UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME		
CENTRE NUMBER		CANDIDATE NUMBER

4618505102

PHYSICS **5054/22**

Paper 2 Theory **May/June 2011**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

UNIVERSITY *of* CAMBRIDGE
International Examinations

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Section A

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

1 A student wishes to find the density of a stone. He uses a measuring cylinder and a spring balance with a scale marked in newtons. The measuring cylinder, spring balance and stone are shown in Fig. 1.1.

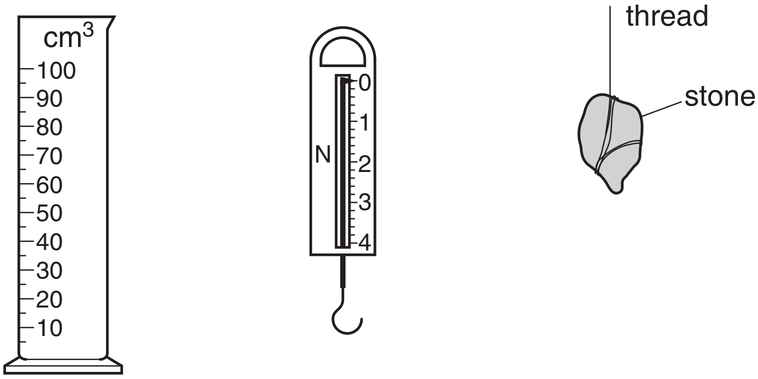

Fig. 1.1

The student knows that the gravitational field strength is 10 N / kg.

(a) Describe how the student uses the spring balance to find the mass of the stone.

....

....

....[2]

(b) Describe how the student uses the measuring cylinder to find the volume of the stone.

....

....

....[2]

(c) The mass of the stone is 150 g and its volume is 70 cm^3.
Calculate the density of the stone.

density of stone = ...[1]

(d) The stone is taken to another place, where the gravitational field strength is less than 10 N / kg. State how this affects the mass and the weight of the stone.

mass ....

weight ....

[1]

2 Fig. 2.1 illustrates the journey of a cyclist from point A to point B. Points A and B are at the same height.

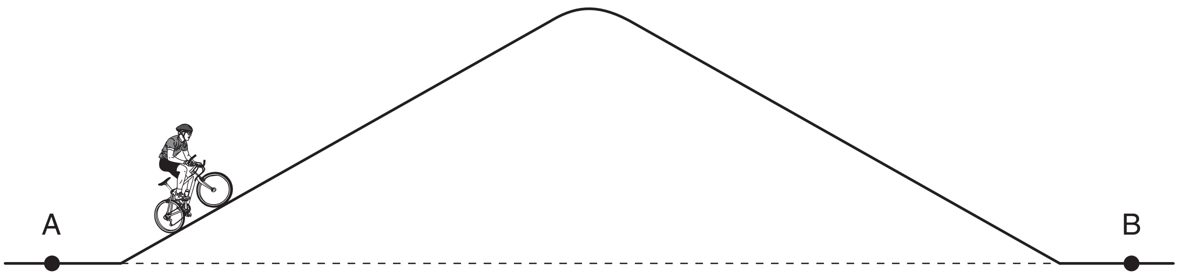

Fig. 2.1

The cyclist starts from rest at A and pedals up and over a hill. Near the bottom of the hill, she starts to brake and comes to rest at B.

(a) Describe the energy changes that take place as she pedals up the hill at constant speed.

....

....

....[3]

(b) Explain how the law of conservation of energy applies to the complete journey from A to B.

....

....

....[1]

(c) At one point in the journey, the gravitational potential energy of the cyclist has increased by 5400 J. The mass of the cyclist is 60 kg. The gravitational field strength is 10 N/kg.

Calculate the height above A of the cyclist at this point.

height above A = ...[2]

3 **(a)** Explain, using ideas about molecules,

(i) why a balloon filled with gas expands when heated,

....

....

....

....[2]

(ii) why a balloon filled with water expands very little when heated.

....

