UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

6644304748

PHYSICS **5054/21**

Paper 2 Theory **May/June 2013**

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 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.

Electronic calculators may be used.
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.

© UCLES 2013

Section A

For Examiner's Use

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

1 Fig. 1.1 shows how the length of a spring varies as the force applied to it increases.

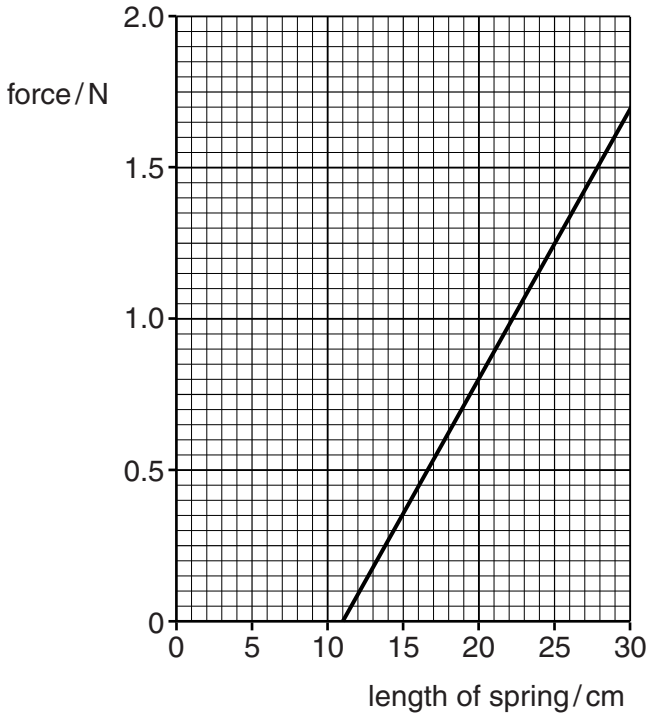


Fig. 1.1

(a) Determine the length of the unstretched spring.

length = ...[1]

(b) Explain how the graph shows that the limit of proportionality is not reached.

.....

.....[1]

(c) The spring is attached to a mass M of 0.20 kg and placed on a frictionless surface, as shown in Fig. 1.2.

For Examiner's Use

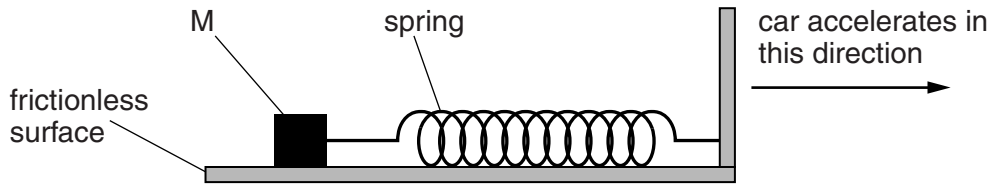


Fig. 1.2 (not to scale)

The apparatus is placed on the floor of a car.

When the car accelerates uniformly in the direction shown, the spring extends.

(i) State what is meant by a *uniform acceleration*.

.....

.....

.....[2]

(ii) The extension of the spring is 9.0 cm.

Using Fig. 1.1, determine

1. the horizontal force on M,

force = ...[1]

2. the acceleration of M.

acceleration = ...[2]

