UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

1337822775

PHYSICS **5054/22**

Paper 2 Theory **October/November 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.

This document consists of **15** printed pages and **1** blank page.

DC (CW/SW) 37000/4

UNIVERSITY *of* CAMBRIDGE International Examinations

[Turn over

Section A

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

1 A builder needs to determine the density of a solid cube of wood.

He places the 50 cm mark of a uniform metre rule on a pivot, so that the rule balances.

He then places the cube on the rule with its centre of gravity directly above the 75 cm mark. A mass of 0.050 kg is moved along the rule until balance is restored. This is shown in Fig. 1.1.

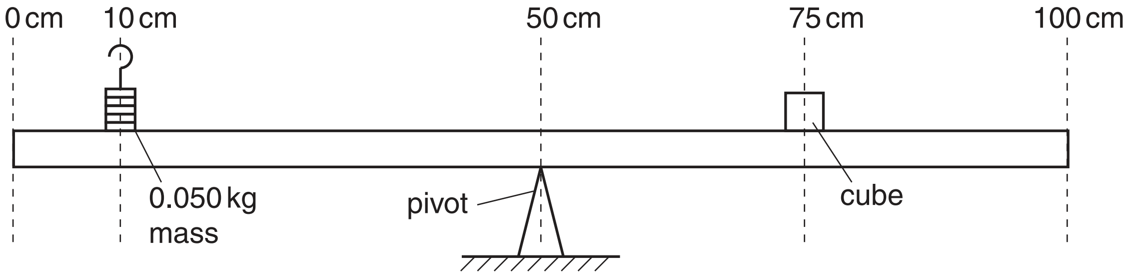


Fig. 1.1 (not to scale)

The rule is balanced when the 0.050 kg mass is at the 10 cm mark.

(a) Calculate the mass of the cube.

mass = ...[3]

(b) The cube has a volume of $1.6 \times 10^{-4}\,m^3$. Determine the density of the wood.

density = ... [2]

2 Fig. 2.1 shows a skier of mass 85 kg skiing down a very steep slope.

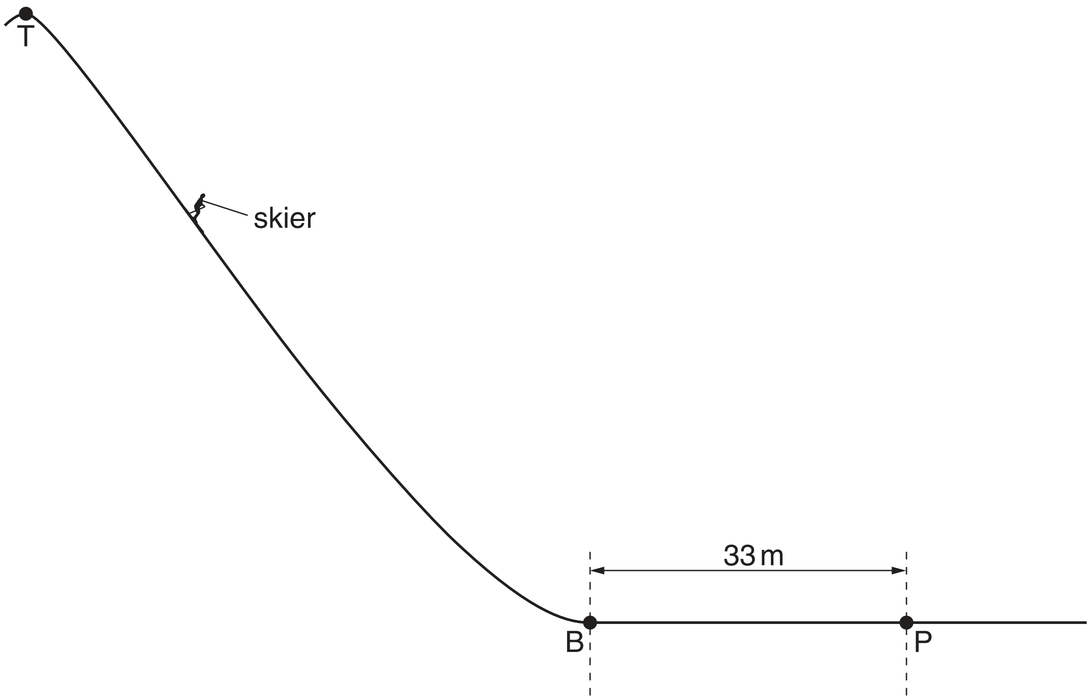


Fig. 2.1 (not to scale)