....[1]

(b) **(i)** A bubble of gas rises from the bottom of a lake to the surface. The pressure at the bottom of the lake is 3.0×10^5 Pa and the pressure at the surface is 1.0×10^5 Pa. The volume of the bubble at the bottom of the lake is $2.0\,cm^3$.

Calculate the volume of the bubble at the surface.

volume = ...[2]

(ii) State one assumption that you have made in your calculation in **(i)**.

....

....[1]

4 Fig. 4.1 shows circular wavefronts produced at the centre of a circular ripple tank.

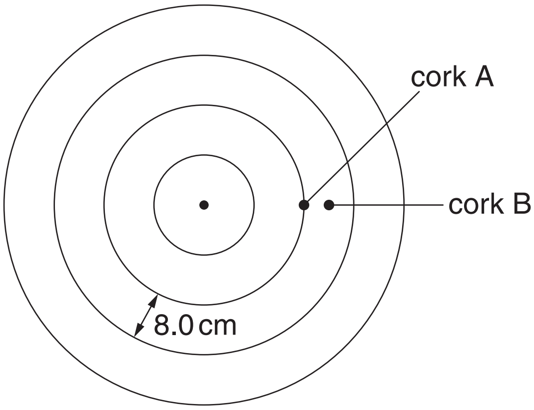

Fig. 4.1

Two corks, A and B, float on the water in the ripple tank. They move up and down on the surface of the water as the wave passes. The wavelength of the wave is 8.0 cm.

Fig. 4.2 shows how the displacement of A varies with time.

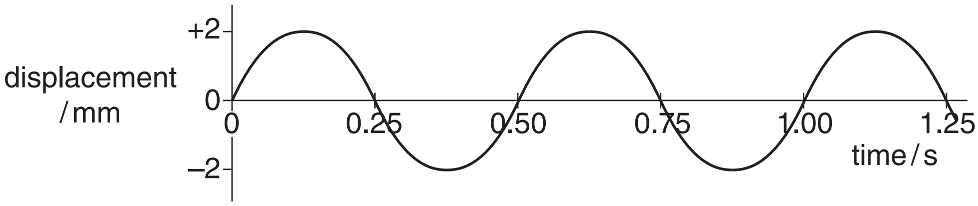

Fig. 4.2

(a) State the amplitude of the vibrations of A as the wave passes.

amplitude = ...[1]

(b) The horizontal distance between A and B is half the wavelength of the wave.

On Fig. 4.2, sketch a graph to show how the displacement of B varies with time. [2]

(c) (i) Use Fig. 4.2 to determine the frequency of the wave.

frequency = ...[2]

(ii) The distance between the centre of the ripple tank and its edge is 40 cm.

Determine the time taken by a wavefront to travel from the centre of the tank to the edge.

time = ...[2]

5 Fig. 5.1 shows part of a low-voltage lighting circuit.

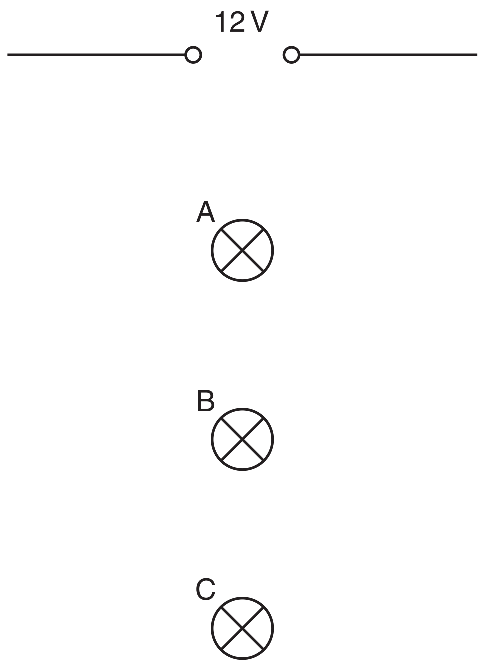

Fig. 5.1

The power supply voltage is 12 V.

