Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

2934736749

PHYSICS **5054/22**

Paper 2 Theory **May/June 2015**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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 **20** printed pages.

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Section A

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

1 The apparatus shown in Fig. 1.1 is used to measure the extension of a spring.

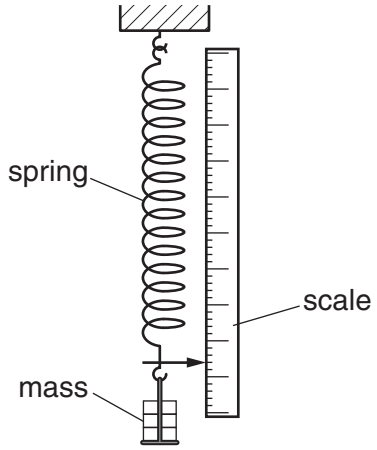


Fig. 1.1

(a) Explain how the mass causes a force on the spring.

.....

..... [1]

(b) The force on the spring is a vector quantity. State what is meant by a *vector* quantity.

.....

..... [1]

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(c) Fig. 1.2 shows a graph of the length of the spring plotted against the force on the spring, for forces between 0 and 10 N.

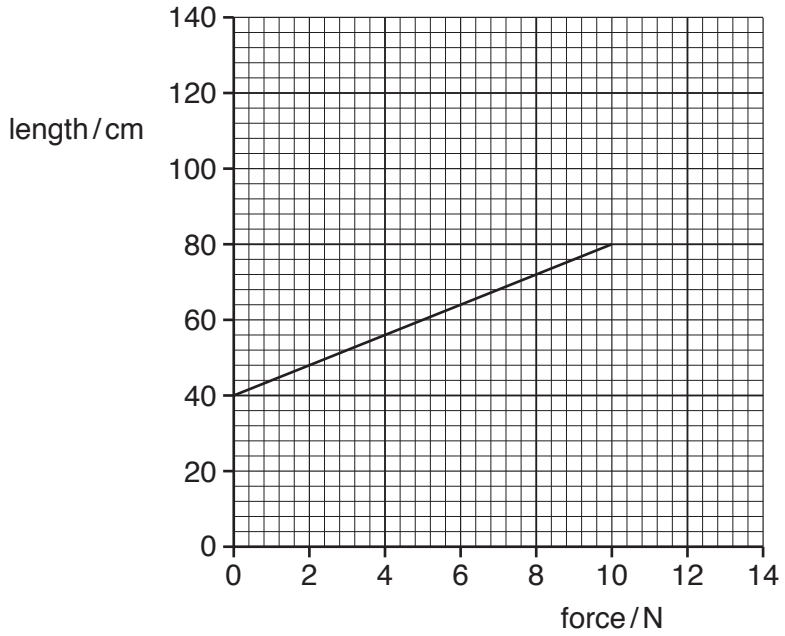


Fig. 1.2

(i) **1.** State a formula that relates the unstretched length l_0 of the spring, the stretched length l of the spring and the extension e of the spring.

..... [1]

2. A mass produces a force of 9.0 N on the spring. Determine the extension of the spring caused by this mass.

extension = ... [1]

(ii) The limit of proportionality of the spring is reached when the force is 10 N.

The spring is easier to stretch after the limit of proportionality.

On Fig. 1.2, continue the line to suggest how the length changes when the force is greater than 10 N. [1]

