UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **5054/21**

Paper 2 Theory **May/June 2010**

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.

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.

For Examiner's Use	
Section A	
Q9	
Q10	
Q11	
Total	

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

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Section A

For Examiner's Use

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

1 Fig. 1.1 shows the speed-time graph of a ball. The ball is dropped at time $t = 0$.

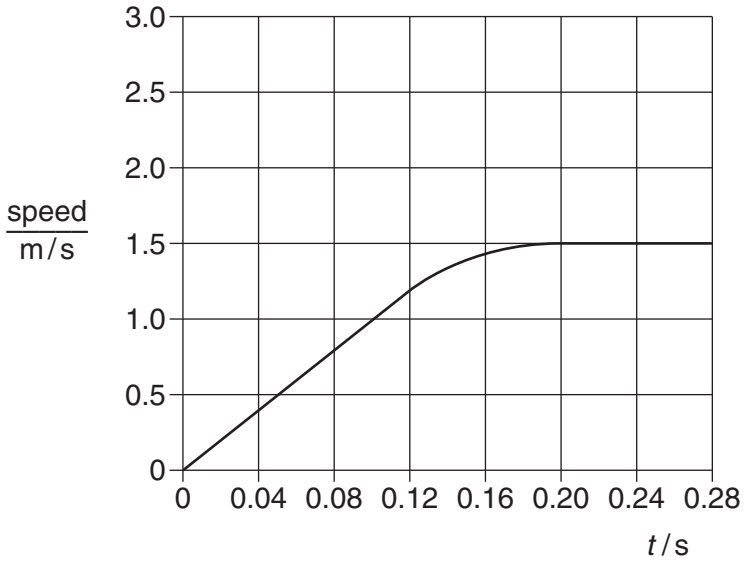


Fig. 1.1

(a) After $t = 0.20$ s, the ball falls at a constant speed.

Explain, using ideas about forces, why the speed of the ball is constant after time $t = 0.20$ s.

.....

.....

.....[1]

(b) At $t = 0$, a different ball is dropped from rest. Until $t = 0.20$ s, this ball has a constant acceleration equal to the acceleration of free-fall. After $t = 0.20$ s, its acceleration decreases.

(i) State the value of the acceleration of free-fall.

.....[1]

(ii) Determine the speed of the second ball at $t = 0.20$ s.

speed = ...[2]

(iii) On Fig. 1.1, draw the speed-time graph for the second ball from $t = 0$ to $t = 0.28$ s. [2]

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2 Fig. 2.1 shows a weight of 4.0 N attached to a spring.

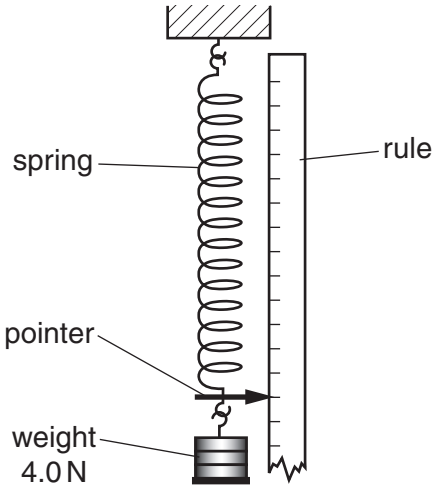


Fig. 2.1

The unstretched length of the spring is 8.0 cm. With the 4.0 N weight attached to the spring, the length is 14.0 cm. The spring is within its limit of proportionality.

(a) State what is meant by the *limit of proportionality* of a spring.

.....

.....

.....[1]

(b) The 4.0 N weight is replaced with a 2.0 N weight. Calculate the new length of the spring.

new length = ...[2]

(c) Describe how the apparatus in Fig. 2.1 is used to obtain readings to plot an extension-load graph.

.....

.....

.....

.....[2]

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[Turn over

3 Fig. 3.1 shows a student rubbing her hands together.

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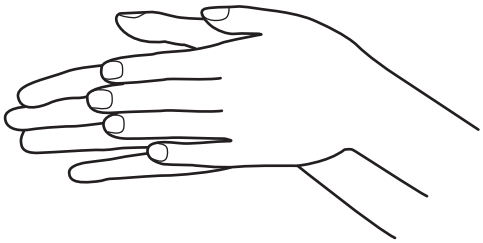


Fig. 3.1

(a) State the main energy conversion that causes the hands to become warm.

