OCR
Oxford Cambridge and RSA

Tuesday 19 May 2015 – Morning

AS GCE PHYSICS A

G481/01 Mechanics

Candidates answer on the Question Paper.

OCR supplied materials:
- Data, Formulae and Relationships Booklet (sent with general stationery)

Other materials required:
- Electronic calculator
- Protractor
- Ruler (cm/mm)

Duration: 1 hour

* G 4 8 1 0 1 *

* 4 8 6 5 0 3 1 7 1 6 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.



Where you see this icon you will be awarded marks for the quality of written communication in your answer.

This means for example you should:
- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- organise information clearly and coherently, using specialist vocabulary when appropriate.

- This document consists of **16** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 In each of the following questions a description of a graph is given.

Insert the correct labels for the axes on the dotted lines in Fig. 1.1 to Fig. 1.4.

The first one has been completed for you.

The area under the graph shown in Fig. 1.1 is equal to the elastic potential energy of a spring.

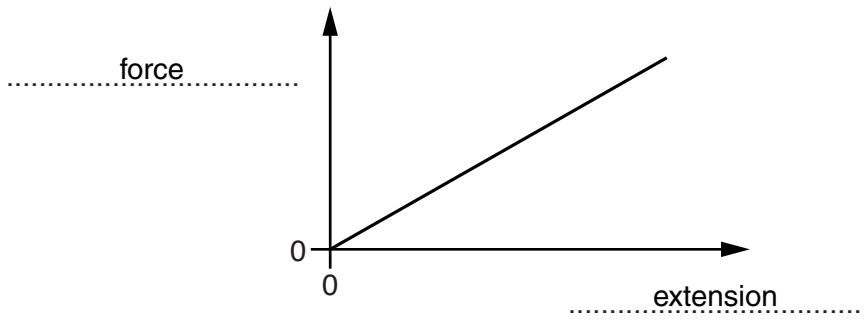


Fig. 1.1

(a) The area under the graph shown in Fig. 1.2 is equal to the displacement of a ball.

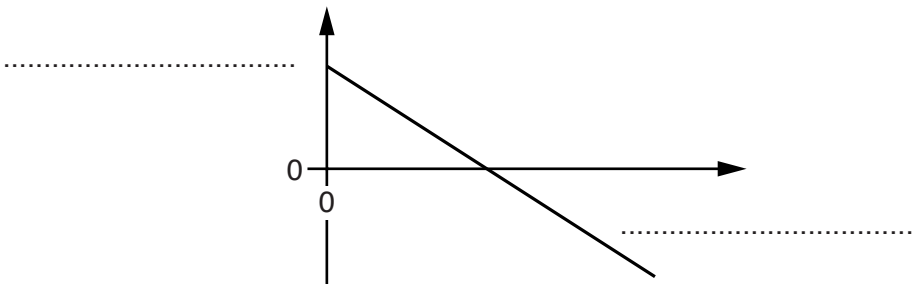


Fig. 1.2

[1]

(b) The gradient of the graph shown in Fig. 1.3 is the Young modulus of a material.

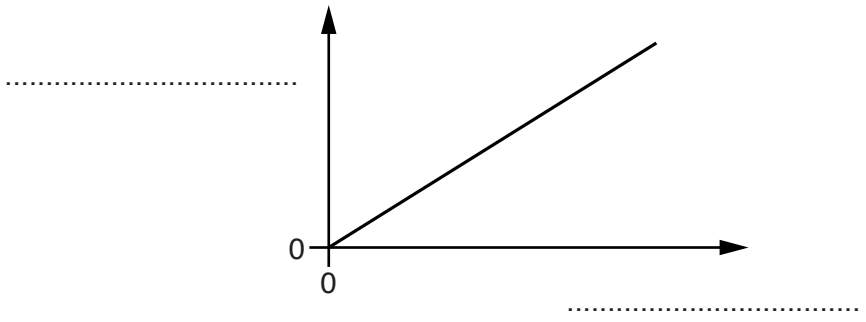


Fig. 1.3

[1]

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(c) The gradient of the graph shown in Fig. 1.4 is the force constant of a wire.