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[Turn over

2 Fig. 2.1 shows two engineers measuring the length of a wall made from concrete.

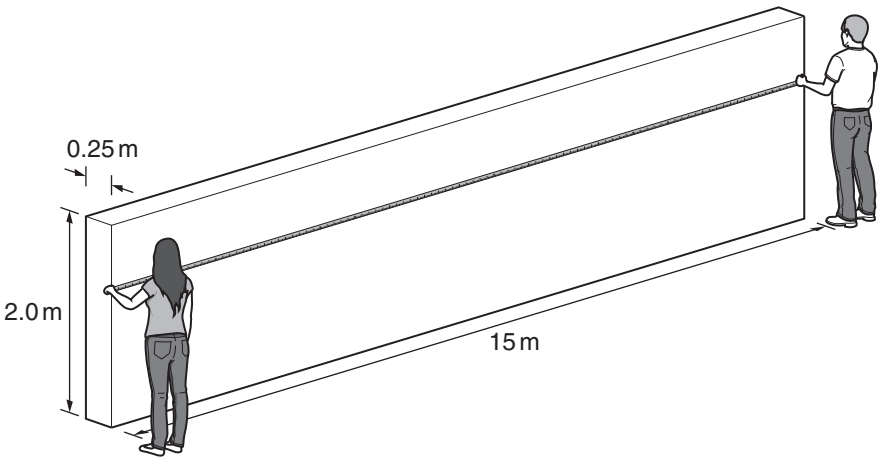


Fig. 2.1 (not to scale)

The wall is 2.0 m high, 15 m long and 0.25 m thick.

The weight of the wall is 180 000 N and the mass of the wall is 18 000 kg.

(a) The engineers measure the length of the wall in one single measurement.

State the name of the measuring instrument they use.

..... [1]

(b) The engineers state that the density of the concrete affects the pressure exerted by the wall on the ground but that the length of the wall does not affect this pressure.

(i) Define *density*.

.....

..... [1]

(ii) Calculate the density of the concrete.

density = ... [2]

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(iii) Calculate the pressure exerted by the wall on the ground.

pressure = ... [2]

(iv) Without further calculation, explain why doubling the length of the wall does not change the pressure that the wall exerts on the ground.

.....

.....

.....

..... [1]

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[Turn over

3 Two different kettles are used to heat water, as shown in Fig. 3.1.

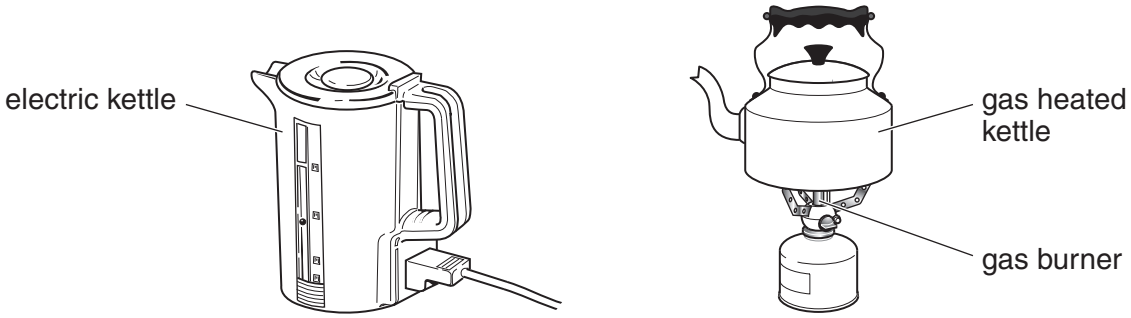


Fig. 3.1

Data for the two kettles is shown in Fig. 3.2.

	energy supplied to the kettle in one minute / J	thermal energy (heat) supplied by the kettle to the water in one minute / J
electric kettle	120 000	95 000
gas heated kettle	130 000	90 000

Fig. 3.2

(a) (i) Calculate the efficiency of the electric kettle.

efficiency = ... [2]

(ii) Calculate the useful power of the gas heated kettle.

power = ... [2]

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(b) Both kettles contain the same mass of water, at the same initial temperature.

State and explain which kettle brings the water to boiling point first.

.....

.....

..... [1]

(c) The boiling water produces steam at 100 °C.

State one difference between molecules in the steam and molecules in the boiling water.

.....

.....

..... [1]

4 A metal can and a plastic bottle, both containing liquid, are cooled by placing them in a jug of melting ice, as shown in Fig. 4.1.

