UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

7007428557

PHYSICS **5054/22**

Paper 2 Theory **May/June 2012**

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.

This document consists of **16** printed pages.

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Section A

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

1 Fig. 1.1 shows apparatus used to obtain the readings for a graph of force against extension for a spring.

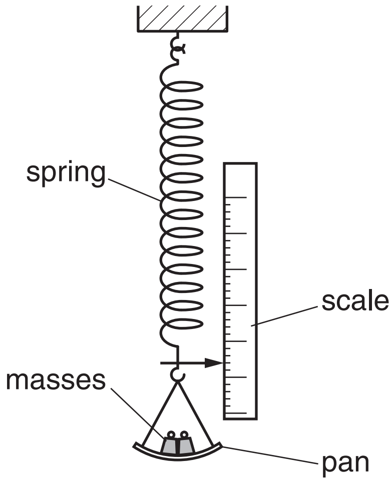

Fig. 1.1

The masses added to the pan produce a force that stretches the spring.

(a) **(i)** State what is meant by the *mass* of a body.

....

....[1]

(ii) Describe how the scale is used to find the extension of the spring.

....

....

....[1]

(b) Fig. 1.2 shows the force-extension graphs for two different springs.

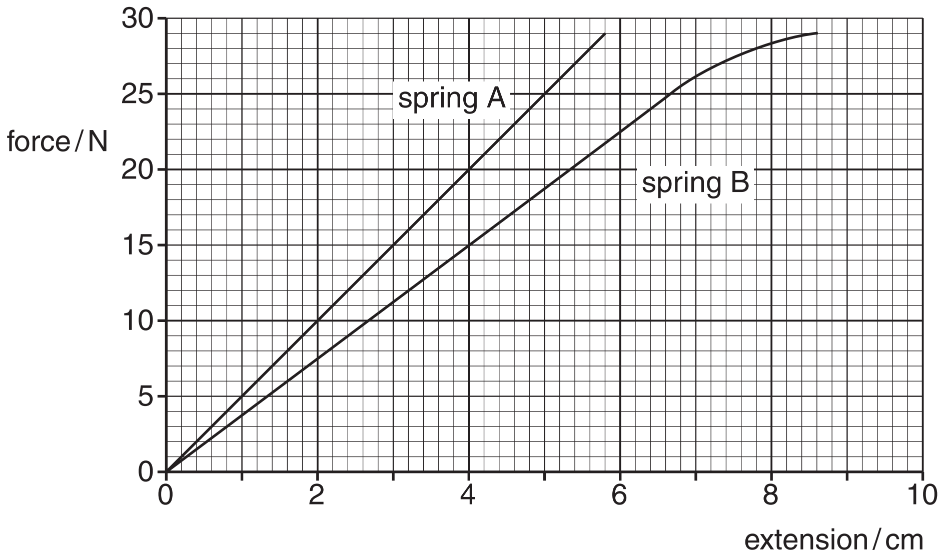

Fig. 1.2

(i) A student states that spring B is easier to stretch than spring A.

Use values from Fig. 1.2 to explain what the student means.

....

....

....[1]

(ii) When a force of 25 N is applied, spring B reaches its limit of proportionality but spring A does not. Explain how Fig. 1.2 shows this.

....

....

....[1]

(iii) The same force is applied to each spring.

Using Fig. 1.2, determine the force that produces an extension of spring B that is 1.0 cm greater than the extension of spring A.

force = ...[1]

2 **(a)** State what is meant by *friction*.

....

....[2]

(b) Fig. 2.1 shows two horizontal forces that act on a car. Force B is caused by air resistance and friction.

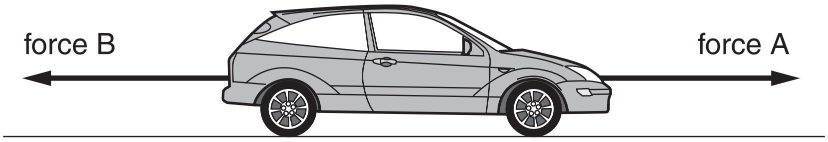

Fig. 2.1

The car is travelling along a straight level road.

