OCR

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Thursday 12 June 2014 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A/ADDITIONAL SCIENCE

A182/02 Modules P4 P5 P6 (Higher Tier)

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

A182/02

3110887334

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

- The 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

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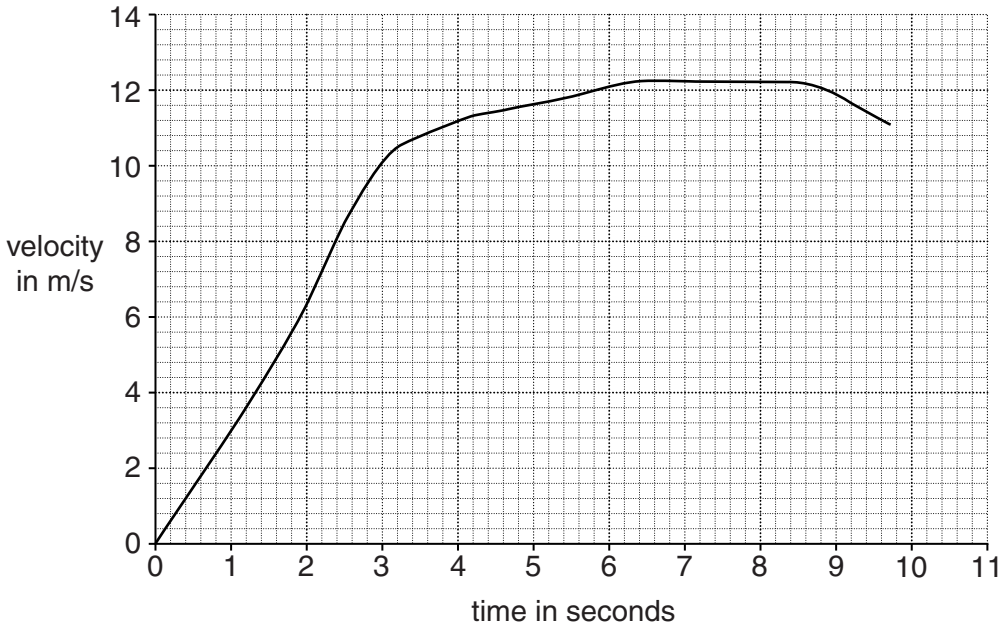
Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 In 2008 Usain Bolt set a new world record for the 100 m race.
This is a velocity-time graph for the race from start to finish.



(a) What was the world record time set by Usain Bolt in 2008? ..... **[1]**

(b) The data can be used to show that the race was 100 m long.

Complete the equation below.
Choose a word from the list.

average **final** **initial** **instantaneous** **maximum**

The distance of the race = the time taken × the ..... velocity **[1]**

(c) Some commentators said that Usain Bolt could have got a faster time.
What evidence from the graph supports this?

.....

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

(d) At what time during the race was Usain Bolt accelerating the fastest?

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

(e) All the velocities on the graph are positive, what does this mean?

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

[Total: 5]

2 Tamsin hits two balls with a bat.
The hard ball has a mass of 0.3 kg.
The soft ball has a mass of 0.2 kg.

Each ball gains the same momentum.

(a) (i) The hard ball will have the smaller velocity.
Explain why.

.....

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

(ii) The soft ball changes shape when hit so it is in contact with the bat for longer.
What effect will this have on the force acting on the soft ball?
Explain your answer.

.....

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

(b) The 0.3 kg hard ball hits a glass window with a speed of 4 m/s.

(i) The glass will not break if the ball has a kinetic energy of less than 10 J.

Will the glass window break?
Use a calculation to help justify your answer.

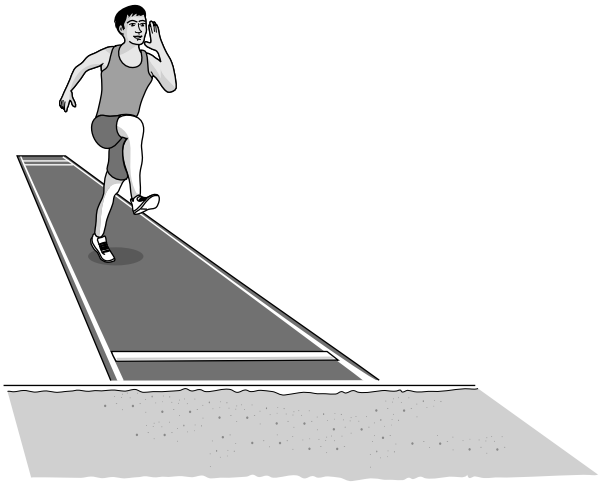
..... **[3]**

(ii) The 0.2 kg soft ball hits the window at a speed of 6 m/s. It bounces back from the window at a speed of 4 m/s.
What is the change in momentum of the soft ball?

change in momentum = ... kg m/s **[1]**

[Total: 7]

3 Amir is a long jumper. He runs as fast as he can before he jumps.
This lets Amir jump much further than if he had jumped without running.



