
Judy had an outlier in her results in the temperature experiment.			
Judy had an outlier in her results in the light intensity experiment.			
The temperature in the light intensity experiment was approximately 20 °C.			
The light intensity in the temperature experiment was approximately 200 lux.			

[4]

[Total: 7]

4 Vikram is building a circuit.

(a) He has a motor that has a resistance of 2400 Ω.

The motor works if the current through it is 0.005 A.

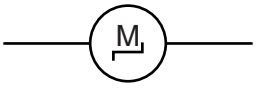
Vikram has some 1.5 V batteries.

How many batteries will be needed to make the motor work correctly?

number of batteries = ... **[3]**

(b) Draw the circuit that Vikram could use to measure the resistance of the motor at different currents.

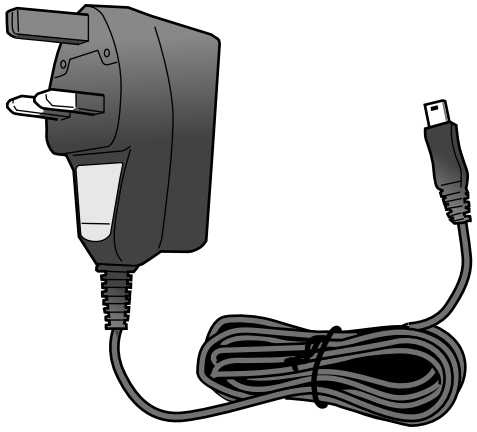
Part of the circuit has been done for you.



[2]

[Total: 5]

5 A mobile phone manufacturer is designing a charger for a new phone.



The charger will plug into the 230V mains supply, and will change the voltage to 12V.

The charger consists of a transformer with two coils of wire around an iron core.

The table shows two different pairs of coils which could be used in this transformer.

Complete the table.

Number of turns in primary coil	Number of turns in secondary coil
3450	.....
.....	600

[2]

[Total: 2]

6 Motors and generators both contain magnets and coils of wire.

Explain the similarities and differences between a motor and a generator.

The quality of written communication will be assessed in your answer.

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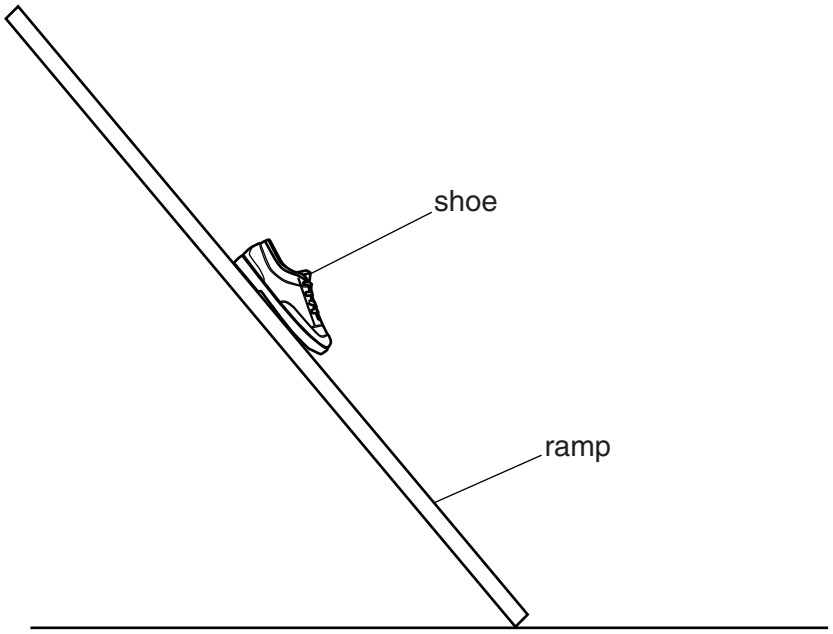
[Total: 6]

7 Ross is doing an experiment with shoes.

He places a shoe at the top of a ramp and measures the time it takes the shoe to slide down the ramp.



Ross has three different size shoes.

He does the experiment three times with each shoe.

Here are his results.

Shoe size	Time to slide down the ramp in seconds		
	Test 1	Test 2	Test 3
5	1.0	0.9	0.8
7	1.3	1.2	1.1
9	1.4	1.5	1.2

(a) (i) What conclusions could Ross make from this data?