(i) The forward force A and the backward force B are equal.
Describe the motion of the car.

....

....[1]

(ii) The mass of the car is 800 kg.
Force A increases to 5000 N. This causes the car to accelerate initially at 1.5 m/s^2.
Calculate the size of force B.

force B = ...[3]

(iii) Force A remains constant at 5000 N. Explain why the acceleration decreases as the car travels along the level road.

....

....[2]

(c) A car of mass 800 kg climbs a hill and rises a vertical distance of 200 m.
Calculate the gain in potential energy of the car. (The gravitational field strength *g* is 10 N/kg.)

gain in potential energy = ...[2]

3 Fig. 3.1 shows the plan of a bedroom and part of the main room of a house. Other rooms are not shown.

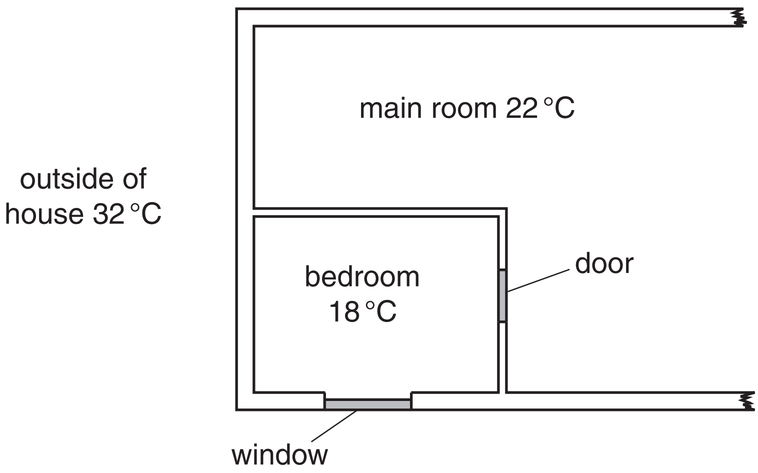

Fig. 3.1

The temperatures of the main room, the bedroom and the outside of the house are shown on Fig. 3.1.

Fig. 3.2 shows all the thermal energy (heat) inputs to the bedroom in one hour.

thermal energy input to bedroom	
through door and walls from main room	50 000 J
through walls from outside of house	2 000 000 J
through window	1 000 000 J
from person sleeping in bedroom	250 000 J

Fig. 3.2

(a) Suggest why more thermal energy enters the bedroom from the outside of the house than from the main room.

....[1]

(b) An air conditioner keeps the temperature constant in the bedroom by removing thermal energy.

(i) Calculate the total thermal energy that the air conditioner removes from the bedroom in one hour.

thermal energy = ...[1]

(ii) The electrical power input to the air conditioner is 300 W.
Calculate the electrical energy input into the air conditioner in 1 hour.

energy = ... [2]

(c) The air conditioner cools the air at the top of the room. This causes a convection current in the room.

Explain how the cold air gives rise to the convection current.

....

....

.... [3]

4 A beaker contains 60 g of a hot substance, initially in the liquid state. Fig. 4.1 shows how the temperature of the substance changes with time t as it cools in a laboratory.