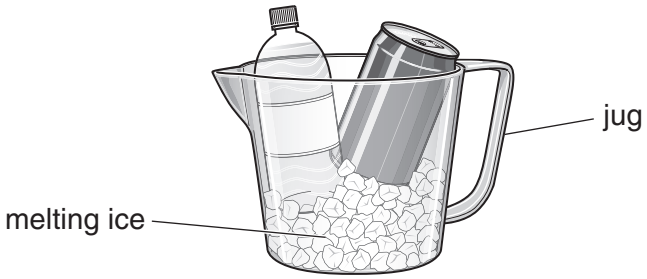


Fig. 4.1

The can and bottle each contain 330 g of the same liquid at 15 °C.

(a) The specific heat capacity of the liquid is 4.2 J/(g °C).

Calculate the thermal energy released when 330 g of the liquid at 15 °C cools to 2 °C.

energy = ... [2]

(b) When water at 0 °C is used in the jug, instead of the melting ice, the cooling is slower.

Explain why cooling is faster when using melting ice in the jug, rather than water at 0 °C.

.....

.....

.....

..... [2]

(c) The liquid in the metal can cools down faster than the liquid in the plastic bottle.

Suggest why this happens.

.....

.....

..... [1]

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5 When a balloon is rubbed on hair, the balloon becomes negatively charged. The balloon is shown in Fig. 5.1.

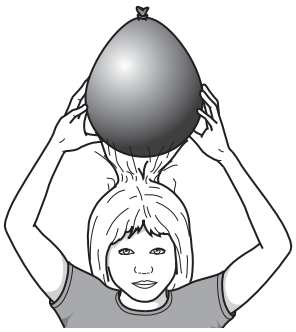


Fig. 5.1

(a) Explain how rubbing causes the balloon to become negatively charged.

.....

.....

..... [2]

(b) Explain why the hair is pulled towards the balloon.

.....

.....

.....

..... [2]

(c) Explain why it is important that the balloon is made from an electrical insulator.

.....

..... [1]

(d) State one example where static electricity is useful.

.....

..... [1]

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[Turn over

6 Fig. 6.1 shows a simple a.c. generator.

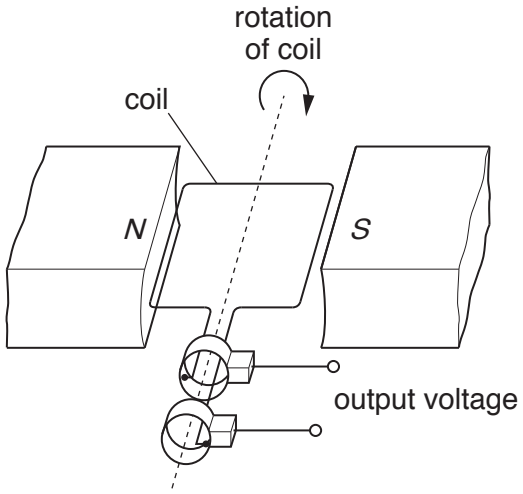


Fig. 6.1

(a) The coil rotates and an alternating electromotive force (e.m.f.) is induced in the coil.

Fig. 6.2 shows how the alternating e.m.f. varies with time as the coil rotates.

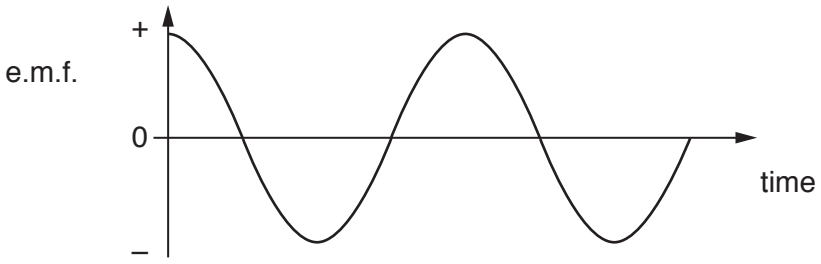


Fig. 6.2

Explain

(i) why an e.m.f. is induced,

.....