The skier starts from rest at the top T of the slope. The force of gravity accelerates him down the slope.
When he reaches the bottom B of the slope, his kinetic energy is 5.5×10^4 J.

(a) The gravitational field strength is 10 N / kg. Calculate

(i) the weight of the skier,

weight = ...[1]

(ii) the minimum possible difference in height between T and B.

height difference = ...[2]

(b) At B, the skier digs his skis into the snow and stops at the point P after travelling 33 m horizontally.

Calculate the average horizontal force that acts on the skier between B and P.

force = ...[2]

3 A helium balloon carries scientific instruments high up in the atmosphere.

Fig. 3.1 shows the partially inflated helium balloon leaving the ground.

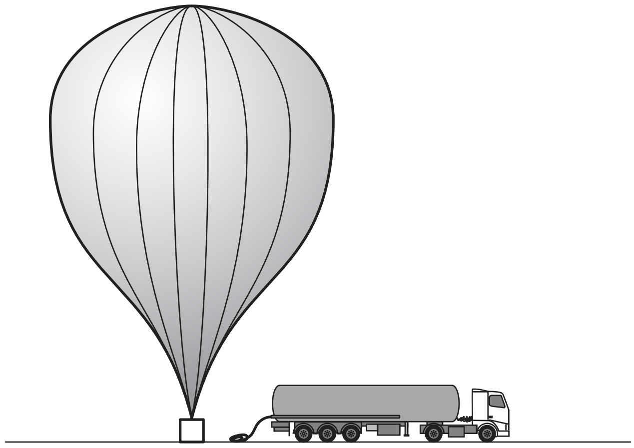


Fig. 3.1

(a) A completely deflated balloon contains no gas. The helium to inflate it is stored in a very large cylinder at a pressure p_1 of 2.5×10^7 Pa. Helium that occupies a volume V_1 of 18 m^3 in the cylinder is slowly released into the balloon until the pressure p_2 in the balloon is 1.0×10^5 Pa. The temperature of the helium remains constant.

(i) State the equation that relates the volume V_2 of the helium in the balloon at launch to p_1, p_2 and V_1.

....[1]

(ii) Calculate V_2.

V_2 = ...[2]

(b) When it leaves the ground, the balloon is only partially inflated. Suggest and explain why this is necessary.

....

....

....[2]

4 Fig. 4.1 represents a microwave travelling in air through points A and B.

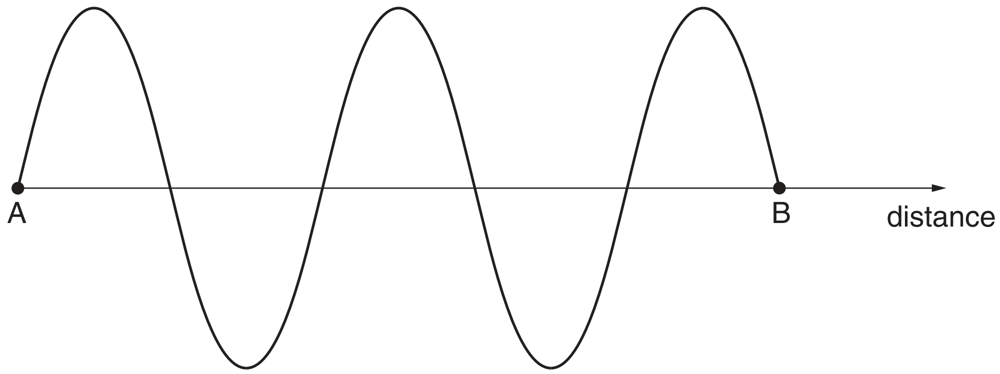


Fig. 4.1 (not to scale)

The distance between A and B is 40 cm.