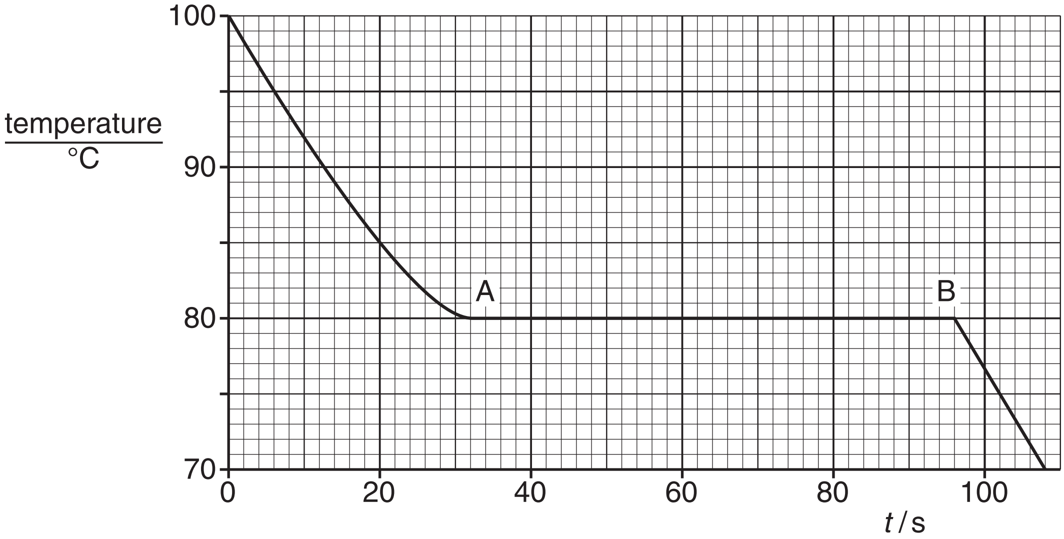

Fig. 4.1

(a) Use Fig. 4.1 to determine the melting point of the substance.

....[1]

(b) The specific heat capacity of the liquid is 1.7 J / (g °C). Calculate the loss of thermal energy (heat) from the liquid between $t = 0$ and $t = 20$ s.

loss of thermal energy = ...[2]

(c) Between points A and B on Fig. 4.1, the temperature is constant as the substance changes from liquid to solid.

(i) Explain why the temperature stays constant, even though thermal energy is lost by the substance.

....

....[2]

(ii) Describe the change in the arrangement of the molecules as the substance changes from a liquid to a solid.

....

....

....[2]

5 Optical fibres are used to transmit telephone signals. Fig. 5.1 shows a ray of light that strikes the inside surface of an optical fibre at P.

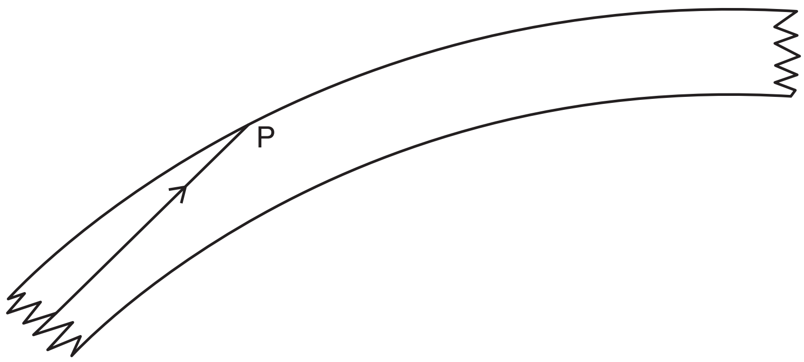

Fig. 5.1

(a) State one advantage of using optical fibres to transmit telephone signals.

....

....[1]

(b) **(i)** On Fig. 5.1, draw a normal at P and mark the angle of incidence with the letter *i*. [1]

(ii) State and explain what happens to the ray at P. Use the term *critical angle* in your answer.

....

....

....[2]

(c) The optical fibre is made of glass of refractive index 1.5.
At the start of the optical fibre, the ray enters the glass from air.
The angle of incidence in the air is 60°.

Calculate the angle of refraction in the glass.

angle = ...[2]

6 Fig. 6.1 shows a wave on the surface of water. The wave is travelling to the right.

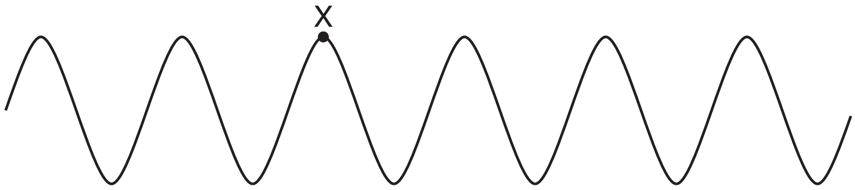

Fig. 6.1 (not to scale)

(a) Describe what is meant by *wave motion*.