.....

.....[2]

(b) State why the hands become even warmer if they are pressed harder together when rubbing.

.....

.....[1]

(c) The average force used to slide one hand along the other is 1.2 N.

In each movement, one hand moves 0.080 m. The other hand remains stationary.

(i) Calculate the number of movements needed for 2.0 J of work to be done.

number = ...[3]

(ii) Each movement takes 0.20 s. Calculate the average power developed.

power = ...[2]

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4 Fig. 4.1 and Fig.4.2 are diagrams of a ripple tank being used to show two properties of waves.

(a) Fig. 4.1 shows wavefronts approaching a barrier in the water.

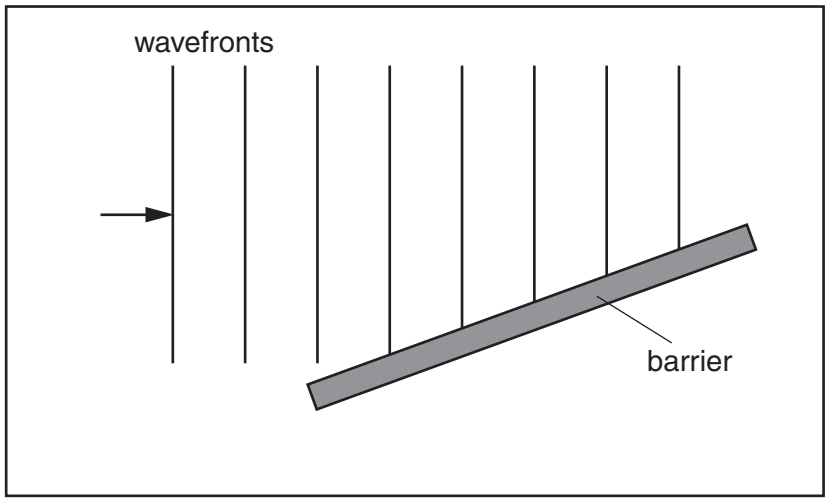


Fig. 4.1

Complete Fig. 4.1 to show the reflection of the wavefronts at the barrier. [2]

(b) Fig. 4.2 shows the wavefronts approaching shallow water above a piece of glass.

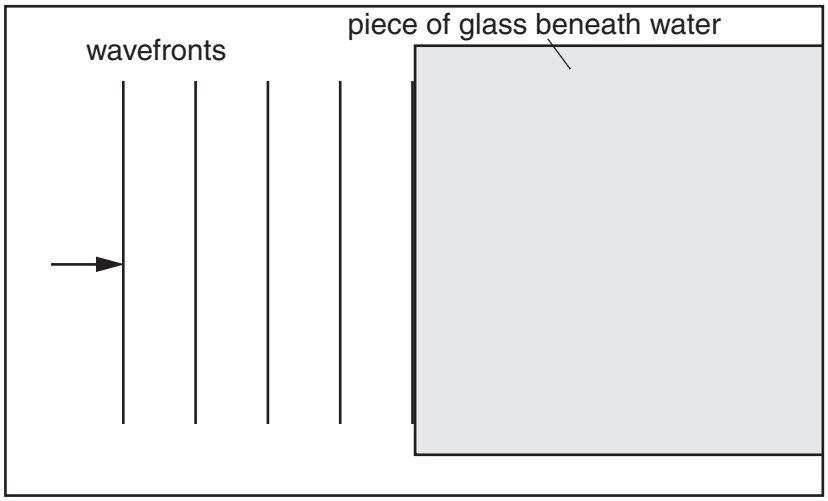


Fig. 4.2

(i) Complete Fig. 4.2 to show the wavefronts in the shallow water. [1]

(ii) As the wave passes into the shallow water, state what, if anything, happens to

1. the wave speed, ...[1]

2. the frequency. .....[1]