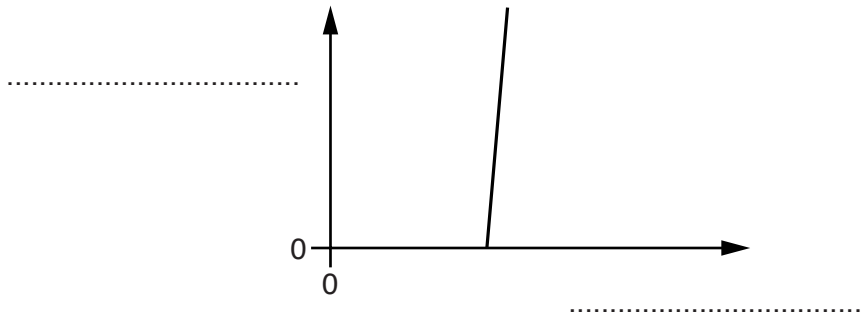


Fig. 1.4

[1]

Turn over for next question

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2 **(a)** *Energy* and *work done* are scalar quantities and have the same unit as each other.

State **two** other scalar quantities in physics that have the same unit as each other.

.....

..... **[1]**

(b) Two forces **A** and **B** act through the same point in an object. These two forces are shown in Fig. 2.1. No other forces act on the object.

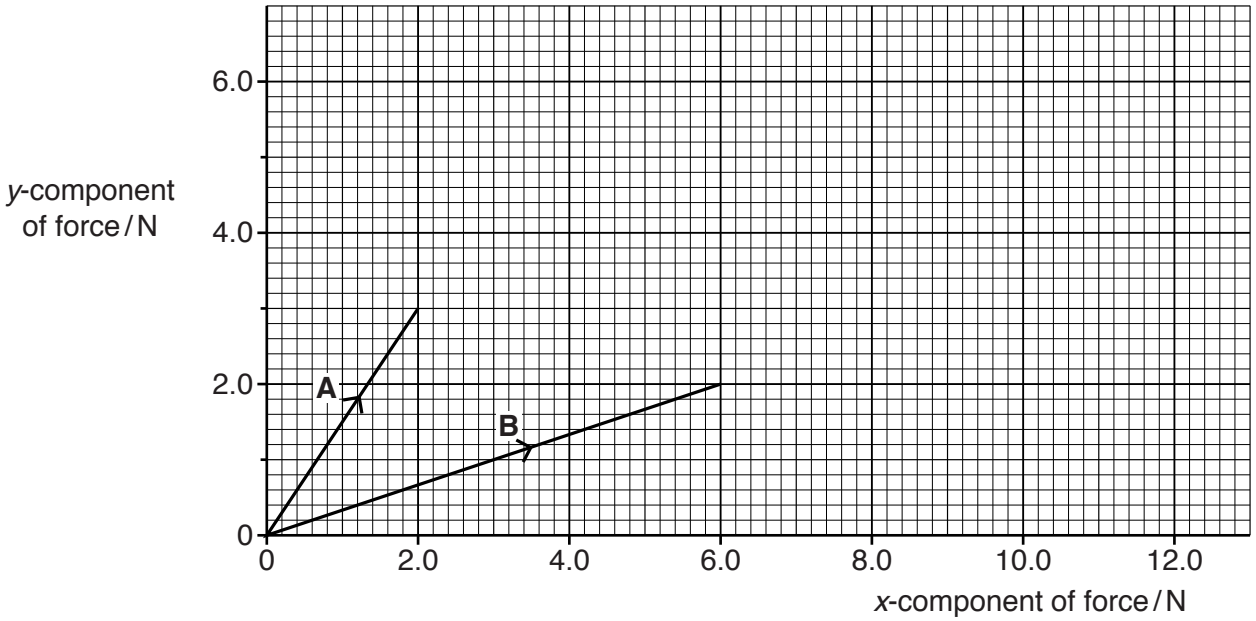


Fig. 2.1

(i) Use Fig. 2.1 to determine the *x*- and *y*- components of the force **B**.

x-component = ... N

y-component = ... N
[1]

(ii) Use Fig. 2.1 to determine the magnitude of the resultant of the two forces **A** and **B**.

resultant force = ... N **[3]**

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(c) Fig. 2.2 shows a jet of water from the end of a hosepipe.