....

....

....[2]

(b) On Fig. 6.1, draw an arrow to show the direction of the movement of a water molecule at X. [1]

(c) The frequency of the water wave is 2.0 Hz and the wavelength is 2.5 cm.

(i) Calculate the speed of the wave.

speed = ...[2]

(ii) On Fig. 6.1, mark a distance which shows how far a wavefront at X moves in 1.0 s.
Label this distance *D*. [1]

7 Fig. 7.1 shows two charged metal spheres.

One sphere has a positive charge and the other sphere has a negative charge.

Fig. 7.1

(a) On Fig. 7.1, draw the electric field between the two spheres. [2]

(b) The negative charge on the sphere is removed and a wire is used to connect the positive sphere to earth. The charge on the positive sphere decreases from 4.8×10^{-9} C to zero in a time of 2.0×10^{-6} s.

Calculate the average current in the wire.

current = ...[2]

Section B

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

8 A student investigates how the resistance of a wire depends upon its length. The student uses an ammeter, a voltmeter, a battery, a fixed resistor and the wire under test, all connected in an electrical circuit.

(a) (i) In the space below, draw a circuit diagram of the apparatus. Label the wire under test with the letter W.

[3]

(ii) Describe how the student obtains one complete set of results.

....

....

....[2]

(iii) During the experiment, the student keeps the temperature of the wire constant.

1. Suggest why it is sensible to keep the temperature of the wire constant.

....

....[1]

2. Suggest how the student keeps the temperature of the wire constant.

....

....[1]

(b) Fig. 8.1 shows part of a circuit containing three resistors X, Y and Z.

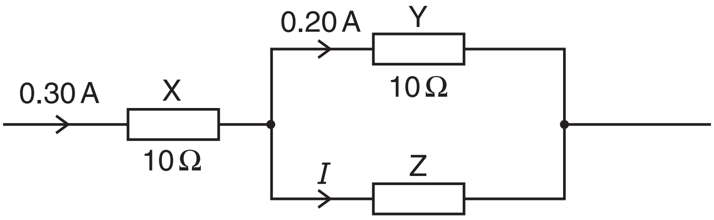

Fig. 8.1

The resistance of X and the resistance of Y are each 10 Ω. The current through X is 0.30 A. The current through Y is 0.20 A.

(i) Calculate the potential difference (p.d.) across Y.

p.d. = ...[2]

(ii) Calculate the current I in resistor Z.

I = ...[1]

(iii) Explain in words, rather than by calculation, how Fig. 8.1 shows that the resistance of Z is larger than the resistance of Y. Use ideas about p.d. and current in your answer.

....

....

....[2]

(iv) Calculate the total resistance of the resistors X, Y and Z in this circuit.

resistance = ...[3]

9 Fig. 9.1 shows two coils of insulated wire wound on an iron ring. Coil A is connected to a battery and a switch. The switch is open. Coil B is connected to a sensitive centre-zero voltmeter.

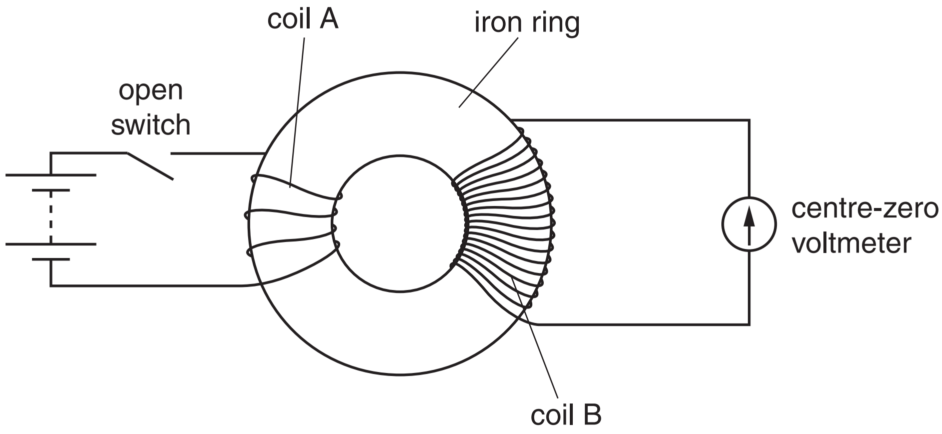

Fig. 9.1

The switch is closed. There is a current in coil A.