2 Fig. 2.1 shows apparatus used to investigate the turning effect of a force.

For Examiner's Use

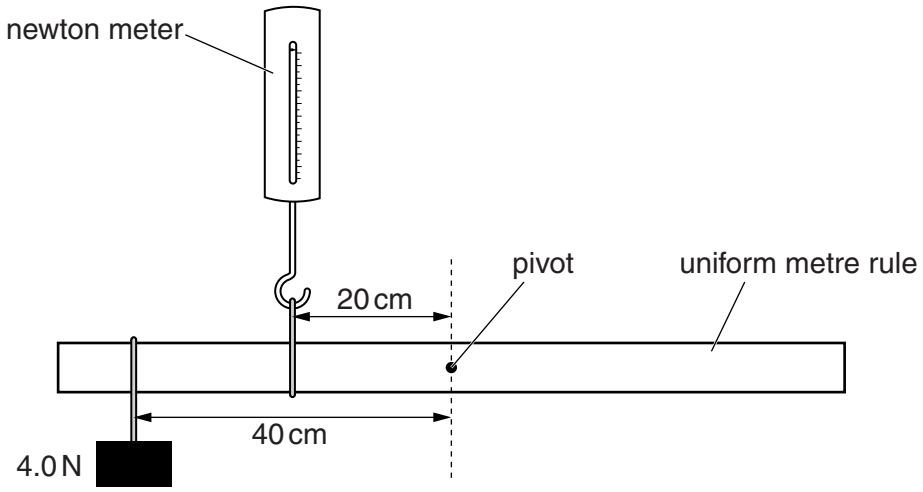


Fig. 2.1

The uniform metre rule is freely pivoted at its centre.

The newton meter is 20 cm from the pivot and a 4.0 N weight is 40 cm from the pivot.

The metre rule is in equilibrium.

(a) State the principle of moments for a body in equilibrium.

.....

.....

.....[1]

(b) Calculate the reading on the newton meter.

reading = ...[2]

(c) The weight of the metre rule is 1.2 N.

Calculate the size of the force exerted on the metre rule by the pivot.

force = ...[2]

© UCLES 2013

3 Fig. 3.1 shows a glass tube dipped into mercury. A vacuum pump is connected to the top of the tube and switched on. The mercury rises up the tube and stops.

For Examiner's Use

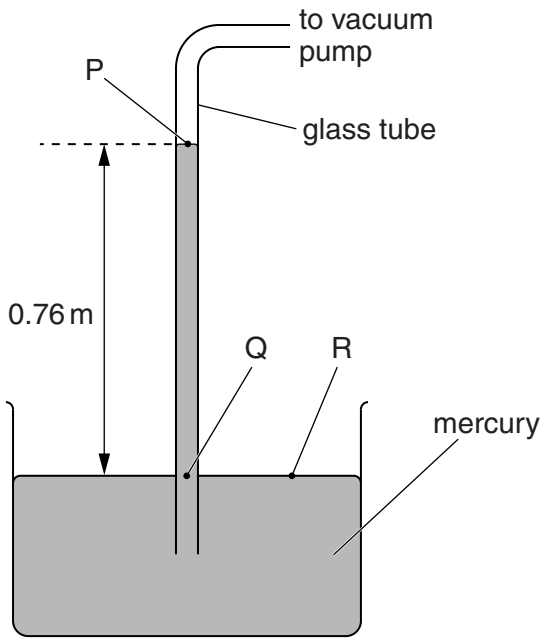


Fig. 3.1

(a) Three points on Fig. 3.1 are labelled P, Q and R.

State which **two** of these points are at atmospheric pressure.

.....[1]

(b) The density of mercury is 13600 kg/m^3 and the gravitational field strength g is 10 N/kg.

Calculate the pressure due to the column of mercury of length 0.76 m.

pressure = ...[2]

(c) State and explain what happens if the mercury in the apparatus shown in Fig. 3.1 is replaced with water.

.....

.....

.....[2]

© UCLES 2013

[Turn over

For Examiner's Use

4 **(a)** Fig. 4.1 shows a laboratory thermometer.

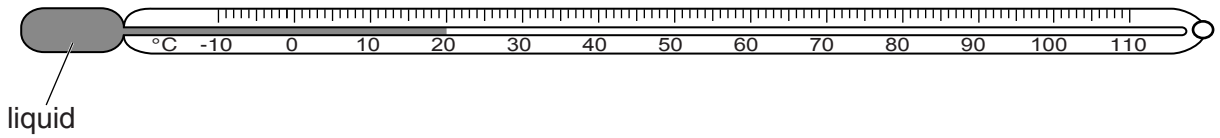


Fig. 4.1

(i) State the range of the thermometer shown in Fig. 4.1.

.....[1]

(ii) Describe how Fig. 4.1 shows that the thermometer has a linear scale.