(a) On Fig. 5.1, complete the circuit, adding components as necessary, so that:

- the total current in the circuit can be measured,
- lamp A is on all the time,
- lamps B and C are in series with each other and are switched on or off together.

[3]

(b) All the lamps are on. The potential difference (p.d.) across lamp B is 8.0 V and the current in lamp B is 50 mA.

(i) Calculate the resistance of lamp B.

resistance = ... [2]

(ii) State the current in lamp C.

current = ... [1]

6 The cable from the mains plug to a washing machine contains a live wire, a neutral wire and an earth wire. The earth wire is connected to the metal case of the washing machine.

(a) Explain how connecting the earth wire to the metal case makes the washing machine safer.

....

....

....[2]

(b) When in use, the average input power to the washing machine is 500 W.

Calculate the number of kW h of energy used by the washing machine in 45 minutes of use.

number of kW h = ...[2]

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7 Fig. 7.1 shows some parts of a cathode-ray oscilloscope.

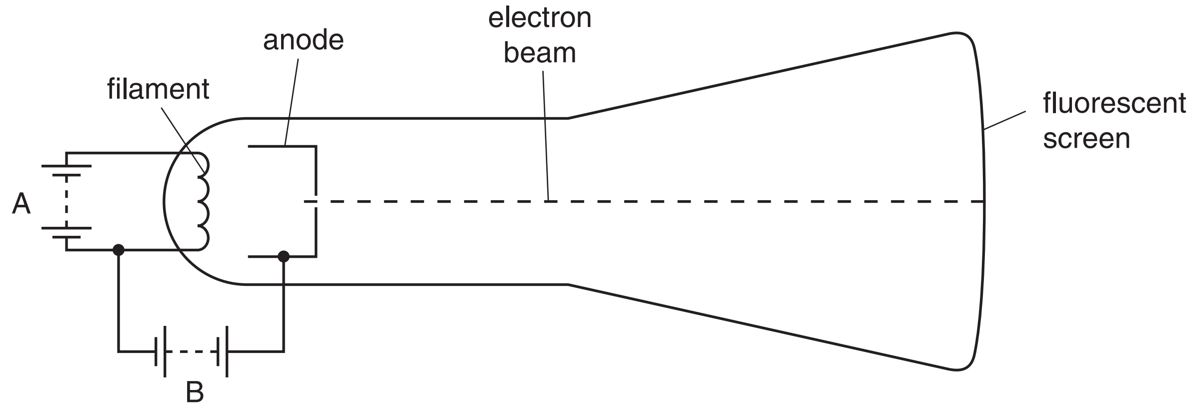

Fig. 7.1

(a) Explain why reversing battery A has no effect on the electron beam.

....

....

....[2]

(b) The connections to battery B are reversed. State and explain the effect on the electron beam.

....

....

....[2]