(a) On Fig. 9.1,

(i) mark the direction of the current in coil A, [1]

(ii) draw the magnetic field lines produced in the iron ring. [3]

(b) As the switch is closed, the voltmeter deflects to the right and then returns to zero.

(i) Explain why there is a deflection on the voltmeter.

....

....

....[2]

(ii) The switch is opened. State and explain what happens to the deflection on the voltmeter.

....

....

....[2]

(iii) Without changing coil A, state two changes to the apparatus that cause a greater deflection of the voltmeter.

1. ....

2. ....

[2]

(c) The battery in Fig. 9.1 is replaced by an alternating current (a.c.) supply. The output from coil B is used to power a lamp that is a long distance away. Each lead from coil B to the lamp has a resistance of 2.5 Ω. These leads are represented by the two resistors shown in Fig. 9.2.

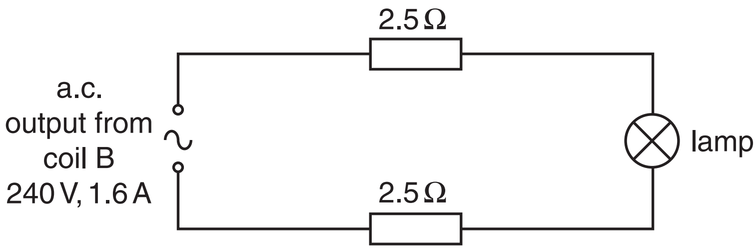

Fig. 9.2

The output voltage of coil B is 240 V and the current in the circuit is 1.6 A.

(i) Calculate the electrical power produced by coil B.

power = ...[2]

(ii) Calculate the total power loss in the leads to the lamp.

power loss = ...[3]

10 To find out whether a radioactive source emits alpha-particles, beta-particles or gamma-rays, the source is placed in front of a radiation detector, as shown in Fig. 10.1.

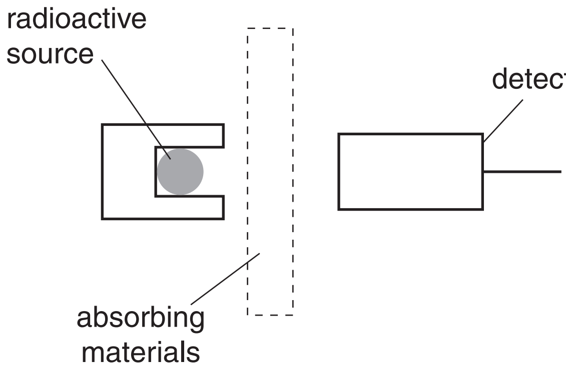

Fig. 10.1

Different absorbing materials are placed between the source and the detector. The detector measures the number of counts per minute.

(a) State what is meant by

(i) an alpha-particle,

....

....[2]

(ii) a gamma-ray.

....

....[2]

(b) **(i)** Suggest why, in this experiment,

1. the distance between the source and the detector is only a few centimetres,

....

....[2]

2. the half-life of the radioactive source is longer than a few minutes.

....

....[1]

(ii) State one precaution taken when using a radioactive source.

....

....[1]

(c) Fig. 10.2 shows the results obtained.

source present	material between source and detector	counts per minute
no	none	10
yes	none	1200
yes	thin paper	820
yes	5 mm aluminium	820

Fig. 10.2

Using information from Fig. 10.2, state and explain whether the source emits

(i) alpha-particles,

....

....[1]

(ii) beta-particles,

....

....[2]

(iii) gamma-rays.

....

....[1]

(d) There is a count recorded even when no source is present. This is caused by background radiation.

State two sources of background radiation.

1. ....

2. ....

[2]

(e) Describe one effect on the human body of a very high level of radiation.

....

....[1]