.....

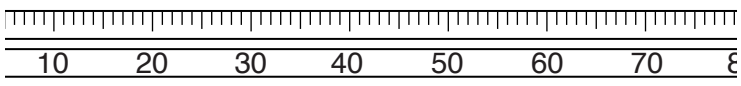
.....

.....[1]

(iii) The manufacturer of the thermometer changes the design to make a more sensitive thermometer.

Fig. 4.2 shows part of the scale on the original thermometer.

On Fig. 4.3, draw a more sensitive scale.



part of the scale on the original thermometer

Fig. 4.2

your scale showing a more sensitive thermometer

Fig. 4.3 [1]

(b) State one other property, apart from volume or expansion, which can be used to measure temperature.

.....[1]

5 Fig. 5.1 shows a ray of light that enters a semicircular glass block at A.
At B, some of the light is reflected and some light leaves the glass and travels along the surface.

For Examiner's Use

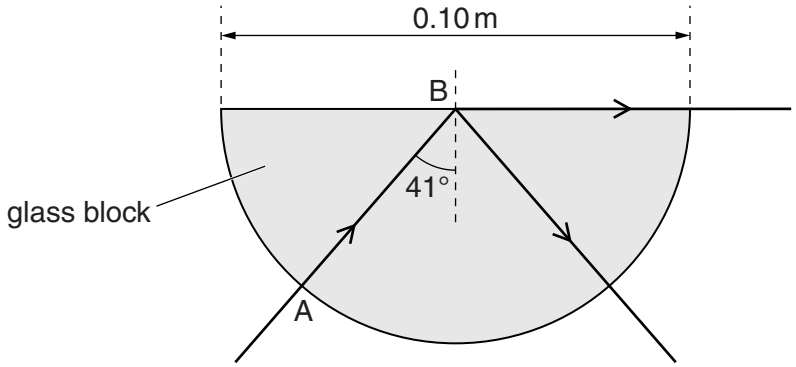


Fig. 5.1

(a) State the name of the angle of incidence marked 41°.

.....[1]

(b) Rays of light are incident at B with different angles of incidence.

(i) On Fig. 5.2a, the angle i_1 is less than 41°.
Draw the path taken by the ray of light after B.

(ii) On Fig. 5.2b, the angle i_2 is greater than 41°.
Draw the path taken by the ray of light after B.

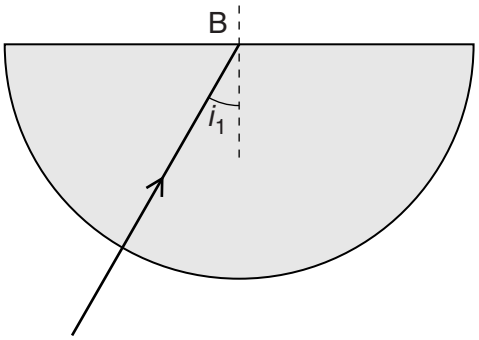


Fig. 5.2a

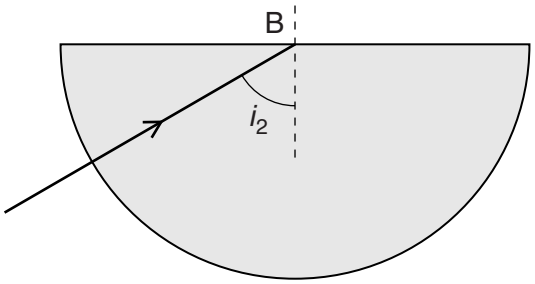


Fig. 5.2b [2]

(c) The speed of light in the glass block is 2.0×10^8 m/s.
The diameter of the glass block is 0.10 m.