Use ideas about forces and motion to explain how the running helps Amir jump further.

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

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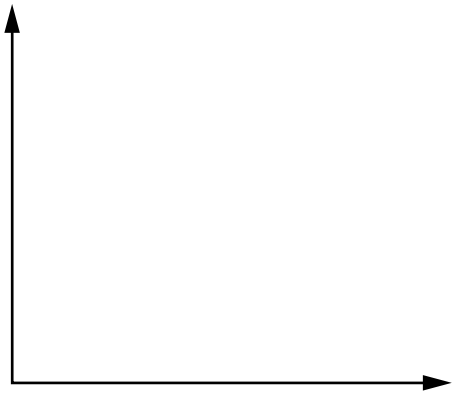
..... **[6]**

[Total: 6]

4 This data shows the relationship between the current in a wire and the power lost by the wire.

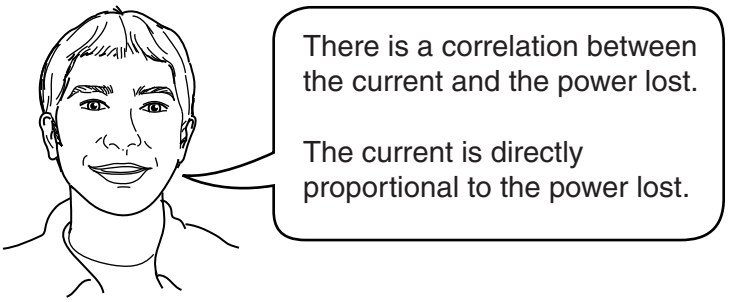
Current in amps	Power lost in watts
0.5	1
1.0	4
1.5	9
2.0	16

(a) Sketch a graph of these results on the axis below.
You do not need to plot any points.



[3]

(b) Edward looks at the data and draws conclusions.



Is Edward correct?
Justify your answer.

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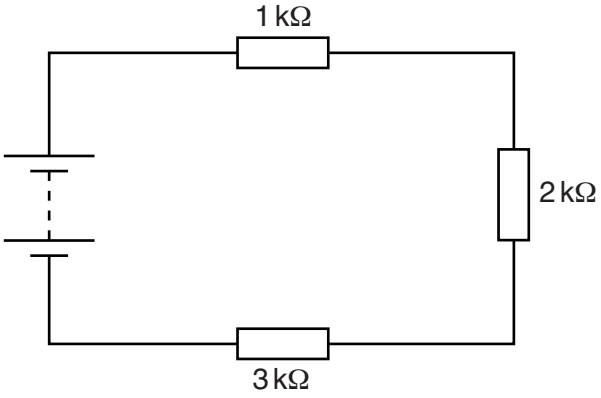
..... **[3]**

[Total: 6]

5 **(a)** Tim does an experiment using a circuit with three resistors in series.



(i) Which resistor will have the largest potential difference across it? ..... **[1]**

(ii) Which statement best explains this? Put a tick (✓) in the box next to the correct answer.

The same battery voltage causes a larger current to flow through a smaller resistance than through a bigger one. ☐

More work is done by the charge moving through a large resistance than through a small one. ☐

A change in the resistance of one component will result in a change in the potential difference across all the components. ☐

The current through each component is the same as if it were the only component present. ☐

[1]

(iii) The total potential difference across the three resistors is equal to the potential difference across the battery.
Explain this statement, using the idea of work done.

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

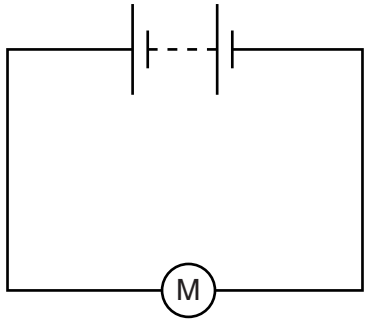
(b) In another experiment, Tim is using 100 kΩ and 200 kΩ resistors.
Which arrangement of resistors will have the **smallest** total resistance?
Put a tick (✓) in the box next to the correct answer.

100 kΩ on its own	☐
100 kΩ and 200 kΩ in series	☐
100 kΩ and 100 kΩ in parallel	☐
100 kΩ and 100 kΩ in series	☐

[1]

Question 5 continues on page 10

(c) Tim builds a circuit to test a motor.



He decides to increase the voltage.

(i) He tries adding an identical battery in **parallel** with the first battery.

What will happen to the voltage and the current in the circuit?
Put a tick (✓) in the box next to the correct answer.

voltage increases, current increases	☐
voltage increases, current stays the same	☐
voltage decreases, current increases	☐
voltage stays the same, current stays the same	☐

[1]

(ii) Tim tries using a transformer to change the voltage.
The transformer does not work in this circuit.
Explain why.

.....

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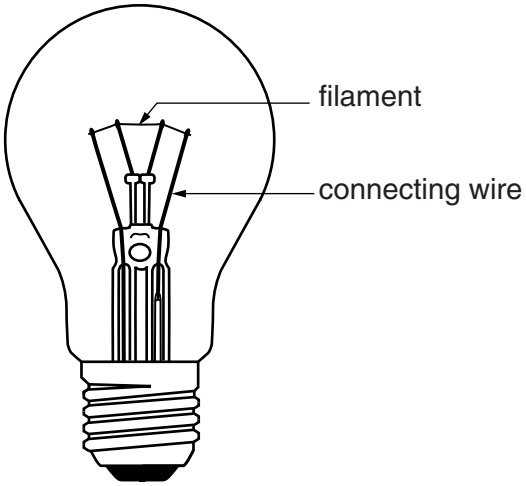
..... **[2]**

[Total: 8]

6 A filament lamp emits light when a current is passed through it.



The filament wires in the lamp are much thinner than the connecting wires.

When the lamp is turned on the filament emits visible light but the connecting wires do not. Explain why this happens.

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

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

[Total: 6]

7 Ionising radiation can damage and kill living cells.

(a) Which of the following uses of radiation work by killing living cells?
Put ticks (✓) in the boxes next to the **three** correct answers.

detecting cracks in metal pipes	☐
as a tracer in the body	☐
sterilising surgical instruments	☐
irradiating food	☐
treating cancer	☐
detecting smoke	☐

[2]

(b) People working with radioactive sources often wear detectors to measure how much ionising radiation they are exposed to.

One type of detector is a badge with photographic film covered by three different materials.

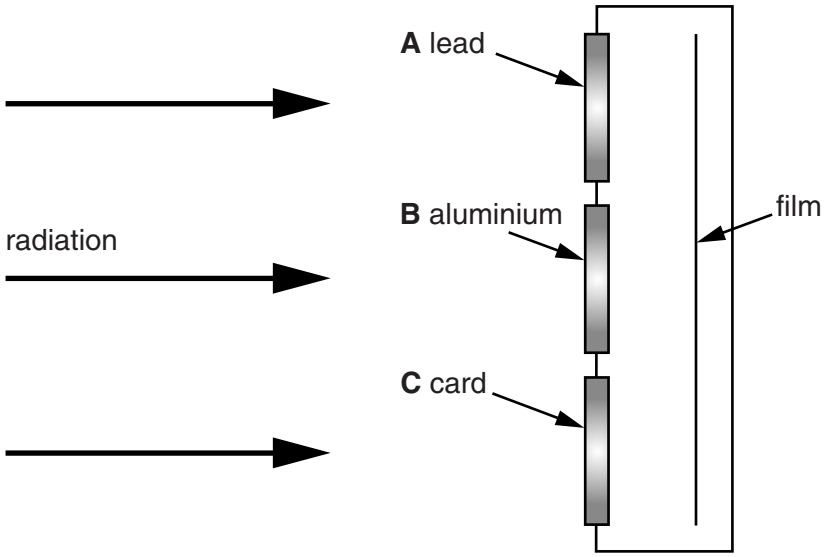
The photographic film records the amount of radiation that reaches it.

The badge has three sections.

Section **A** is covered with lead.

Section **B** is covered with aluminium.

Section **C** is covered with card.



(i) Which sections can be used to detect beta and gamma radiation?
Explain your answer.

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

(ii) The badge cannot be used to detect alpha radiation.
Explain why.

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

[Total: 5]

8 The energy from a nuclear reactor is produced using the nuclear fuel uranium.
The reactor produces an average of 3.0×10^9 joules of thermal energy per second.

(a) (i) What mass of uranium will be converted to energy by the power station during one second?
The speed of light is 3×10^8 m/s.

mass = ... kg **[3]**

(ii) How does this compare with the mass of coal used in a coal fired power station that produces the same amount of energy per second?

Explain your answer.

.....

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

(b) (i) Energy in the power station is produced by the fission of uranium.
Complete this nuclear equation for a fission reaction in the power station

$$ {}_0^1n + {}_{92}^{235}U \rightarrow {}_{40}^{98}Zr + {}_{.....}^{.....}Te + 3{}_0^1n $$

[2]

(ii) Explain how the nuclear fission reaction is controlled in a nuclear power station.
Include the following in your answer:
chain reaction, **fuel rod**, **control rod**, **coolant**.

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..... **[4]**

[Total: 11]

9 The Government is considering building more nuclear reactors.

One of the arguments against using nuclear reactors to produce energy is that they produce radioactive waste.

Are people in government right to worry about the risks of the different types of radioactive waste and how they are disposed of? Explain your answer.

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

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

[Total: 6]

END OF QUESTION PAPER

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