Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/42**

Paper 4 Theory (Extended) **February/March 2018**

1 hour 15 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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m/s^2).

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 syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

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

1 **(a)** Define *acceleration*.

..... [1]

(b) Fig. 1.1 shows the speed-time axes for the graph of the motion of a car.

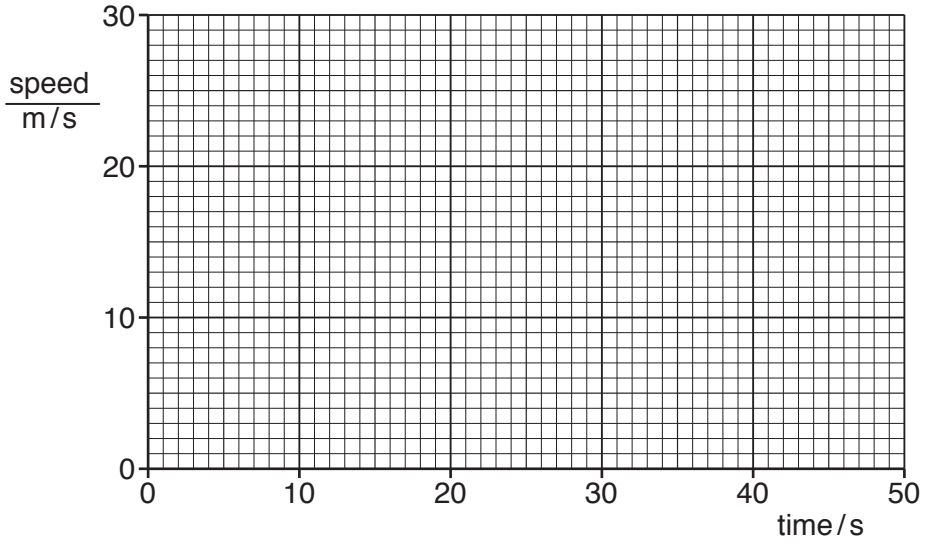


Fig. 1.1

(i) The car starts from rest.

From time = 0 to time = 15 s, the car has a constant acceleration to a speed of 28 m/s.

From time = 15 s to time = 32 s, the car has a constant speed of 28 m/s.

From time = 32 s, the car has a constant deceleration of 2.0 m/s^2 until it comes to rest.

On Fig. 1.1, draw the graph, using the space below for any calculations.

[5]

(ii) From time = 15 s to time = 32 s, the path of the car is part of a circle.

For this motion, state

1. the direction of the resultant force on the car,

.....

2. what happens to the velocity of the car.

.....
[2]

[Total: 8]

2 **(a)** A force is used to move an object from the Earth's surface to a greater height.

Explain why the gravitational potential energy (g.p.e.) of the object increases.

.....

..... [1]

(b) Fig. 2.1 shows a train moving up towards the top of a mountain.

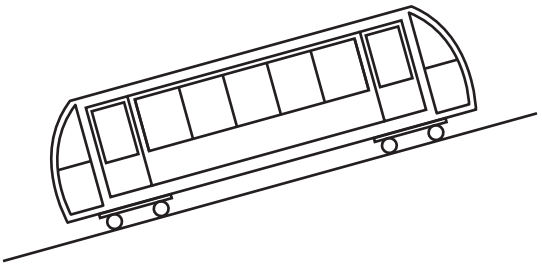


Fig. 2.1

The train transports 80 passengers, each of average mass 65 kg, through a vertical height of 1600 m.

Calculate the increase in the total gravitational potential energy (g.p.e.) of the passengers.

increase in g.p.e. = ... [2]

(c) The engine of the train has a power of 1500 kW. The time taken to reach the top of the mountain is 30 minutes.

Calculate the efficiency of the engine in raising the 80 passengers 1600 m to the top of the mountain.

efficiency = ... [4]

[Total: 7]

[Turn over

3 **(a)** Complete the statement by writing in the blank spaces.

The moment of a force about a pivot is equal to .....

multiplied by..... [1]

(b) Fig. 3.1 shows a horizontal rod of length 2.4 m and weight 160 N. The weight of the rod acts at its centre. The rod is suspended by two vertical ropes X and Y. The tension in each rope is 80 N.