(a) State the speed of microwaves in air.

speed = ... [1]

(b) Determine the wavelength of the microwave shown in Fig. 4.1.

wavelength = ... [1]

(c) Describe how microwaves are used in the transmission of television signals by satellite.

....

....

....

.... [3]

(d) State two properties common to all electromagnetic waves.

1. ....

2. ....

[2]

5 Fig. 5.1 shows part of an electric bell.

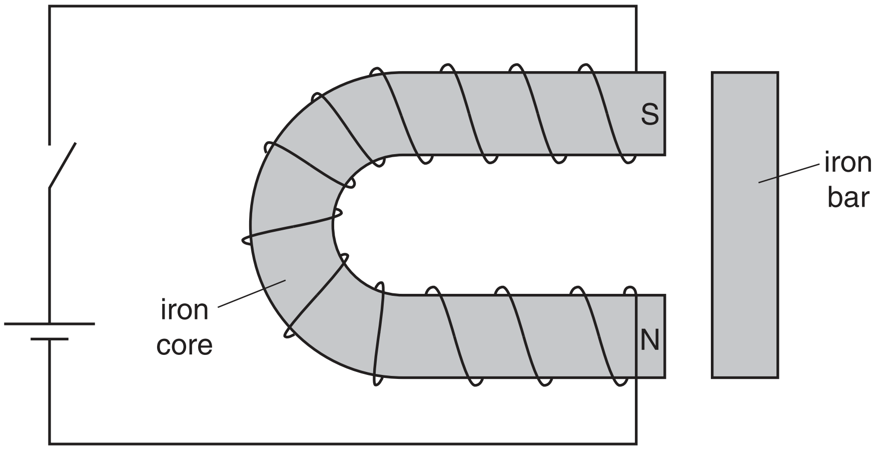


Fig. 5.1

A switch and a cell are in series with a length of wire coiled around an iron core.

The switch is closed and the current in the wire produces a south pole S and a north pole N at the ends of the core, as shown in Fig. 5.1. Magnetic poles are also produced in a small iron bar, placed near to the ends of the core.

(a) **(i)** On Fig. 5.1, mark with an N the position of the north pole produced in the iron bar and mark with an S the position of the south pole produced in the iron bar. [1]

(ii) State and explain what happens to the iron bar once it is magnetised.

....

....[2]

(b) The switch is opened and there is no current in the wire. State what happens to the magnetic poles in the iron bar.

....

....[1]

6 An electrical engineer measures the potential difference across a length of metal wire and the current in the wire. He does this for different values of the current.

(a) **(i)** Draw a labelled circuit diagram of a circuit that enables the engineer to do this.

[3]

(ii) Describe how the circuit is used.

....

....

....

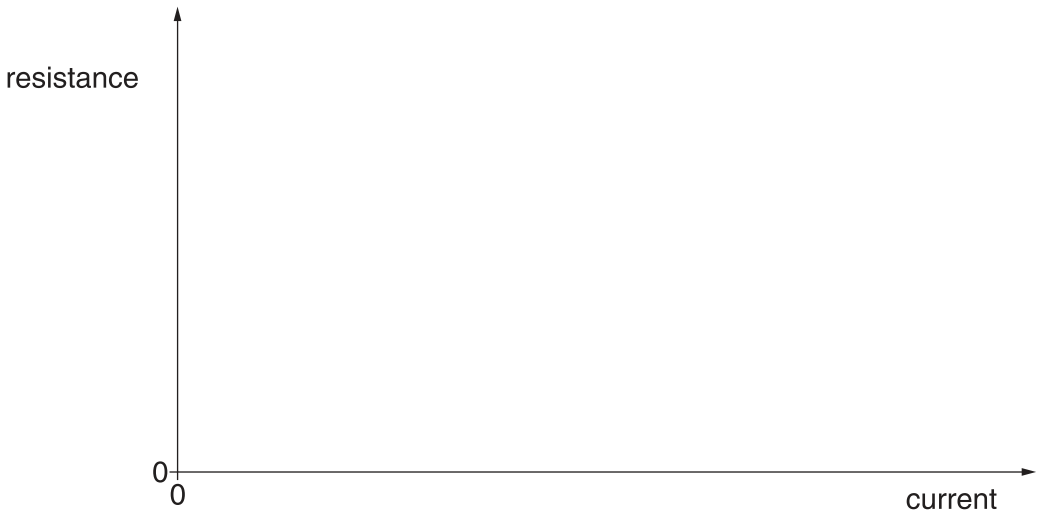
....[2]