.....

..... [2]

(ii) why the e.m.f. is sometimes positive and sometimes negative.

.....

.....

..... [1]

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(b) Changes are made to the a.c. generator, one at a time:

- stronger magnets are used
- more turns are wound on the coil
- the coil is turned faster.

Complete the table in Fig. 6.3 to show what happens to the maximum value of the e.m.f. and to the frequency of the alternating e.m.f.

changes made	what happens to the maximum value of the e.m.f.	what happens to the frequency of the e.m.f.
stronger magnets		
more turns on the coil		
the coil is turned faster		

Fig. 6.3

[3]

7 An electric hairdryer and an electric heater are connected to the mains supply, as shown in Fig. 7.1.

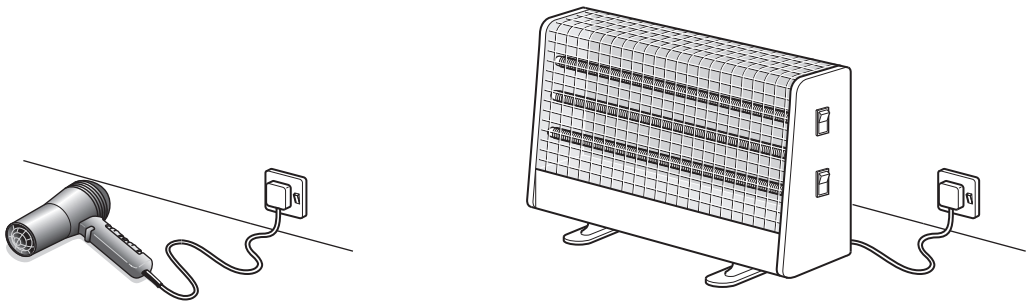


Fig. 7.1

The cable from the heater to the mains supply has a live, a neutral and an earth wire.

(a) State the purpose of the neutral wire.

.....

..... [1]

(b) The live wire in the electric heater touches the outer metal case.

Explain how the earth and the fuse together protect the user from electric shock.

.....

.....

.....

..... [2]

(c) The hairdryer does not have an earth wire. Explain why this hairdryer is still safe to use.

.....

..... [1]

(d) In some modern homes, circuit breakers are used instead of fuses.

Suggest one advantage of using a circuit breaker rather than a fuse.

.....

..... [1]

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8 Two isotopes of hydrogen are written as $^{1}_{1}H$ and $^{2}_{1}H$.

(a) Complete Fig. 8.1 to show the number of protons and neutrons in one nucleus of each of these isotopes of hydrogen.

	number of protons	number of neutrons
$^{1}_{1}H$		
$^{2}_{1}H$		

Fig. 8.1

[2]

(b) Explain, using ideas about electrons, neutrons and protons, why atoms of $^{1}_{1}H$ and $^{2}_{1}H$ are uncharged.

.....

.....

.....

.....

.....

..... [3]