8 Fig. 8.1 illustrates the process that occurs in the core of a nuclear reactor.

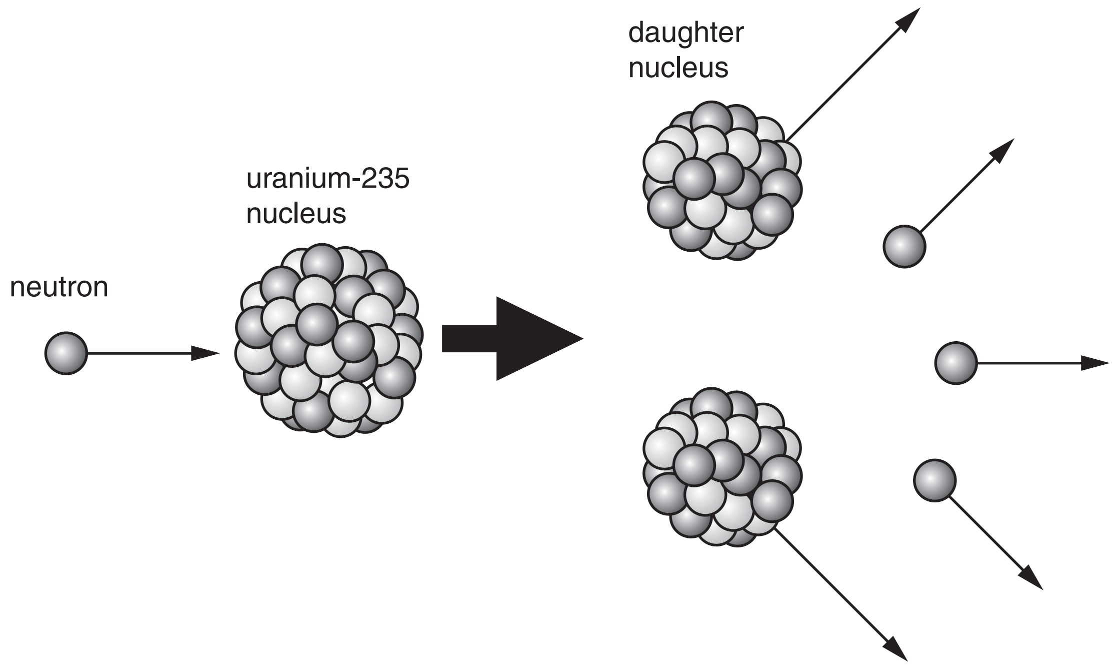

Fig. 8.1

(a) State the name of the process illustrated in Fig. 8.1.

....[1]

(b) Describe what happens during this process.

....

....

....[2]

(c) Some of the waste from a nuclear reactor is radioactive with a long half-life.

Explain what is meant by

(i) *radioactive*,

....

....[1]

(ii) a *long half-life*.

....

....[2]

Section B

Answer **two** questions from this section. Answer in the spaces provided.

9 Fig. 9.1 shows a sky-diver falling vertically.

Fig. 9.1

The sky-diver starts from rest at time $t = 0$.
His acceleration is non-uniform until he reaches a steady speed of 50 m/s at $t = 10$ s.
He opens his parachute at $t = 20$ s and decelerates until $t = 25$ s.
From $t = 25$ s he falls at a steady speed of 5 m/s.

(a) (i) On Fig. 9.2, draw the speed-time graph for the sky-diver. [4]