(iii) State the equation that defines resistance.

....[1]

(b) The engineer performs the experiment and notices that the potential difference across the wire is directly proportional to the current in it. He calculates the resistance of the wire and plots a graph of the resistance against the current.

On Fig. 6.1, sketch the shape of this graph.



[1]

Fig. 6.1

7 The current in the transmission line used to supply electrical power to a village is 65 A. The power is transmitted at a voltage of 23 000 V.

(a) Calculate the power supplied to the village.

power = ...[2]

(b) The transmission line has a resistance of 3.0 Ω. Calculate

(i) the potential difference across a 3.0 Ω resistor that carries a current of 65 A,

potential difference = ...[2]

(ii) the thermal energy (heat) produced in 1.0 s in a 3.0 Ω resistor that carries a current of 65 A.

heat = ...[1]

(c) **(i)** State one advantage of transmitting electrical power at a high voltage.

....

....[1]

(ii) Suggest one reason why the mains power supply to the houses in the village is at a voltage much lower than 23 000 V.

....

....

....[1]

8 Fig. 8.1 shows a short-sighted eye.

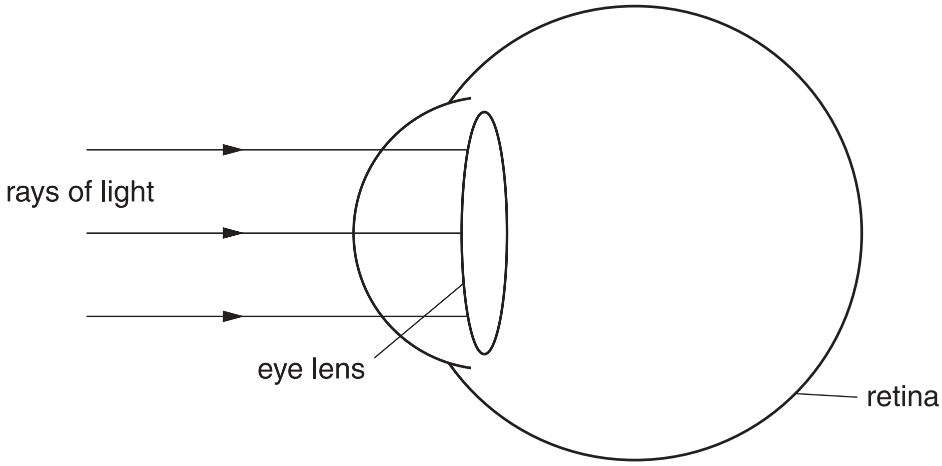


Fig. 8.1

Rays of light from a distant star are parallel as they reach the lens of the eye. Refraction of light as it enters the eye has been ignored in Fig. 8.1.

(a) **(i)** On Fig. 8.1, continue the rays to show their paths inside the short-sighted eye until they strike the retina. [2]

(ii) Explain how your diagram shows that the image of the star seen by the observer is blurred.

....

....[1]

(b) Fig. 8.2 shows three parallel rays of light.