Justify your answer.

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..... **[2]**

(ii) Another student tries to make the same measurements with another ramp and a shoe of size 4.

Here are the results.

Shoe size	Time to slide down the ramp in seconds		
	Test 1	Test 2	Test 3
4	1.2	1.4	1.3

Ross says: "You must have made a mistake. Your results do not fit my data."

Is Ross correct?

Justify your answer.

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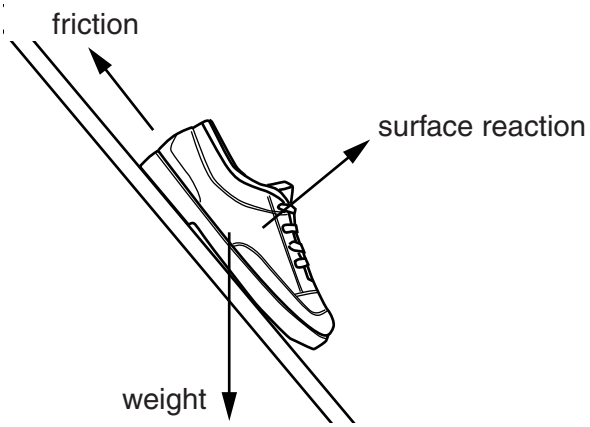
..... **[3]**

(b) The forces on a shoe as it starts to move down a slope are shown in the diagram.



(i) Each force is part of an interaction pair.

Complete the following sentences.

The pair force of the friction from the surface on the shoe is .....

..... .

The pair force of the weight of the shoe is .....

..... .

[2]

(ii) Describe the resultant force on the shoe as it starts to move down the slope.

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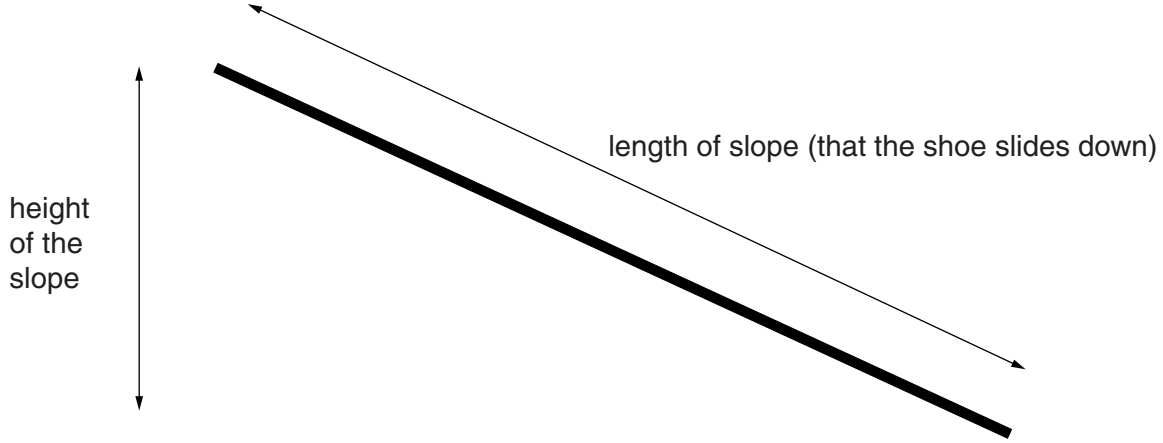
..... **[1]**

(c) Ross measures the **time** it takes for the shoe to move down the slope, the **weight** of the shoe and the **mass** of the shoe.

He then measures the following distances:



He wants to calculate a number of different values using **only** his data.

Which **quantities** does he use to work out each **calculated value**?