Calculate the time taken for the light to travel from A to B.

time = ...[2]

6 Fig. 6.1 is a graph of current against potential difference (p.d.) for a length of metal wire.

For Examiner's Use

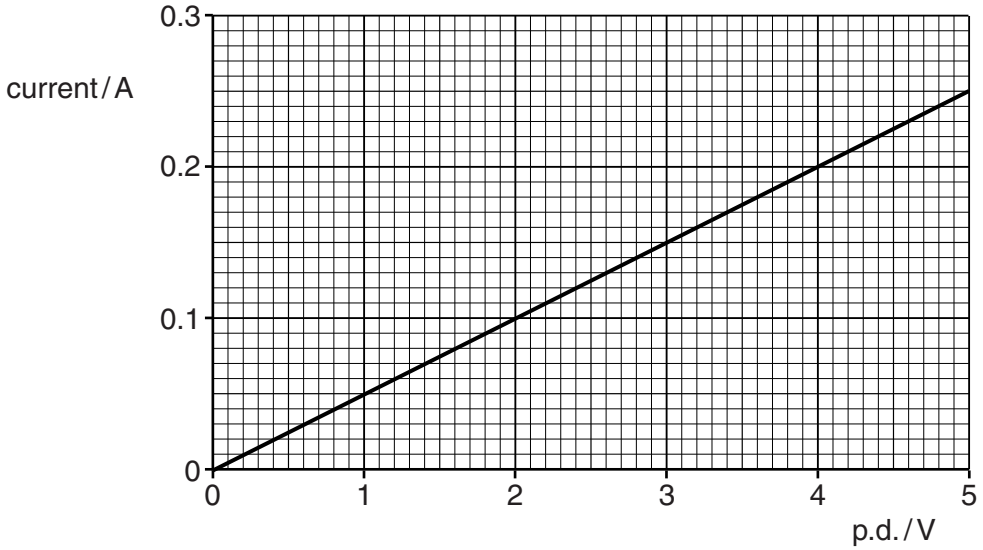


Fig. 6.1

(a) The metal wire obeys Ohm's law. State Ohm's law in words.

.....

.....

.....[2]

(b) Calculate the resistance of the metal wire.

resistance = ...[2]

(c) A new wire is made from the same metal as the original wire. The two wires have the same length. The cross-sectional area of the new wire is half that of the original wire.

(i) Calculate the resistance of the new wire.

resistance = ...[1]

(ii) On Fig. 6.1, draw a line to show how current varies with p.d. for the new wire. [2]

© UCLES 2013

7 A student connects a thermistor in series with a power supply and a fixed resistor.

For Examiner's Use

(a) In the space below, draw the circuit diagram of the apparatus.

[2]

(b) Values for potential difference (p.d.) and current are given in Fig. 7.1.

p.d. across the thermistor/V	p.d. across the fixed resistor/V	e.m.f. of power supply/V	current in the thermistor/A	current in the fixed resistor/A
8.0	4.0		0.018	

Fig. 7.1

The maximum power rating of the thermistor is 150 mW.

(i) In the blank spaces in Fig. 7.1, insert the values of the electromotive force (e.m.f.) of the power supply and the current in the fixed resistor. [2]

(ii) Calculate the power produced in the thermistor.

power = ...[2]

(iii) The e.m.f. of the power supply is doubled. Describe what happens to the thermistor.

.....

.....[1]

© UCLES 2013

[Turn over

8 Fig. 8.1 shows a simple transformer.

For Examiner's Use

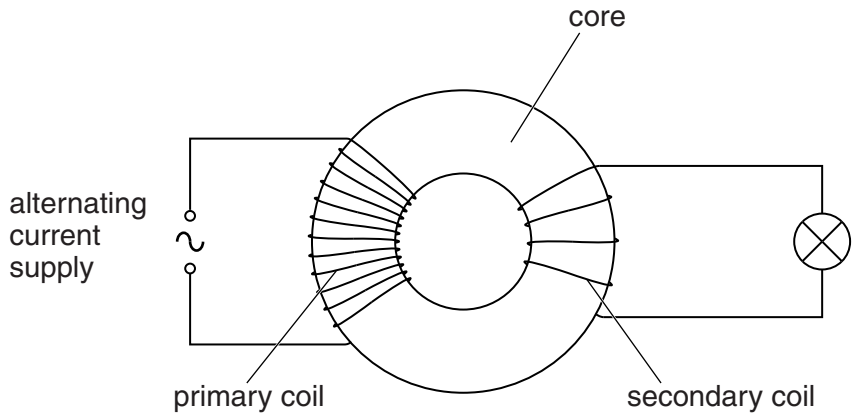


Fig. 8.1

(a) State the metal used for the core of a transformer.