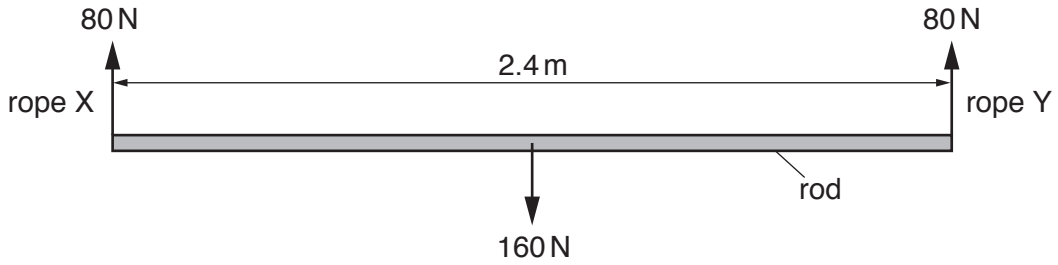


Fig. 3.1

(i) State the name given to the point at which the weight of the rod acts.

..... [1]

(ii) Calculate the mass of the rod.

mass = ... [1]

(iii) The rod is in equilibrium.

Using data from Fig. 3.1, explain why.

.....

.....

.....

.....

.....

..... [4]

[Total: 7]

4 Fig. 4.1 shows a cold plastic spoon that has just been placed in hot liquid in a cup.

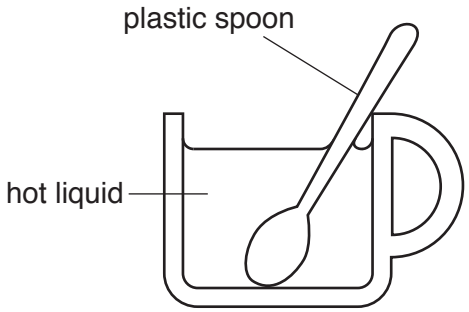


Fig. 4.1

(a) Describe, in terms of molecules, why the temperature of the whole of the spoon increases.

.....

.....

.....

.....

..... [3]

(b) The plastic spoon is replaced by a metal spoon.

Describe an additional process by which the temperature of the whole of this spoon increases.

.....

.....

..... [2]

(c) The cup contains 150 g of liquid of specific heat capacity 4.2 J / (g °C). When the cold spoon is placed into the hot liquid, the temperature of the liquid decreases from 80 °C to 56 °C.

Calculate the loss of thermal energy from the liquid.

energy loss = ... [3]

[Total: 8]

[Turn over

5 **(a)** Fig. 5.1 shows the apparatus used to observe the motion of smoke particles that are in the air in a box.

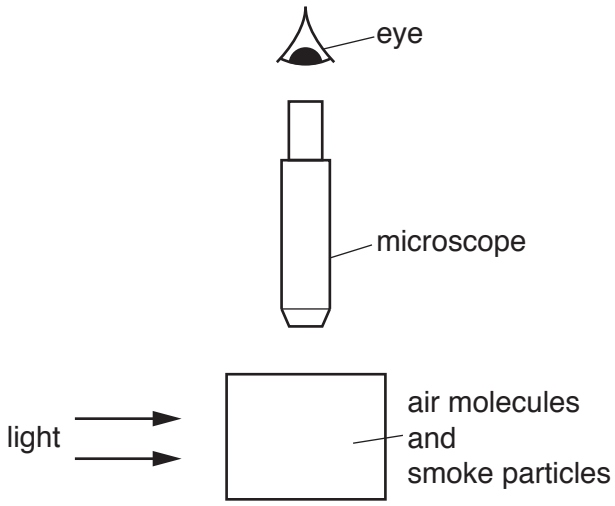
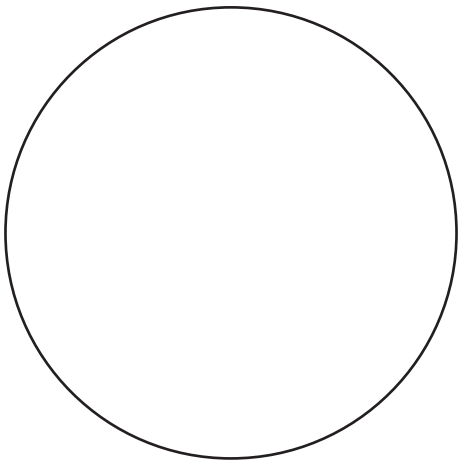


Fig. 5.1

Light from a lamp enters the box through a window in one side of the box. The smoke particles are observed using a microscope fixed above a window in the top of the box.