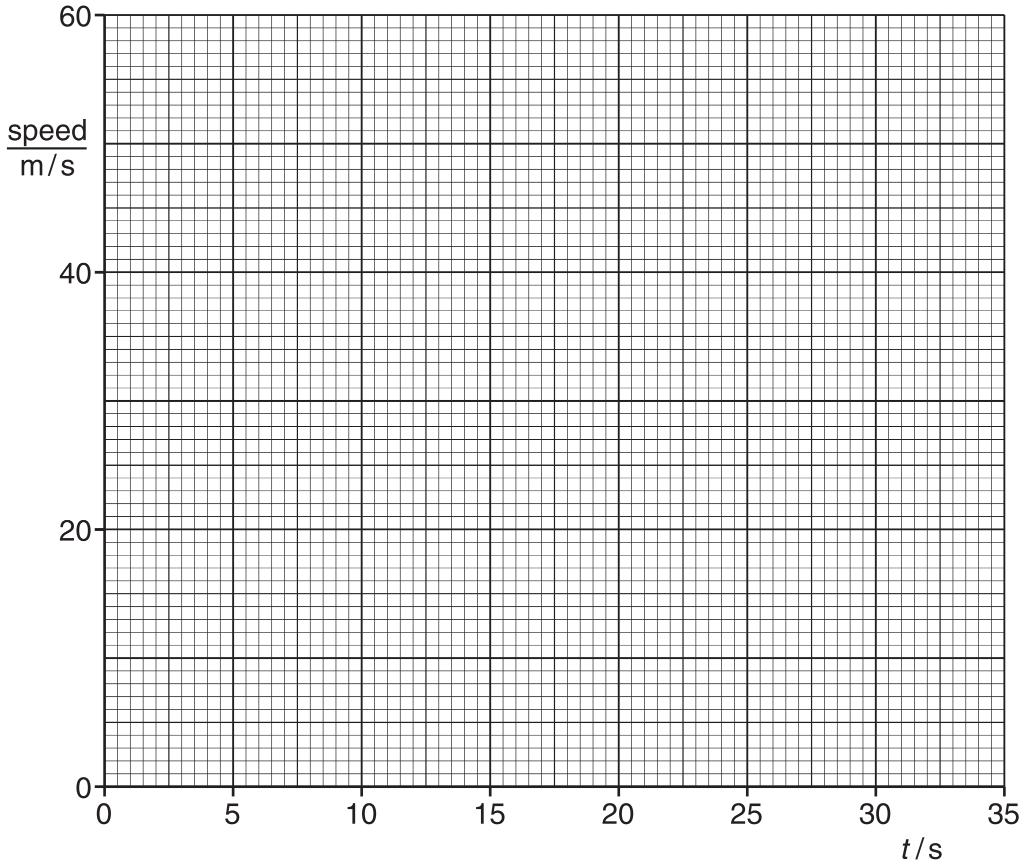

Fig. 9.2

(ii) State how your graph shows that the acceleration is non-uniform between $t = 0$ and $t = 10$ s.

....

....[1]

(b) Explain, in detail, why **after** the sky-diver opens his parachute, he decelerates and eventually reaches a steady speed.

....

....

....

....

....

....[4]

(c) For the time interval between t = 10 s and t = 20 s, calculate the distance that the sky-diver falls.

distance = ...[1]

(d) The mass of the sky-diver is 60 kg.

For the time interval between t = 20 s and t = 25 s,

(i) calculate the average deceleration of the sky-diver,

average deceleration = ...[2]

(ii) calculate the average resultant force acting on the sky-diver,

force = ...[2]

(iii) state how your graph in Fig. 9.2 may be used to obtain the distance that the sky-diver falls.

....

....[1]

10 **(a)** Describe an experiment to measure the critical angle for light in glass or perspex.

Your answer should include a labelled diagram.

....

....

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....

....

....

....

....[5]

(b) Fig. 10.1 represents a simple camera.

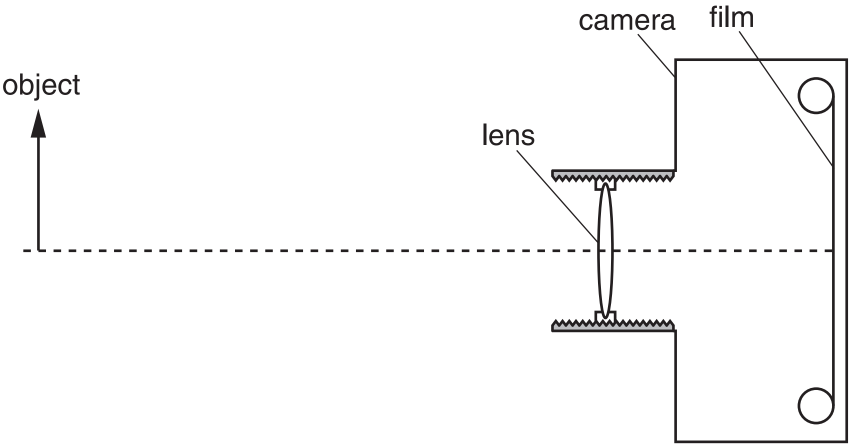

Fig. 10.1 (to scale)

(i) State the type of lens used in this simple camera.

....[1]

(ii) Draw two rays from the top of the object to show how the image is formed on the film. Mark and label the image on the film. [3]

(iii) Define the term *linear magnification*.

....

....[1]

(iv) Fig. 10.1 is drawn to scale. Determine the linear magnification of the object shown in Fig. 10.1.

magnification = ...[1]

(v) Apart from its size, state one other property of the image formed by the lens.

....[1]

(vi) Explain why, when taking photographs of other objects, it may be necessary to move the lens towards the film.

....

....

....

....[3]

11 (a) In an experiment to measure the specific heat capacity of water, an electric heater heats water in a glass beaker. The temperature of the water is measured at regular intervals of time. Fig. 11.1 shows how the temperature varies with time t.