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[Turn over

Section B

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

9 Fig. 9.1 shows the wavefronts of a water wave in deep water in a ripple tank.

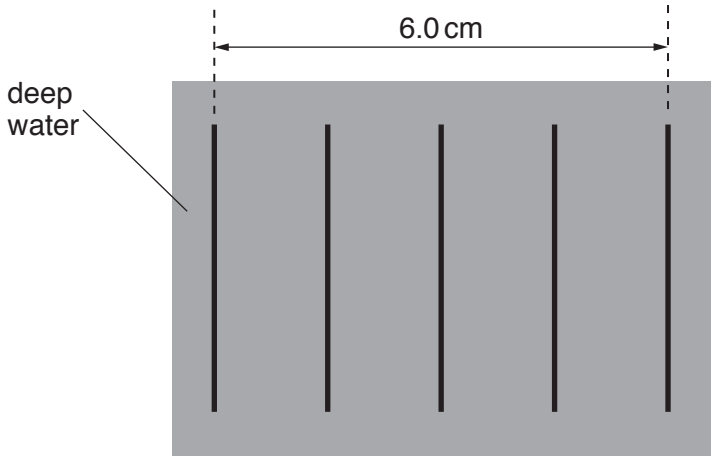


Fig. 9.1

The frequency of the wave in deep water is 5.0 Hz.

(a) Explain what is meant by the *frequency* of a wave.

.....

.....

..... [2]

(b) **(i)** Determine the wavelength of the wave in deep water.

..... [1]

(ii) Calculate the speed of the wave in deep water.

speed = ... [2]

(c) The wave passes from deep water into shallow water. The speed of the wave is less in shallower water.

(i) State and explain how this affects the wavelength of the wave.

.....

.....

..... [2]

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(ii) The wave in deep water shown in Fig. 9.2 travels towards the right and enters the shallow water at an angle. The wave refracts.

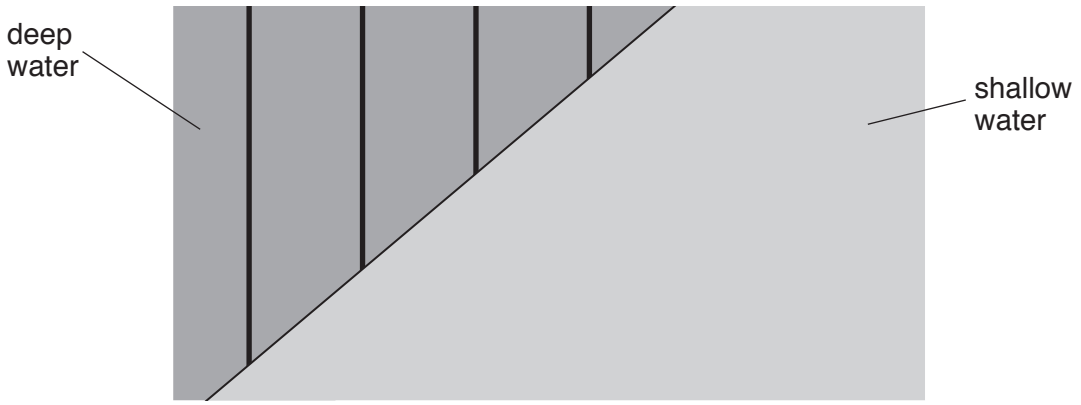


Fig. 9.2

On Fig. 9.2, draw the wavefronts in the shallow water. [3]

(d) Sound is also a wave.

(i) Describe one difference between a sound wave and a water wave.

.....

.....

.....

..... [2]

(ii) The speed of sound in carbon dioxide gas is less than the speed of sound in air. Using this information, or otherwise, describe an experiment to show the refraction of sound waves. You may include a diagram of your apparatus.

.....

.....

.....

.....

.....

..... [3]

10 Fig. 10.1 shows a relay connected to a cell and a switch.

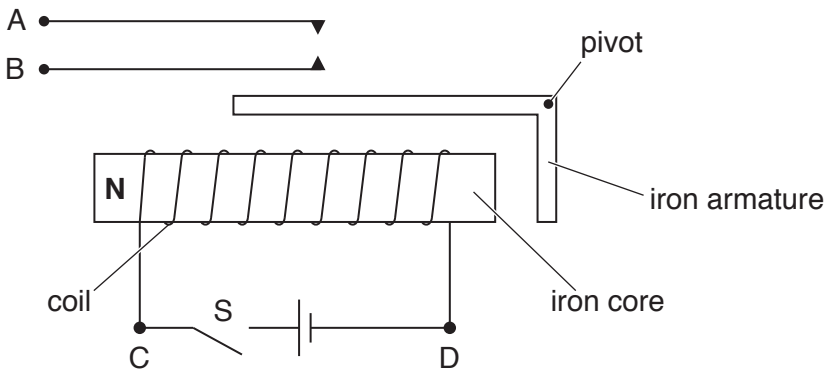


Fig. 10.1

(a) When switch S is closed, the iron core is magnetised. The left side of the core is an N-pole, as shown in Fig. 10.1. The iron armature is attracted to the core.