.....[1]

(b) Explain how an alternating current in the primary coil causes the lamp to light.

.....

.....

.....

.....

.....

.....[3]

(c) Transformers are used to produce high voltages for the transmission of electrical power over long distances.

State one advantage of high voltage transmission.

.....

.....

.....[1]

Section B

For Examiner's Use

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

9 Fig. 9.1 shows a conveyor belt carrying suitcases into an aeroplane.

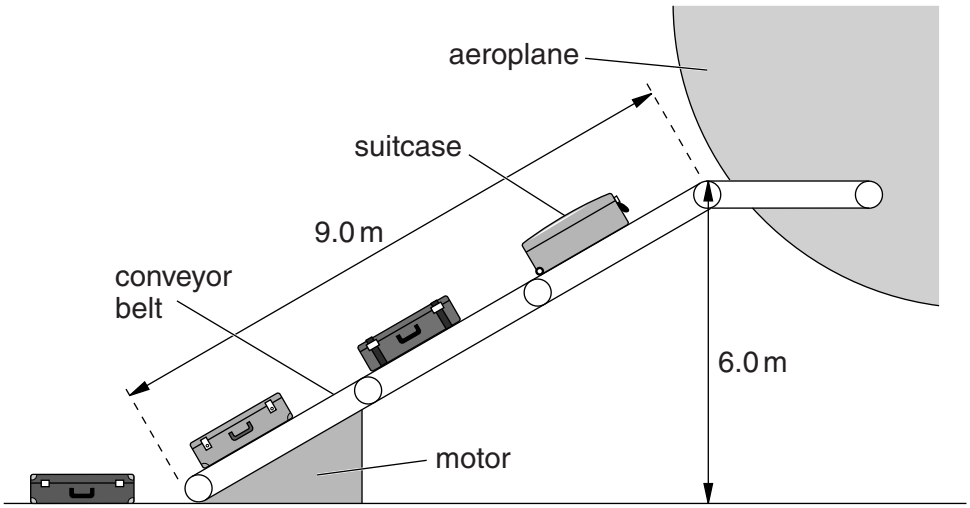


Fig. 9.1 (not to scale)

An electric motor drives the conveyor belt.

(a) A suitcase of mass 20 kg is lifted from the ground into the aeroplane.

(i) Explain what is meant by *mass* and by *weight*.

.....

.....

.....[2]

(ii) The gravitational field strength *g* is 10 N/kg.
Calculate the increase in the gravitational potential energy of the suitcase.

increase in potential energy = ...[2]

(iii) The suitcase takes 12 s to travel 9.0 m along the conveyor belt.
Calculate the kinetic energy of the suitcase.

kinetic energy = ...[3]

(iv) The electric motor is powered by an input voltage of 230 V and a current of 1.5 A. Calculate the electrical energy input to the motor in 12 s.

For Examiner's Use

energy = ...[2]

(v) **1.** State the principle of the conservation of energy.

.....

.....

.....[2]

2. Explain how this principle applies to the lifting of the suitcases into the aeroplane.

.....

.....

.....[1]

(b) Some of the electrical energy for the motor comes from renewable energy sources.

(i) Explain what is meant by a *renewable energy source*.

.....

.....

.....[1]

(ii) State two renewable energy sources.

1. .....

2. .....
[2]

© UCLES 2013

10 (a) The average input power to a freezer is 80 W. The cost of 1 kW h is 25 cents.

For Examiner's Use

(i) Explain what is meant by the *kilowatt-hour* (kW h).

.....

.....[2]

(ii) Calculate the cost of running the freezer for one week.

cost = ...[3]

(b) A large jug containing 1.5 kg of water is placed in the freezer.