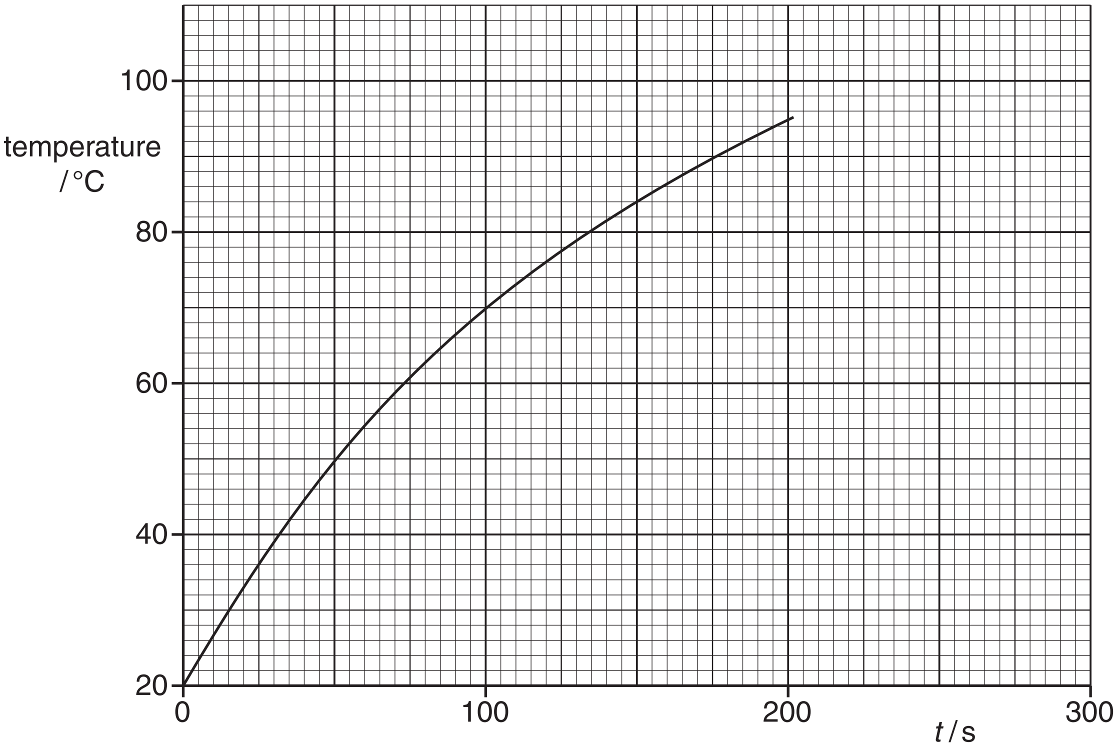

Fig. 11.1

(i) Use Fig. 11.1 to determine the change in temperature between

$t = 0$ and $t = 100\,\text{s}$,

change = ...

$t = 100\,\text{s}$ and $t = 200\,\text{s}$.

change = ...

[1]

(ii) State and explain why the values in **(i)** are different.

....

....

....[2]

(iii) Describe and explain what happens to the water if the heating is continued.

....

....

....[2]

(b) **(i)** The experiment in **(a)** is repeated using 72 g of water. The heater supplies 7400 J of thermal energy (heat) to the water and the temperature rise of the water is 23 °C.

Calculate the specific heat capacity of water.

specific heat capacity = ...[2]

(ii) A bullet of mass 72 g is fired from a gun at a speed of 450 m/s.

Calculate the kinetic energy of the bullet.

energy = ...[3]

(iii) The amount of internal energy gained by the water and the amount of kinetic energy gained by the bullet are approximately equal.

Describe the change in the motion of the molecules of the water and of the molecules of the bullet that this addition of energy has caused.

water: ....

....

bullet: ....

....
[3]

(c) A thermocouple is used in the experiment in **(a)**. In the space below, draw a labelled diagram of a thermocouple thermometer. Show clearly the part of the thermocouple that is placed in the water in this experiment.

[2]

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