(i) The motion of a single smoke particle is observed through the microscope.

In the circle shown, sketch the path of this smoke particle.



[1]

(ii) Explain why the smoke particle follows the path that is observed.

.....

.....

.....

..... [3]

(b) A tennis player is practising by hitting a ball many times against a wall.

The ball hits the wall 20 times in 60 s. The average change in momentum for each collision with the wall is 4.2 kg m / s.

Calculate the average force that the ball exerts on the wall.

average force = ... [3]

[Total: 7]

6 **(a)** Fig. 6.1 represents the electromagnetic spectrum.

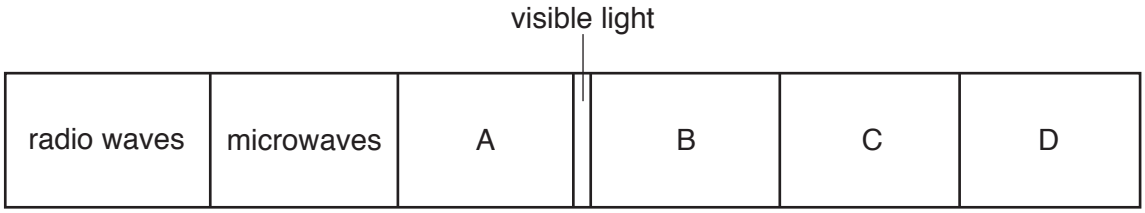


Fig. 6.1

State the radiation in each of the regions represented by A, B, C and D in Fig. 6.1.

A .....

B .....

C .....

D .....

[2]

(b) A source emits visible light.

Fig. 6.2 shows a ray of red light from the source incident on the face XY of a glass prism at point S.

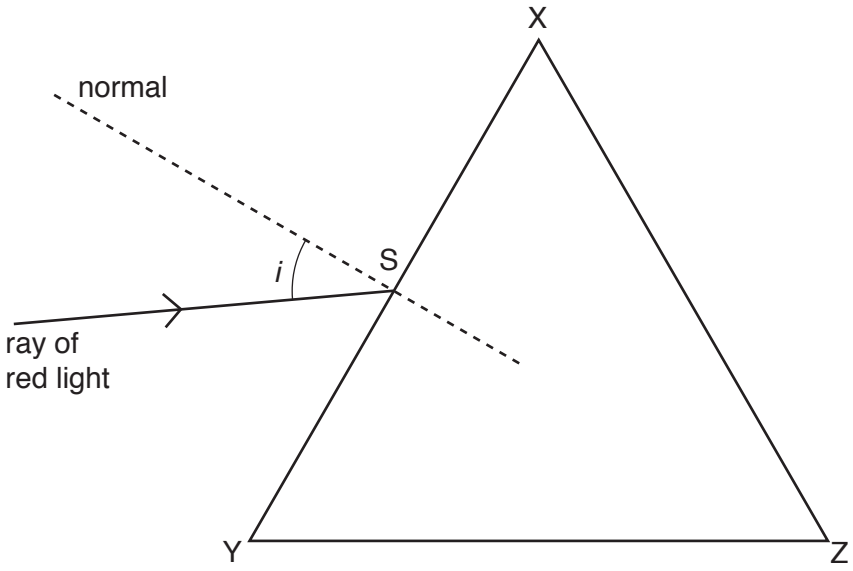


Fig. 6.2

The angle of incidence *i* of the ray is 35°. The refractive index of the glass for red light is 1.5.

(i) Calculate the angle of refraction in the glass at S.

angle of refraction = ... [2]

(ii) On Fig. 6.2, draw the refracted ray at face XY and the ray emerging from face XZ of the prism. Label this ray R. [2]

(iii) A ray of blue light follows the same path as the ray of red light incident on the face XY.

On Fig. 6.2, draw the path of this ray in the prism and emerging from the prism.

Label this ray B. [2]

[Total: 8]

[Turn over

7 **(a)** The speed of a light wave in air is 3.00×10^8 m/s. The refractive index of water is 1.33.

Calculate the speed of the light wave in water.

speed = ... [2]

(b) Fig. 7.1 shows parallel wavefronts of a light wave in air incident on a boundary with a transparent plastic.