5 Fig. 5.1 shows a ray of white light incident on a glass prism.

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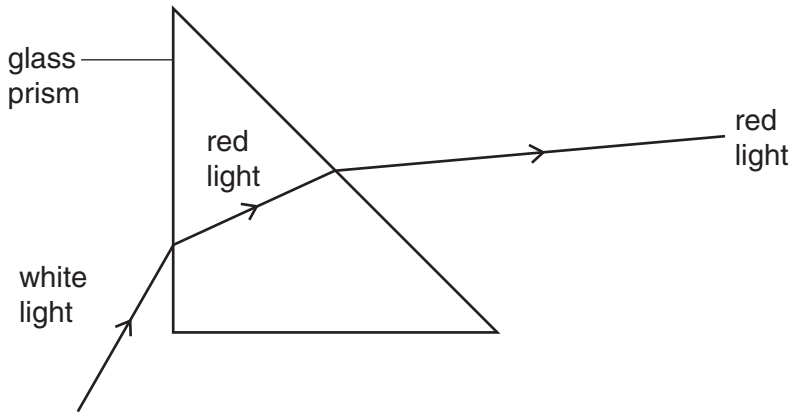


Fig. 5.1

Fig. 5.1 is not complete; it shows only the ray of red light produced from the white light.

(a) (i) On Fig. 5.1, draw the ray of blue light produced in, and beyond, the prism. [2]

(ii) State **two** colours of the spectrum found between the red and blue rays.

.....[1]

(b) Fig. 5.2 shows the same prism with the ray of white light incident at a different angle.

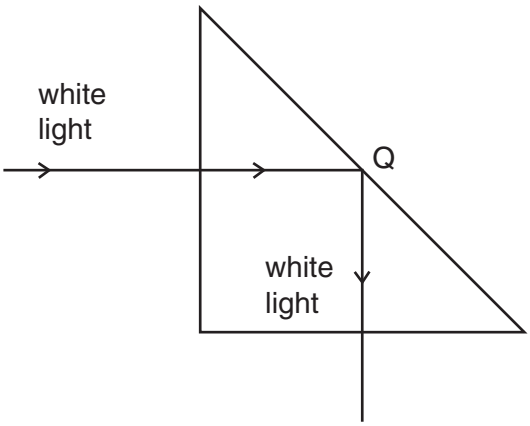


Fig. 5.2

Fig. 5.2 is complete; no spectrum is produced.

(i) Explain why no light emerges from the prism at Q.

.....

.....[1]

(ii) Explain why no spectrum is produced.

.....

.....[1]

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6 Fig. 6.1 shows a circuit used in an experiment to measure the current in a lamp for different values of the potential difference (p.d.) across the lamp.

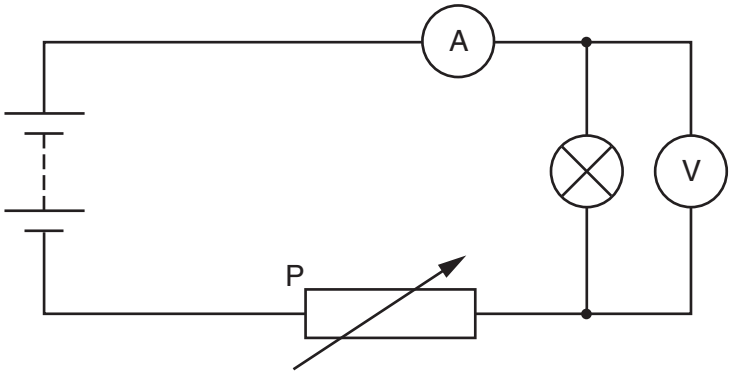


Fig. 6.1

(a) State the name of component P.

.....[1]

(b) On the axes below, sketch a graph of current against p.d. for a filament lamp.



[2]

(c) (i) State how the resistance of the lamp changes as the p.d. increases.

.....[1]

(ii) Explain how the graph in **(b)** shows the change you have described in **(c)(i)**.

.....

.....

.....[1]

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7 **(a)** Fig. 7.1 shows a circuit with two resistors in series.

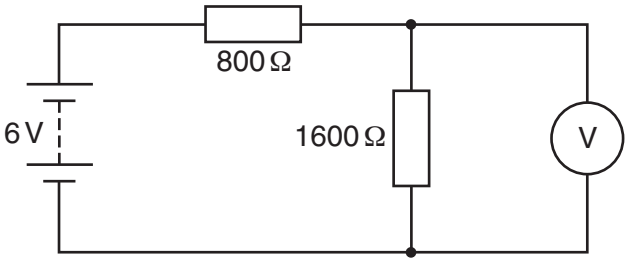


Fig. 7.1

(i) Calculate the current in the circuit.

current = ……[2]

(ii) Calculate the reading on the voltmeter.

voltmeter reading = ……[1]

(b) Fig. 7.2 and Fig. 7.3 show circuits containing a capacitor and a transistor respectively.