(i) On Fig. 10.1, mark

1. the S-pole of the iron core

2. the N-pole and the S-pole of the iron armature.

[2]

(ii) The cell is reversed.

State what happens to the poles and to the armature.

.....

..... [2]

(iii) Explain why the core is made of iron and not steel.

.....

.....

..... [2]

(b) Fig. 10.2 shows the relay connected in a circuit to a 12V battery. The bell is not ringing.

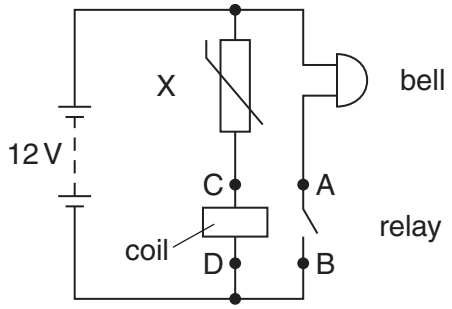


Fig. 10.2

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(i) State the name of component X.

..... [1]

(ii) Explain why the bell rings when the temperature of X rises.

.....

.....

..... [2]

(iii) When the resistance of X is 2000 Ω, the current in the coil is 1.5 mA. This causes the contacts in the relay to close. The resistance of the bell is 200 Ω.

Calculate

1. the potential difference (p.d.) across X,

p.d. = ... [2]

2. the p.d. across the coil,

p.d. = ... [1]

3. the current in the battery.

current = ... [2]

(iv) Component X is removed from the circuit and replaced by a different component Y. The bell now rings when bright light shines on Y.

State the name of component Y.

..... [1]

11 A bungee jumper falls from a bridge above a river, as shown in Fig. 11.1.

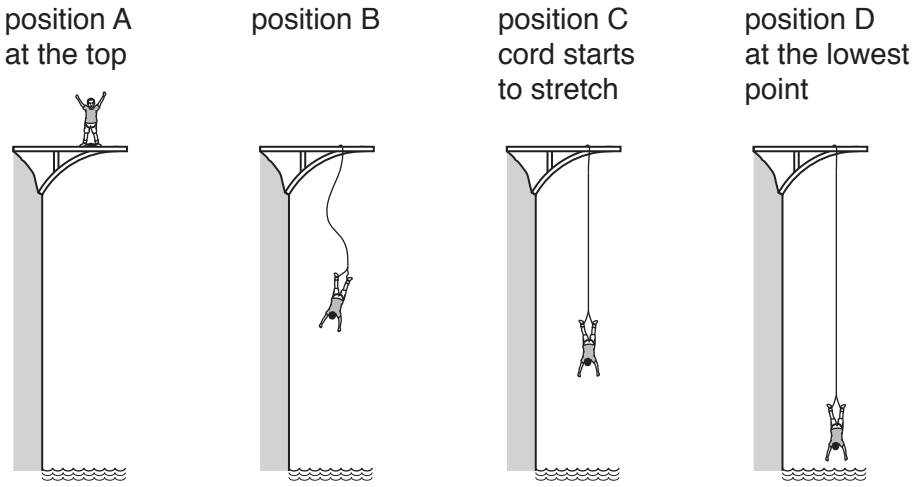


Fig. 11.1 (not to scale)

The man starts from position A in Fig. 11.1. The elastic cord starts to stretch at position C and he stops for the first time at position D. He continues to rise and fall.