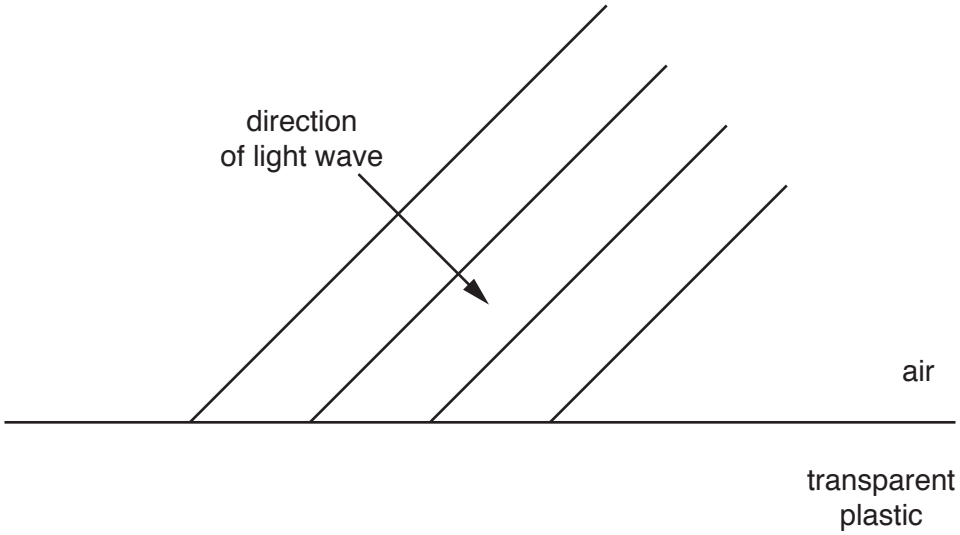


Fig. 7.1

On Fig. 7.1,

(i) draw the positions of the four refracted wavefronts in the plastic, [3]

(ii) draw an arrow to show the direction of travel of the refracted wave, [1]

(iii) label the angle of refraction *r* of the light wave. [1]

[Total: 7]

8 **(a)** The lamp of a car headlight is rated at 12 V, 50 W.

Calculate the current in the lamp when operating normally.

current = ... [2]

(b) A car is driven at night.

In a journey, the total charge that passes through the 12 V battery is 270 kC.

(i) Calculate the electrical energy transferred.

energy = ... [3]

(ii) The fuel used by the car provides 3.6×10^4 J / cm^3.

Calculate the volume of fuel used to provide the energy calculated in **(b)(i)**.

volume = ... [2]

[Total: 7]

9 Fig. 9.1 shows current-potential difference graphs for a resistor and for a lamp.

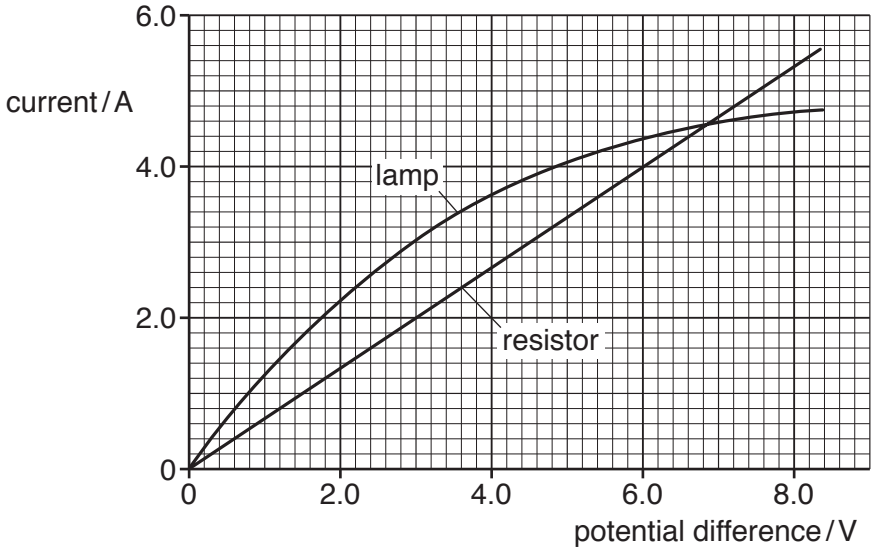


Fig. 9.1

(a) (i) The potential difference (p.d.) applied to the resistor is increased. Tick the box that indicates the effect on the resistance of the resistor.