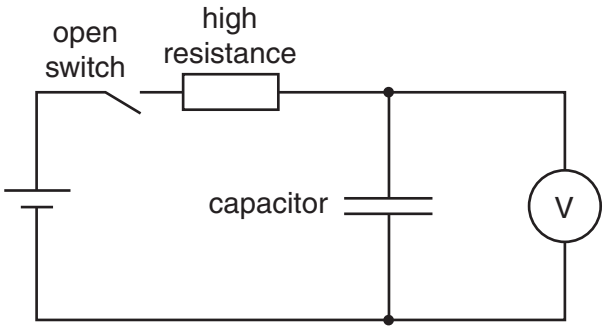


Fig. 7.2

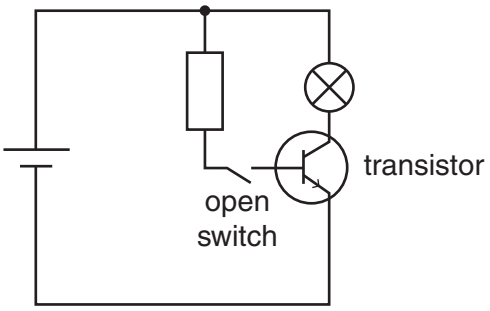


Fig. 7.3

EITHER Explain the action of the capacitor shown in Fig. 7.2 when the switch is closed.

.....

.....

.....[2]

OR Explain the action of the transistor shown in Fig. 7.3 when the switch is closed.

.....

.....

.....[2]

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8 Fig. 8.1 shows two coils of wire wound on an iron ring. One coil is connected in series to a switch and a d.c. supply. The other coil is connected to a very sensitive centre-zero ammeter.

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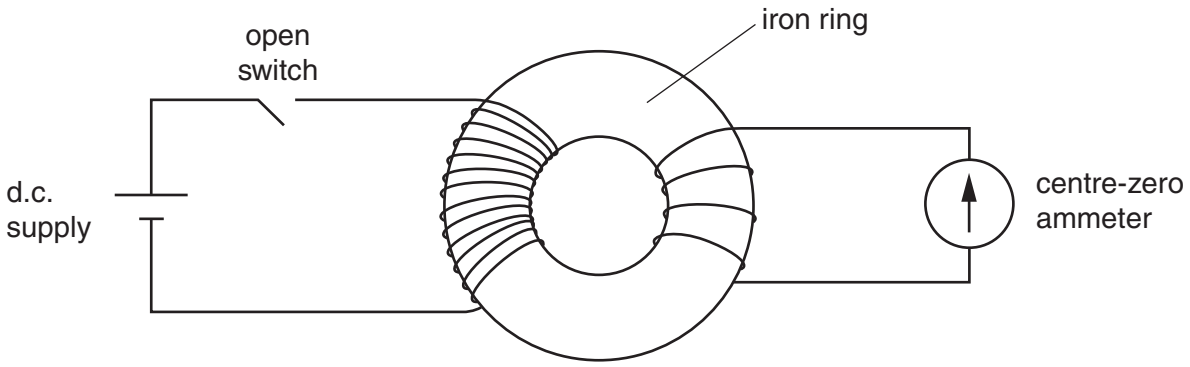


Fig. 8.1

At first the switch is open, as shown in Fig. 8.1.

The following actions are taken in turn.

Describe and explain what happens to the reading on the ammeter in each case.

(a) The switch is closed.

.....

.....

.....

.....[3]

(b) The switch is left closed for a long time.

.....

.....

.....[1]

(c) The switch is opened.

.....

.....

.....[2]

Section B

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

9 Fig. 9.1 shows a laboratory thermometer.

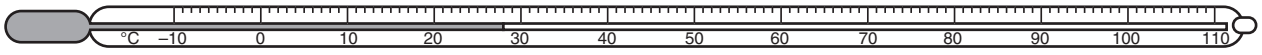


Fig. 9.1

(a) (i) State the range of the thermometer.