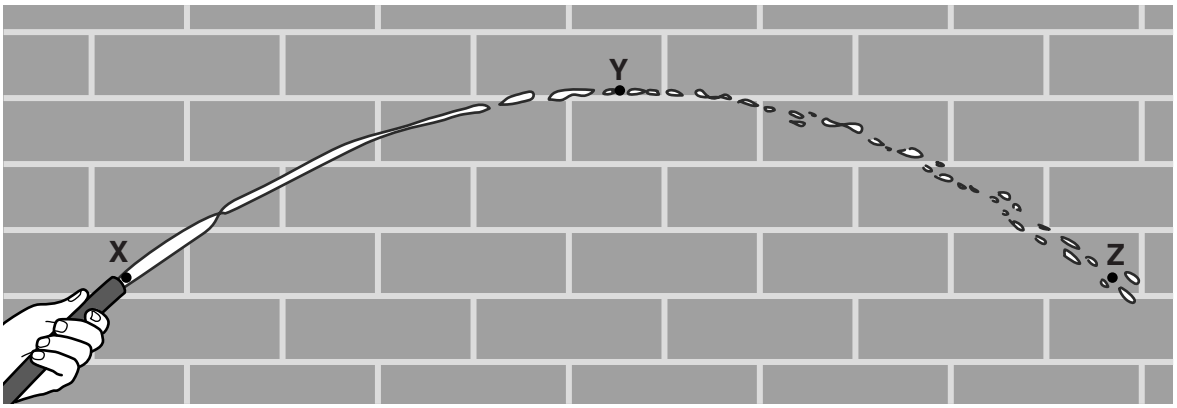


Fig. 2.2

Air resistance has negligible effect on the motion of the water jet. The water jet reaches maximum height at point **Y**.

(i) State the direction of the force acting on the water at **Y**.

..... **[1]**

(ii) Describe and explain how the horizontal component of the velocity of the water varies from point **X** to point **Y**.

.....

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..... **[2]**

(iii) Describe how the vertical component of the velocity of the water varies from point **X** to point **Z**.

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..... **[2]**

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3 **(a)** Fig. 3.1 shows the path taken by an aircraft as it flies from **A** to **B**.

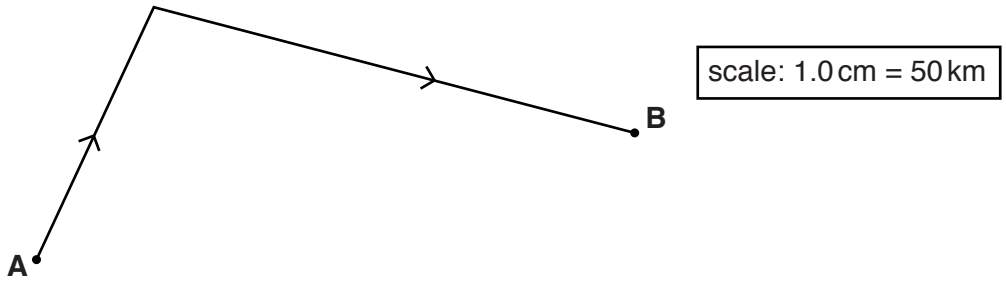


Fig. 3.1

On Fig. 3.1, a distance of 1.0 cm represents a distance of 50 km travelled by the aircraft. The aircraft takes 25 minutes to travel from **A** to **B**.

(i) Use Fig. 3.1 to determine the magnitude of the average velocity of the aircraft as it travels from **A** to **B**.

average velocity = ... $m\,s^{-1}$ **[3]**

(ii) Without doing any calculations, explain why the average speed of the aircraft is not the same as the magnitude of its average velocity.

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..... **[1]**

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(b) Io is one of the many moons of Jupiter. It travels at constant speed around Jupiter in a circular orbit of radius 4.2×10^8 m. Io takes 1.5×10^5 s to orbit once around Jupiter.

(i) Calculate the speed of Io in its orbit.

speed = ... $m\,s^{-1}$ **[2]**

(ii) Io has several active volcanoes on its surface. One of these volcanoes produces jets of sulphur with a velocity of $1.3\,km\,s^{-1}$ that rise to 470 km above the volcano.

Calculate the constant acceleration of free fall on the surface of Io.

acceleration = ... $m\,s^{-2}$ **[3]**

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4 **(a)** An object falling towards the ground has both kinetic energy and gravitational potential energy.

Explain what is meant by *gravitational potential energy* without using an equation.

.....

..... **[1]**

(b) A ball of mass 0.20 kg is thrown vertically downwards at a speed of $15\,m\,s^{-1}$ towards the ground from a height of 2.8 m. The ball hits the ground and rebounds at a speed of $12\,m\,s^{-1}$, as shown in Fig. 4.1. Assume air resistance has negligible effect on the motion of the ball.

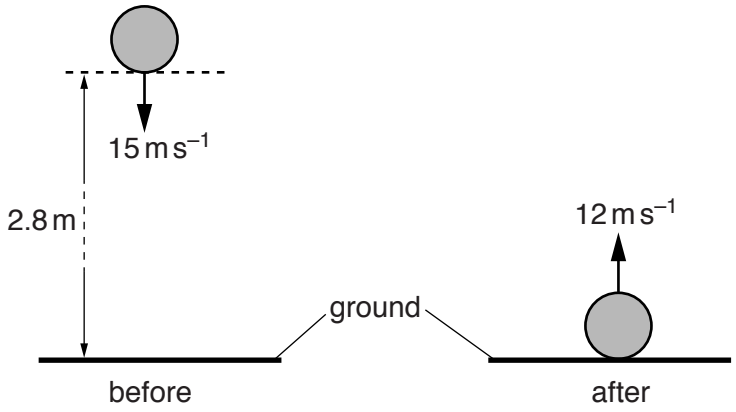


Fig. 4.1

(i) Calculate the speed of the ball just before it hits the ground.

speed = ... $m\,s^{-1}$ **[2]**

(ii) Calculate the energy transferred to the ground during the impact.

energy transferred = ... J **[3]**

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(iii) The time of impact of the ball with the ground is 0.065 s.

Calculate the magnitude of the average force exerted by the ground on the ball during the impact.

force = ... N **[2]**

5 A student wants to carry out an experiment to determine the input power to a small electric motor without using electrical meters. The motor is used to lift light loads. The efficiency of the motor is 15%. Describe how this student can determine the input power to the motor. Your description should include:

- the measurements taken
- the instruments used to take the measurements
- how the measurements are used to determine the input power to the motor.

In your answer, you should use appropriate technical terms, spelled correctly.

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..... **[4]**

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6 **(a)** The drag force F acting on a car travelling at a speed v is given by the equation

$$F = kAv^2$$

where A is the area of the front of the car.

Show that a suitable unit for the quantity k is kg m^{-3}.

[2]

(b) A table tennis ball experiences drag as it travels through the air. Fig. 6.1 shows the ball in three different situations, **A**, **B** and **C**.

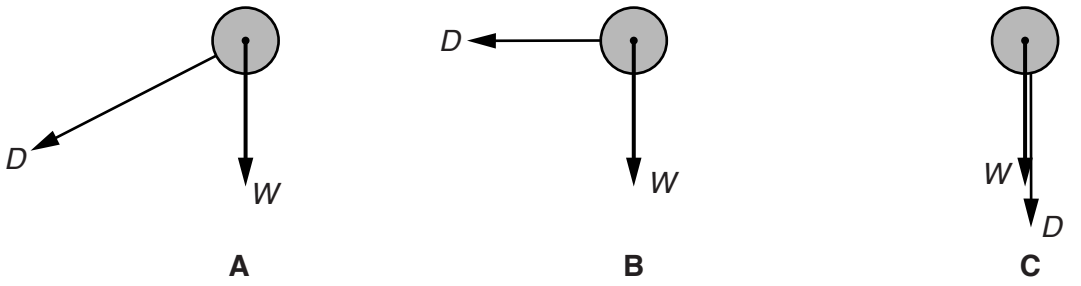


Fig. 6.1

The ball has weight W and the drag force is D.