Fig. 11.2 shows how the velocity of the man varies with time *t*.

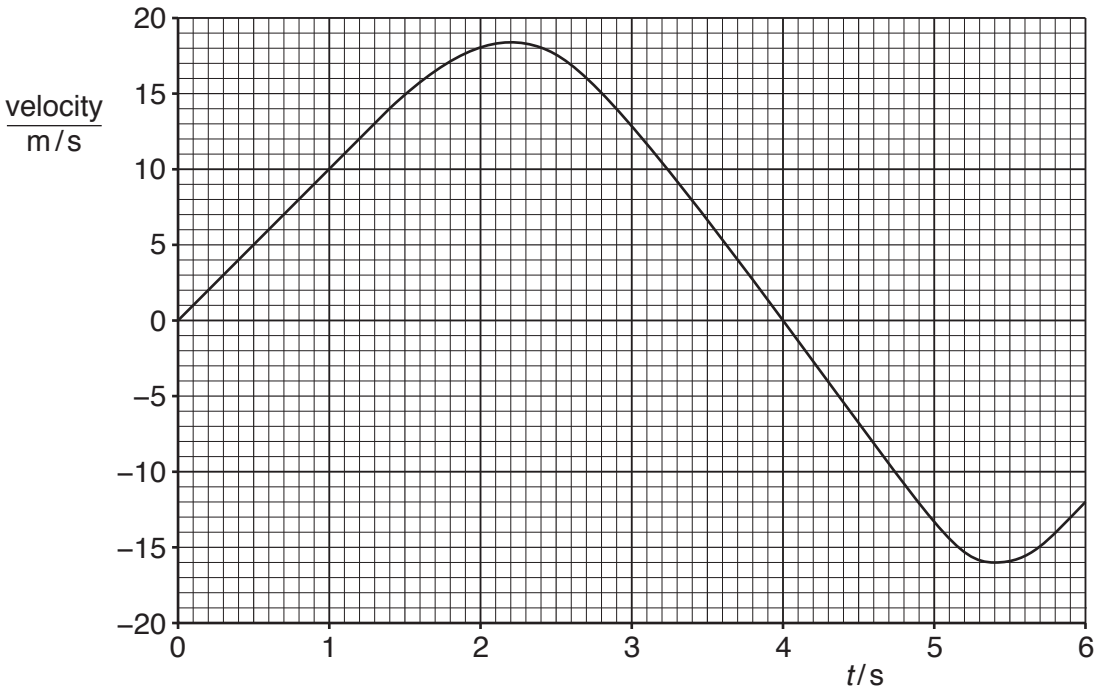


Fig. 11.2

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(a) (i) State what is meant by *velocity*.

.....

..... [2]

(ii) State the difference between a positive velocity and a negative velocity.

.....

..... [1]

(iii) In the first 1.4 s the acceleration is uniform.

1. Using values from Fig. 11.2, determine the acceleration of the man in the first 1.4 s.

acceleration = ... [3]

2. Comment on your value of acceleration.

.....

..... [1]

(iv) **1.** State the value of t when the man is at position D.

..... [1]

2. Explain, in terms of the forces acting, why the man is accelerating upwards at D.

.....

.....

.....

.....

..... [3]

(b) Fig. 11.3 shows the values for the gravitational potential energy of the man, the kinetic energy of the man and the elastic potential energy in the cord at A, C and D.

You may ignore the effect of air resistance in this question.

	gravitational potential energy/J	kinetic energy/J	elastic potential energy/J
position A	20000	0	0
position C	15000		0
position D	0	0	

Fig. 11.3

(i) Complete Fig. 11.3 to show the kinetic energy of the man at C and the elastic potential energy in the cord at D. [2]

(ii) The man has a mass of 50 kg.

The gravitational field strength g is 10 N/kg.

Using values from Fig. 11.3, calculate the vertical distance between A and C.

distance = ... [2]

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