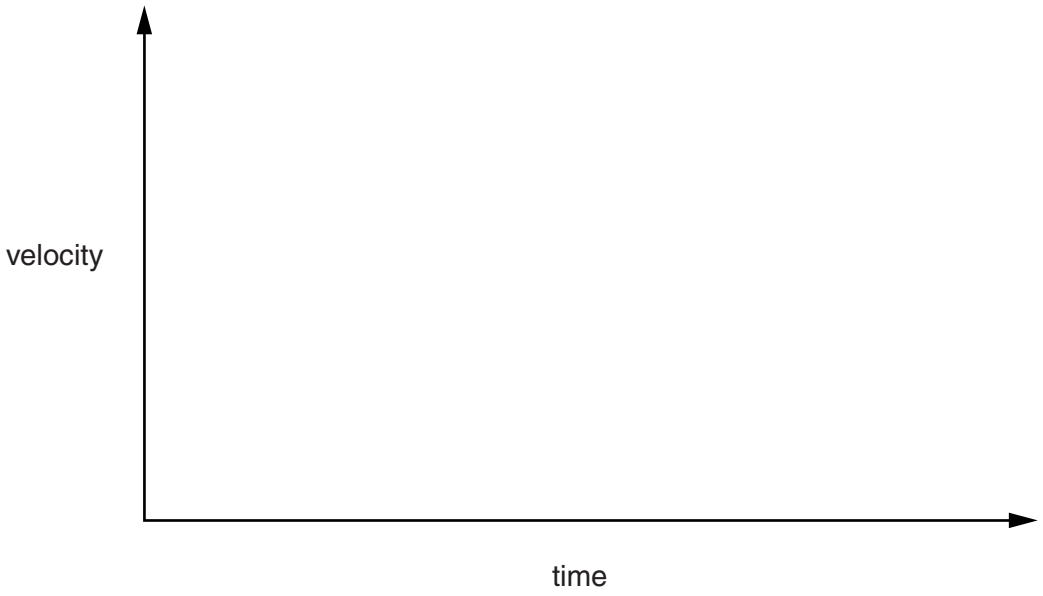
Put ticks (✓) in the correct boxes in each row.

Calculated value	**Quantity**				
	Time	**Mass of the shoe**	**Weight of the shoe**	**Height of slope**	**Length of slope**
average speed along slope					
average vertical velocity					
change in gravitational potential energy when the shoe slides down the slope					
average momentum of the shoe down the slope					

[4]

(d) As the shoe moves down the slope, it speeds up.

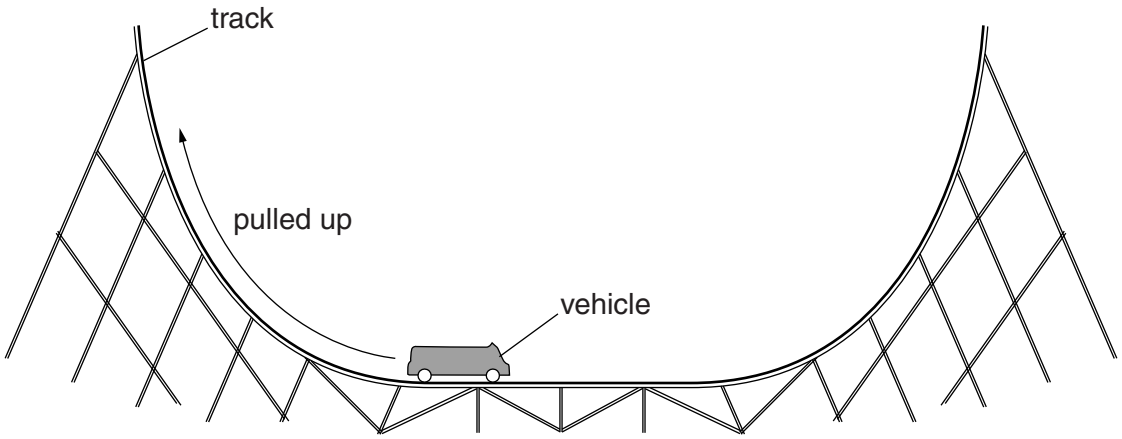
On the axes below, sketch the shape of the velocity-time graph that shows the velocity of the shoe along the slope.



[2]

[Total: 14]

8 A simple roller coaster has one line of track on which a vehicle travels backwards and forwards.



- The vehicle is pulled up the left side of the track, and is then released.
- It travels down the track, speeding up as it moves.
- It rises up the right side of the track, slowing down as it moves upwards.
- It rolls back down.
- It moves backwards and forwards on the track several times, with each move becoming lower and lower and the top speed becoming slower and slower.

Use ideas of energy to explain the motion of the vehicle.

The quality of written communication will be assessed in your answer.

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[Total: 6]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE