Candidate Name	Centre Number	Candidate Number
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WJEC CBAC

GCSE

247/02

SCIENCE PHYSICS
HIGHER TIER
PHYSICS 3

A.M. FRIDAY, 28 May 2010

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark awarded**
1.	**8**	
2.	**5**	
3.	**8**	
4.	**8**	
5.	**11**	
6.	**6**	
7.	**4**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2 of the examination paper. In calculations you should show all your working.

EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

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

$$v = u + at$$

$$v^2 = u^2 + 2ax$$

$$x = ut + \tfrac{1}{2}at^2$$

$$x = \tfrac{1}{2}(u + v)t$$

where x = distance
u = initial velocity
v = final velocity
a = acceleration
t = time

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

where V_1 = voltage across the primary
V_2 = voltage across the secondary
N_1 = number of primary turns
N_2 = number of secondary turns

momentum = mass × velocity

kinetic energy = $\frac{mv^2}{2}$, where m = mass,
v = velocity or speed.

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

wave speed = wavelength × frequency

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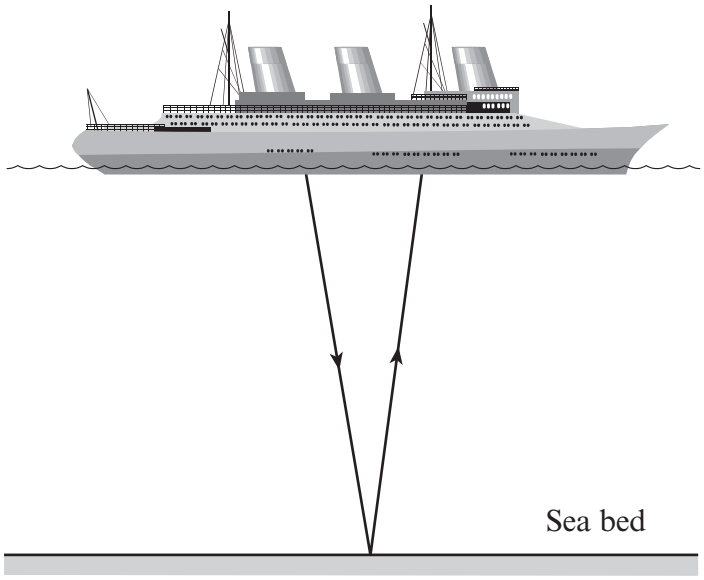
Answer **all** *questions.*

1. Ultrasound is used in sonar instruments to measure the depth of the sea.
These instruments operate at a frequency of 50 000 Hz.
The waves travel at a speed of 1500 m/s in water.



A wave is sent out from the boat to the sea bed and is received back 3 seconds later.

(a) State why ultrasound cannot be heard by humans. [1]

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(b) Use the equation

Distance = speed × time

to calculate the depth of the sea. [3]

Depth of sea = ... m

(c) State **one** other **non-medical** use of ultrasound. [1]

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(d) Use the equation

$$\text{wavespeed} = \text{wavelength} \times \text{frequency}$$

to find the wavelength of the ultrasound waves. [3]

wavelength = ... m

8

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2. The "two-second rule" can be used by drivers who want to keep at a safe distance behind the car in front.

The time taken to say "ONLY A FOOL BREAKS THE TWO-SECOND RULE" is about two seconds. The car in front passes a post. You are too close if you reach the post in less than two seconds.

The graph shows the official stopping distances given in the Highway Code and the stopping distances given by the 2-second rule.

(a) What is the stopping distance given by the Highway Code for a speed of 30 m/s? [1]

Stopping distance = ... m

(b) How much further does the 2-second rule give you to stop than the Highway Code at a speed of 10 m/s? [2]

Further distance = ... m

(c) Using the information from the graph, explain why the 2-second rule should not be used at speeds above 17 m/s. [1]

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(d) Explain why the **Highway Code graph** does not support the statement: "The stopping distance is proportional to the speed of the car". [1]

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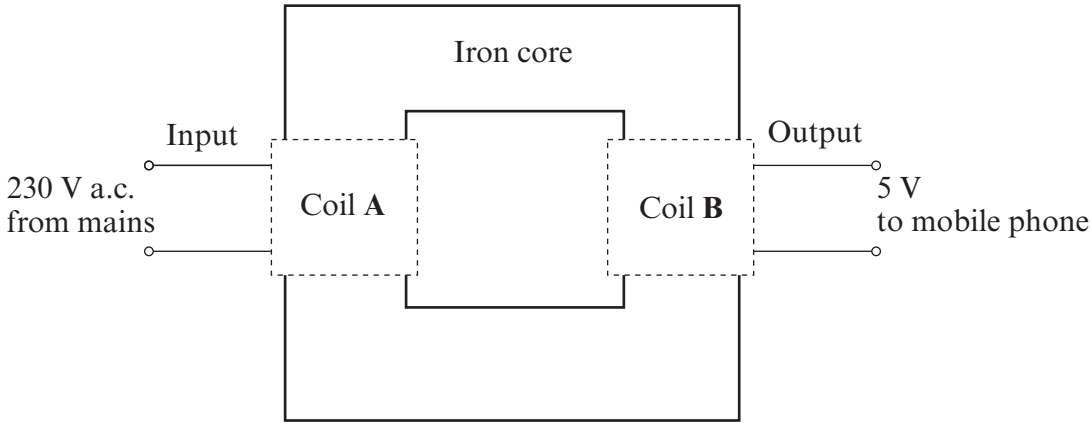
3. A mobile phone charger has a transformer in its plug. It changes a 230 V input to a 5 V output.



(a) Which coil, A or B should have the fewer number of turns?
Give a reason for your answer. [2]

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(b) Explain why the input voltage has to be alternating for the transformer to work. [1]

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(c) Explain the purpose of the iron core. [1]

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(d) Explain why an output voltage is produced. [1]

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(e) Coil **A** has 9200 turns.

Write down an equation as it appears on page 2 and use it to calculate the number of turns in coil B.

Equation: .....

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[1]

Calculation: [2]

Number of turns in coil B = ...

8

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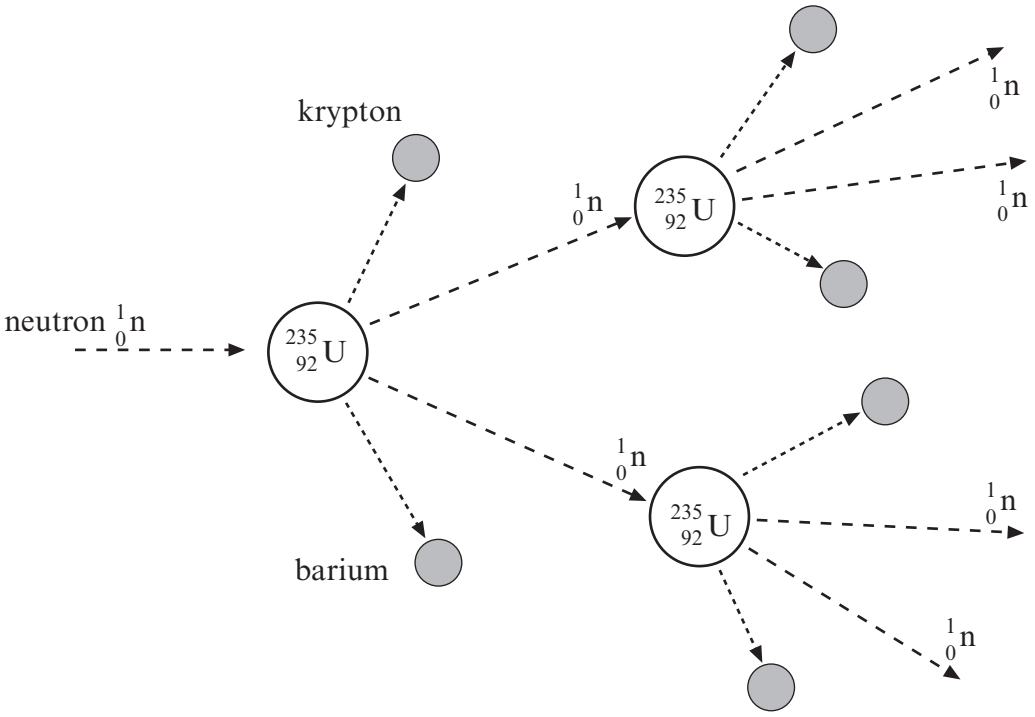
4. The diagram shows an uncontrolled nuclear fission reaction.

When a **slow-moving** neutron strikes an atom of $^{235}_{92}U$, the atom splits.

In this reaction two **fast moving** neutrons are produced together with the radioactive fission fragments of Ba (barium) and Kr (krypton).



(a) What name is given to an uncontrolled fission reaction? ..... [1]

(b) Complete the nuclear equation for this reaction. [2]

$$^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{144}_{\ldots\ldots}Ba + {}^{\ldots\ldots}_{36}Kr + 2\,{}^{1}_{0}n$$

(c) In a nuclear reactor, the fission reaction is controlled using control rods of boron steel which readily absorb neutrons and a graphite moderator which improves the chances of uranium atoms splitting apart.

(i) State how the graphite moderator improves the possibility of fission of uranium. [1]

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(ii) Explain how the energy released from a nuclear reactor can be increased. [1]

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(d) Outline the advantages of producing electricity from nuclear fusion rather than nuclear fission in the future. [3]

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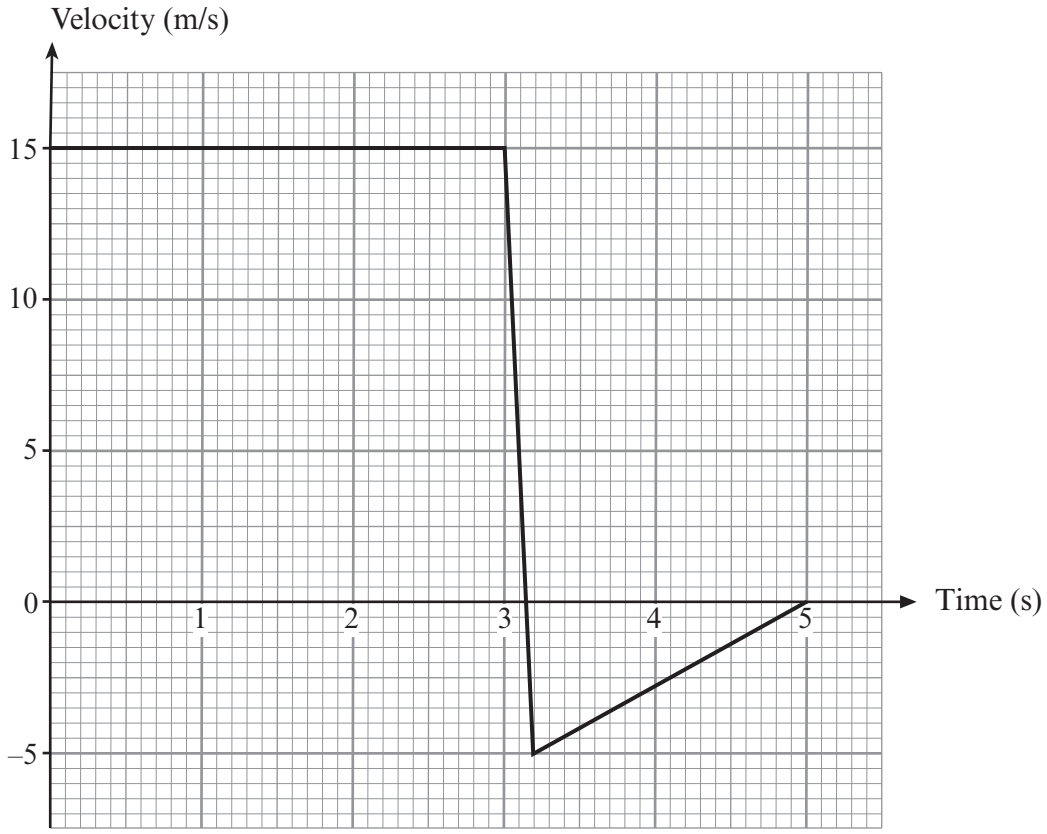
5. The graph shows the motion of a car travelling at 15 m/s colliding with a wall. The car rebounds with a speed of 5 m/s and comes to rest 2 seconds after hitting the wall.
The mass of the car is 1200 kg.



(a) How can you tell from the graph that the car is hit backwards in the collision? [1]

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(b) (i) Write down the duration of the collision. Duration = ... s [1]

(ii) Calculate the change in velocity of the car caused by the collision with the wall. [1]

Change in velocity = ... m/s

(iii) Use the equation

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

to calculate the force acting on the car during the collision. [2]

Force = ... N

(c) Select an equation from page 2 and use it to estimate the distance that the car rebounds from the wall.

Show your working

Equation .....

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[1]

Calculation: [3]

Rebound distance = ... m

(d) Name one safety feature in a modern car that reduces the force on the driver in a head-on collision and explain how it brings about that reduction. [2]

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6. Following Thomson's discovery of the electron in 1897, he proposed the plum pudding model of the atom.

(a) With the aid of a labelled diagram, describe Thomson's plum pudding model. [3]

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(b) Thomson's plum pudding model was later replaced by the Bohr-Rutherford model which has the following main features:

- At the core of every atom is a nucleus in which protons are contained, carrying the vast majority of the atom's mass.
- The electrons move in particular orbits around the nucleus.
- The electrons cannot exist anywhere between the orbits.

Use this information to explain how atoms can be made to emit radiation. You should use a diagram to help your answer. [3]

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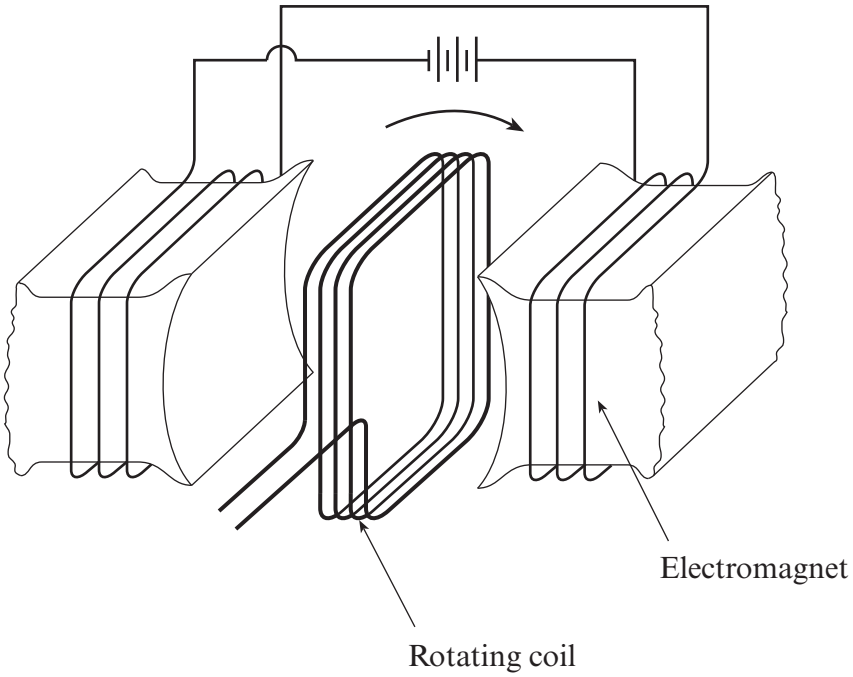
Examiner only

7. The diagram shows the construction of an a.c. generator.



Explain how the following design features maximise the effectiveness of the generator. [4]

- electromagnets are used instead of permanent magnets.
- the rotating coil has many turns instead of just one.
- the electromagnets have curved pole pieces.

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