(i) The water cools from 25 °C to 0 °C in a time of 60 minutes. The specific heat capacity of water is 4.2 J/(g °C).

Calculate the thermal energy (heat) removed from the water as it cools from 25 °C to 0 °C.

energy removed = ...[3]

(ii) After the water has reached 0 °C, thermal energy is removed from the water at the same rate as in **(i)**.

The specific latent heat of fusion of water is 3.3×10^5 J/kg.

Calculate the mass of water at 0 °C that becomes ice in 60 minutes.

mass = ... [2]

For Examiner's Use

(iii) Describe the arrangement and the movement of the molecules

1. in liquid water,

.....

.....

.....

.....[2]

2. in ice.

.....

.....

.....

.....[2]

(iv) Ice at 0 °C becomes water at 0 °C.

State what, if anything, happens to the kinetic energy and the potential energy of the molecules as this happens.

kinetic energy: .....

potential energy: .....
[1]

© UCLES 2013

For Examiner's Use

11 **(a)** The nucleus of an atom of carbon-14 is represented as $^{14}_{6}C$.

(i) Describe the structure of an atom of carbon-14.

.....

.....

.....[3]

(ii) Carbon has several isotopes.

Describe, in terms of the particles within the nucleus, how isotopes are

1. different from one another,

.....[1]

2. the same as one another.

.....[1]

(b) Carbon-14 decays by beta emission to a stable isotope of nitrogen.

Carbon-14 has a half-life of 5700 years and is used to find the age of objects by carbon dating.

(i) A pure sample of carbon-14 initially contains 8.0×10^{20} atoms.

Calculate the number of atoms of carbon and of nitrogen present in the sample after 11 400 years.

number of atoms of carbon = ...

number of atoms of nitrogen = ...
[3]

(ii) Explain why carbon-14 is not used to find the age of a piece of coal that has been in the ground for millions of years.

.....

.....[1]

(c) A teacher sets up the apparatus shown in Fig. 11.1.

For Examiner's Use

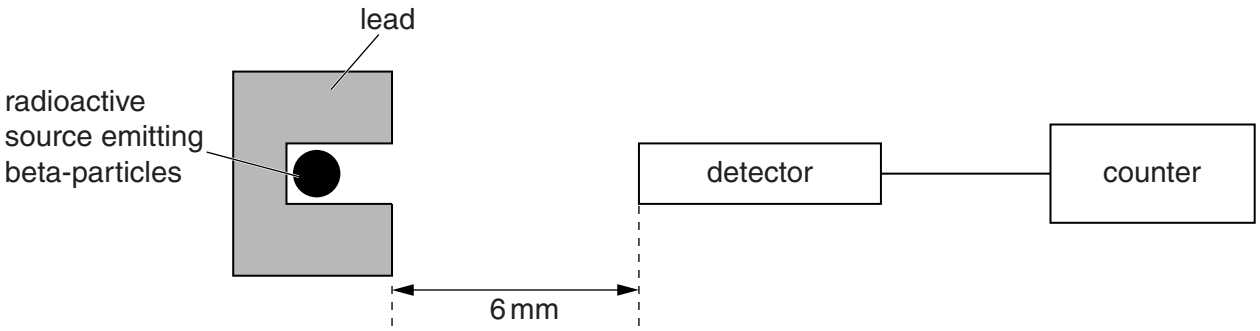


Fig. 11.1

The teacher also has available a number of sheets of aluminium, each of which is 1 mm thick.

(i) Describe how the apparatus and the sheets are used to demonstrate that beta-particles are stopped by 5 mm of aluminium.

In your account, make clear how the background count is measured and used.

.....

.....

.....

.....

.....

.....[4]

(ii) Suggest why the lead in Fig. 11.1 is placed around the radioactive source during the demonstration.

.....

.....[1]

(iii) The radioactive source in Fig. 11.1 is changed for one that emits gamma-rays.

Describe why the apparatus cannot be used to find the thickness of aluminium needed to stop gamma-rays.

.....

.....[1]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.