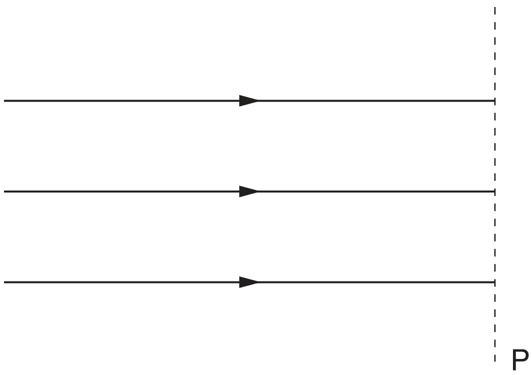


Fig. 8.2

(i) On the line P in Fig. 8.2, draw the shape of a lens that is used to correct short sight. [1]

(ii) On Fig. 8.2, continue the three rays through the lens that you have drawn. [1]

Section B

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

9 Fig. 9.1 is the speed-time graph for a racing car of total mass 650 kg as it sets off from rest at the start of a race.

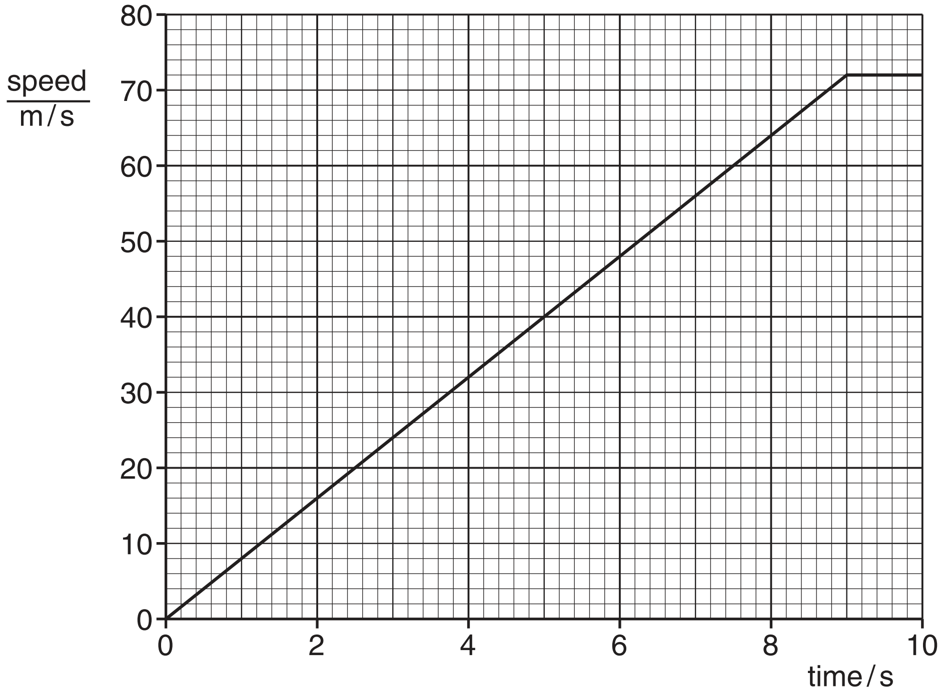


Fig. 9.1

The car travels in a straight line until time $t = 9.0$ s.

(a) State the speed of the car at time $t = 9.0$ s.

speed = ... [1]

(b) Calculate, for the car between times $t = 0$ and $t = 9.0$ s,

(i) the distance travelled,

distance = ... [2]

(ii) the acceleration of the car,

acceleration = ...[2]

(iii) the resultant force acting on the car.

force = ...[2]

(c) The acceleration of the car is constant between $t = 0$ and $t = 9.0\,s$.

Suggest and explain why the driving force on the car must increase to keep the acceleration constant.

....

....

....

....[3]

(d) After $t = 9.0\,s$, the car starts to turn a corner and follows a circular path at constant speed.

(i) Explain why the car is accelerating even though its speed is constant.

....

....

....[2]

(ii) State the direction of this acceleration.

....[1]

(iii) State and explain what causes the car to accelerate as it turns the corner.

....

....[2]

10 A lead bullet of mass 1.9 g is fired from a rifle in a sports club. The bullet misses the target and embeds itself in a wall behind the target. The bullet melts as it is stopped by the wall. The specific latent heat of fusion of lead is 2.2×10^4 J/kg.

(a) State what is meant by *melting point*.

....