☐ resistance increases

☐ resistance is constant

☐ resistance decreases

[1]

(ii) The potential difference (p.d.) applied to the lamp is increased. Tick the box that indicates the effect on the resistance of the lamp.

☐ resistance increases

☐ resistance is constant

☐ resistance decreases

[1]

(b) The p.d. across the lamp is 6.0 V. Calculate the resistance of the lamp.

resistance = ... [2]

(c) The lamp and the resistor are connected in **parallel** to a 6.0 V supply.

Calculate the current from the supply.

current = ... [2]

(d) The lamp and the resistor are connected in **series** to another power supply. The current in the circuit is 4.0 A.

Calculate the total p.d. across the lamp and the resistor.

p.d. = ... [2]

[Total: 8]

[Turn over

10 **(a)** Fig. 10.1 shows a straight wire AB placed in the magnetic field between the poles of a magnet. The ends of AB are connected to a galvanometer.

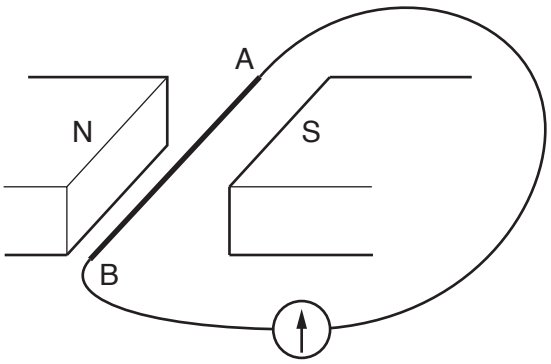


Fig. 10.1

When AB is moved vertically, the needle of the galvanometer shows a deflection.

State **three** factors that affect the size of the deflection.

1 .....

2 .....

3 .....

[3]

(b) Fig. 10.2 shows a transformer.

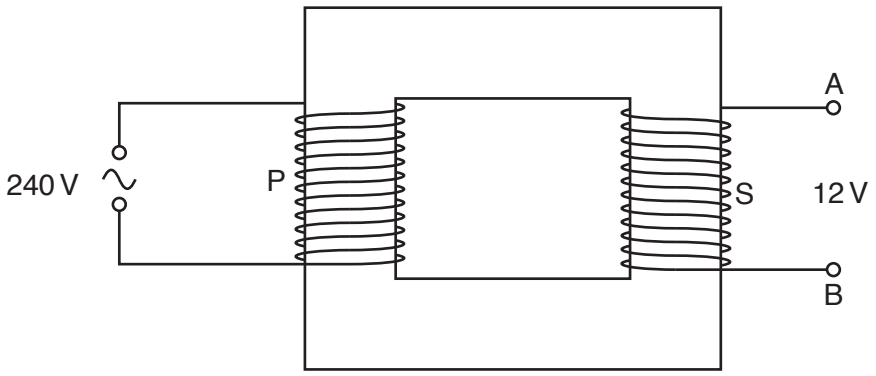


Fig. 10.2

(i) The primary coil P has 8000 turns and an input of 240 V. The secondary coil S has an output of 12 V.

Calculate the number of turns in the secondary coil.

number = ... [2]

(ii) A circuit containing a resistor is connected to the terminals A and B.
A direct current (d.c.) is required in this resistor.

On Fig. 10.2, draw this circuit. [1]

[Total: 6]

[Turn over

11 **(a)** To ensure the safety of workers in laboratories where radioactive sources are used, describe how radioactive materials

(i) should be stored,

.....

..... [1]

(ii) should be handled.

.....

..... [1]

(b) Complete the table below for three types of emission from radioactive sources.

type of emission	nature	range in air	absorbed by
	electromagnetic radiation	several km	
	helium nucleus		0.2 mm paper
	electron		

[3]

(c) State the type of radiation emitted when

(i) an americium nucleus $\left({}^{241}_{95}\mathrm{Am}\right)$ decays into a neptunium nucleus $\left({}^{237}_{93}\mathrm{Np}\right)$,

..... [1]

(ii) a phosphorus nucleus $\left({}^{32}_{15}\mathrm{P}\right)$ decays into a silicon nucleus $\left({}^{32}_{16}\mathrm{Si}\right)$.

..... [1]

[Total: 7]