.....[1]

(ii) State one change in the design of the thermometer to increase its range.

.....

.....[1]

(b) (i) Describe how the behaviour of a more sensitive thermometer is different from a less sensitive thermometer.

.....

.....[1]

(ii) State one change in the design of the thermometer to make it more sensitive.

.....

.....[1]

(c) Describe how a clinical thermometer differs from a laboratory thermometer. A diagram may be included in your answer.

.....

.....

.....

.....[3]

(d) **(i)** In the space below, draw a labelled diagram of a thermocouple thermometer.

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[2]

(ii) State **two** reasons why a thermocouple thermometer is sometimes a better choice than a laboratory thermometer.

.....

.....

.....[2]

(e) Fig. 9.2 shows a copper block of mass 1.8 kg with two holes in the top. An 80 W heater is placed in one hole and a thermometer in the other.

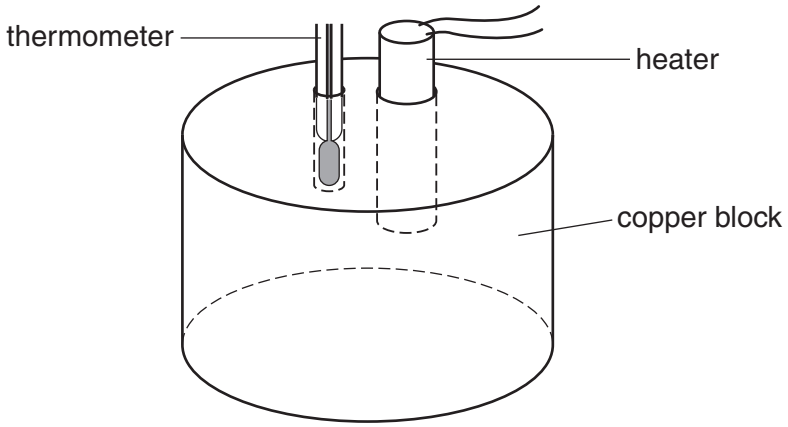


Fig. 9.2

The heater is switched on for 5.0 minutes. Assume that no energy is lost from the block.

(i) Calculate the energy supplied to the block.

energy supplied = ...[2]

(ii) The specific heat capacity of copper is 390 J/(kg °C). Calculate the rise in temperature of the block.

temperature rise = ...[2]

10 Fig. 10.1 shows a car braking system. The brake fluid is an oily liquid.

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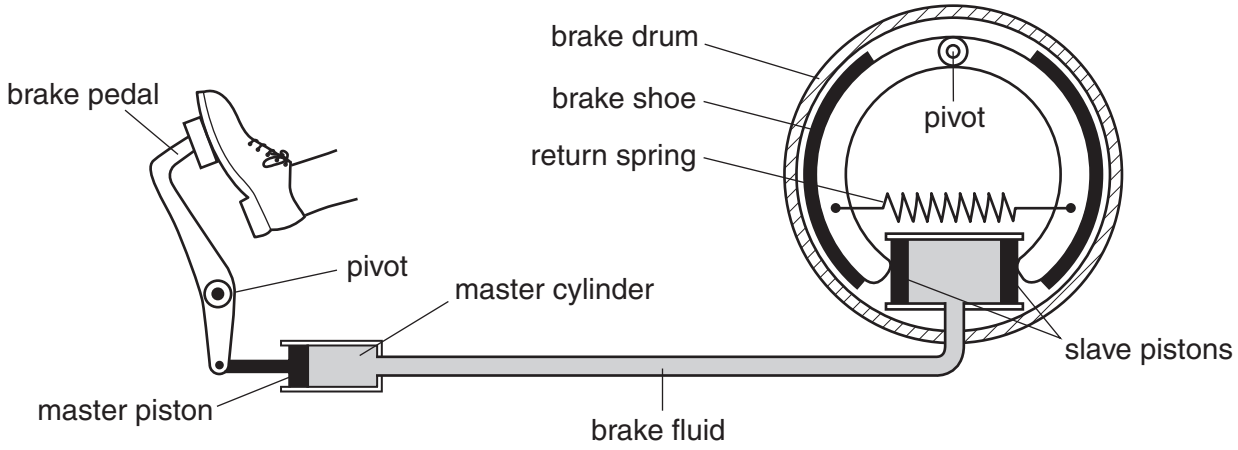


Fig. 10.1

The brake drum rotates with the wheel of the car.