....[1]

(b) (i) Calculate the energy required to melt the bullet, at its melting point, without raising its temperature.

energy = ...[3]

(ii) Assume that the energy that melts the bullet is equal to its kinetic energy just before it strikes the wall. Calculate the speed of the bullet just before it strikes the wall.

speed = ...[3]

(iii) Suggest two reasons why the speed of the bullet as it leaves the rifle is greater than the value calculated in **(ii)**.

1. ....

2. ....
[2]

(c) Describe how the molecular structure of the lead changes as it melts.

....

....

....

....

....[3]

(d) On another occasion, lead bullets of twice the mass are used. One of these heavier bullets hits the wall with the speed calculated in **(b)(ii)**. State and explain whether this bullet melts as it is stopped by the wall.

....

....

....

....[3]

Please turn over for Question 11.

11 Fig. 11.1 illustrates a neutron hitting a uranium-235 nucleus.

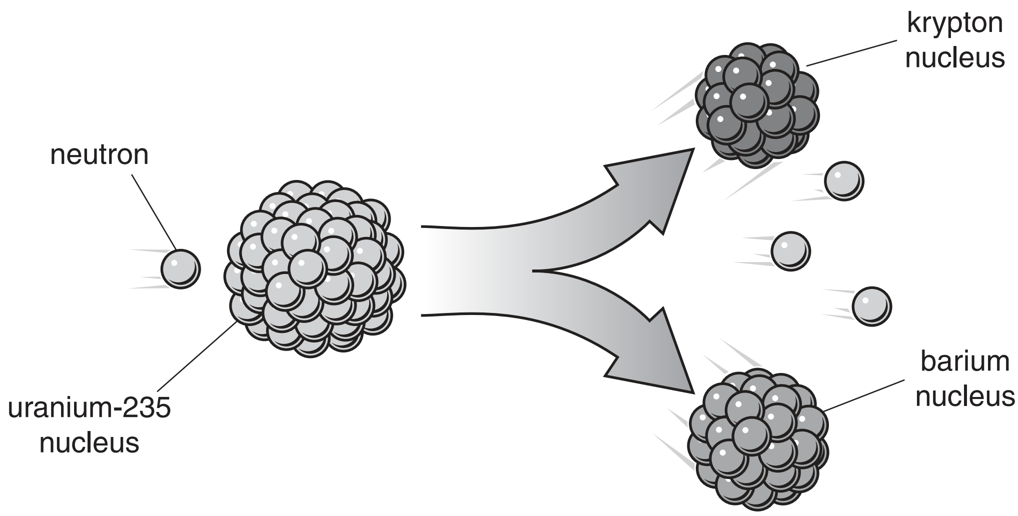


Fig. 11.1

The uranium-235 nucleus splits into a nucleus of barium (Ba) and a nucleus of krypton (Kr) and three neutrons are released.

(a) State the name of this process.

....[1]

(b) This process may be represented by a nuclear equation. An incomplete version of this equation is shown below.

$$^{235}_{92}U + ^{1}_{0}n \rightarrow {}_{56}Ba + {}^{92}Kr + 3\,^{1}_{0}n$$

(i) Calculate

1. the number of neutrons in a nucleus of uranium-235,

number of neutrons = ...[1]

2. the proton number (atomic number) of krypton,

proton number = ...[1]

3. the nucleon number (mass number) of the barium nucleus.

nucleon number = ...[1]

(ii) During this process, there is a decrease in mass. Energy is released. The decrease in mass is 3.1×10^{-28} kg and the speed of light is 3.0×10^{8} m/s.

Calculate the energy released in this process.

energy = ...[3]

(c) A nuclear power station generates electrical energy. In the power station, steam is used to drive a turbine. Describe how the splitting of uranium-235 is used to produce the steam. You may include a block diagram.

....

....

....

....

....[5]

(d) Some of the waste products from a nuclear power station are radioactive and have very long half-lives.

(i) State the meaning of *half-life*.

....

....[2]

(ii) Describe one safety precaution that is taken when radioactive waste products are handled.

....

....[1]

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