(a) Explain how pushing the brake pedal makes the brake shoes rub against the drum.

.....

.....[2]

(b) The cross-sectional area of the master piston is 2.0 cm^2. A force of 140 N is applied to the master piston.

(i) Calculate the pressure created in the brake fluid by the master piston.

pressure = ... N/cm^2 [2]

(ii) The cross-sectional area of each slave piston is 2.8 cm^2.

Calculate the force exerted on each slave piston by the brake fluid.

force = ...[2]

(iii) The force exerted on the master piston is greater than the force applied by the foot on the brake pedal. Using the principle of moments, explain this.

.....

.....

.....[2]

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(c) Fig. 10.2 shows a master cylinder sealed at one end. Instead of brake fluid, the cylinder contains air.

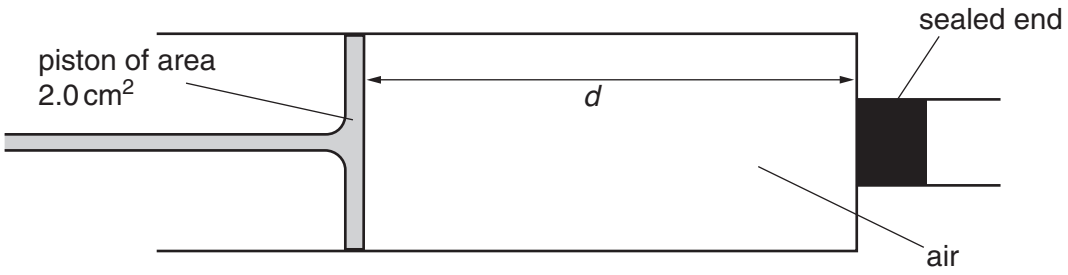


Fig. 10.2

When a force is applied to the piston, the length *d* changes from 6.0 cm to 4.0 cm. The pressure of the air increases but the temperature stays constant.

(i) Describe how the molecules of the air exert a pressure.

.....

.....[1]

(ii) Explain why the pressure increases even though the temperature stays constant.

.....

.....

.....[2]

(iii) The initial pressure of the air inside the cylinder is 1.0×10^5 Pa.

Calculate the final pressure of the air. State the formula that you use in your calculation.

pressure = ...[3]

(d) Air bubbles form in the brake fluid of Fig. 10.1. State the effect this has on the braking system.

.....

.....

.....[1]

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[Turn over

11 (a) Complete the table of Fig. 11.1.

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type of radiation	nature of radiation	charge
alpha-particle	two protons and two neutrons	positive
beta-particle		
gamma-ray		

Fig. 11.1

[4]

(b) Technetium-99 is a radioactive isotope that emits gamma-rays and it has a half-life of 6.0 hours.

In a hospital, a solution containing this isotope is injected into a patient. The solution travels around the body and the isotope attaches to cancer cells. A few hours after the injection, an instrument is used to detect the gamma-rays emitted by the isotope. A high reading on the instrument indicates the position of cancer cells.

(i) Explain what is meant by *half-life*.

.....

.....

.....[2]

(ii) Explain why an isotope emitting gamma-rays is used rather than an isotope emitting alpha-particles.

.....

.....

.....

.....[2]

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(iii) Explain why using an isotope with a half-life of 6 hours is better than using an isotope with a half-life of 6 minutes.

.....

.....[1]

(iv) Explain why using an isotope with a half-life of 6 hours is better than using an isotope with a half-life of 6 days.

.....

.....[1]

(c) A different radioactive isotope used in hospitals has a half-life of 13 hours.

A sample of this isotope and a detector are placed in a lead box.

The count rate is recorded every minute for three minutes.

The values obtained are 3202, 3140 and 3258 counts per minute.

(i) Explain why the three readings are not the same.

.....

.....[1]

(ii) Estimate the time taken for the average count rate to fall to 200 counts per minute.

time taken = ...[3]

(iii) The sample and the detector are taken out of the lead box. The count rate rises slightly because of background radiation.

State one cause of background radiation.

.....

.....[1]

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