(i) On Fig. 6.1 draw an arrow to show the **direction** of travel of the ball in situation **A**. **[1]**

(ii) In situation **B** the magnitude of the weight and the drag are the same.

Explain whether or not the ball is travelling at its terminal velocity.

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..... **[1]**

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(iii) Describe and explain the motion of the ball in situation **C**.

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..... **[2]**

(c) Fig. 6.2 shows a DVD held above the ground.



Fig. 6.2

The DVD is dropped from rest. The circular face remains horizontal as it falls. The DVD does not reach terminal velocity before it hits the ground.

Describe and explain how the acceleration of the DVD varies from the instant it is dropped until just before it hits the ground.

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..... **[4]**

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7 **(a)** A block of concrete rests on the ground, as shown in Fig. 7.1.

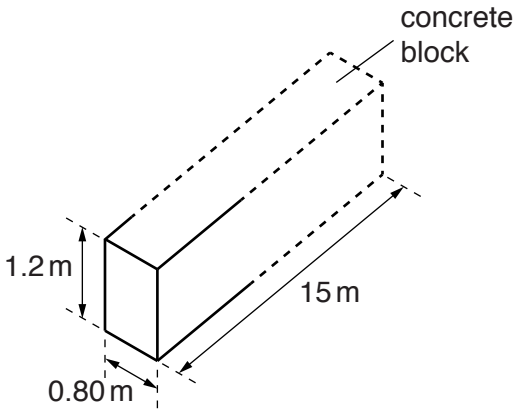


Fig. 7.1

The concrete block is 15 m long, 0.80 m wide and 1.2 m high. The density of concrete is 2.4×10^3 kg m^{-3}. Calculate

(i) the weight of the concrete

weight = ... N **[2]**

(ii) the pressure exerted on the ground by the block of concrete.

pressure = ... Pa **[2]**

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(b) Fig. 7.2 shows two vertical walls supporting a uniform horizontal platform in equilibrium.

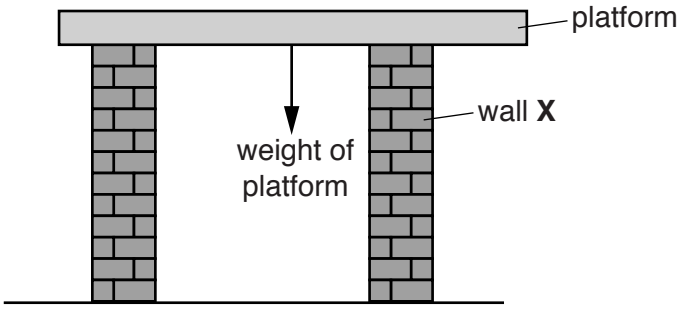


Fig. 7.2

(i) The net force acting on the platform is zero. State another condition that applies to this platform.

.....

..... **[1]**

(ii) The walls exert upward forces on the platform. An engineer suggests that the wall **X** should be moved a little further away from the centre of gravity of the platform and the opposite wall left where it is.

State and explain the effect this change would have on the force exerted by wall **X** on the platform.

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..... **[2]**

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8 **(a)** Fig. 8.1 shows a graph of stress against strain for rubber.

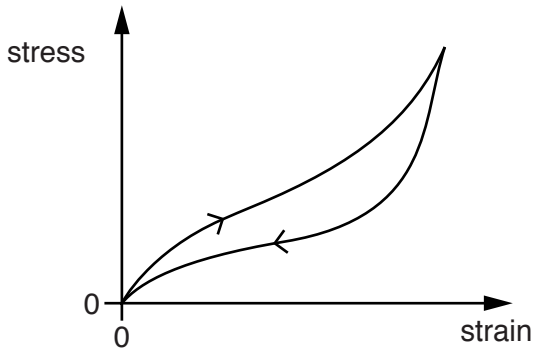


Fig. 8.1

Use Fig. 8.1 to describe the main physical properties of this material.

In your answer, you should use appropriate technical terms, spelled correctly.

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..... **[3]**

(b) Fig. 8.2 shows a metal strip pulled from its ends until it breaks.

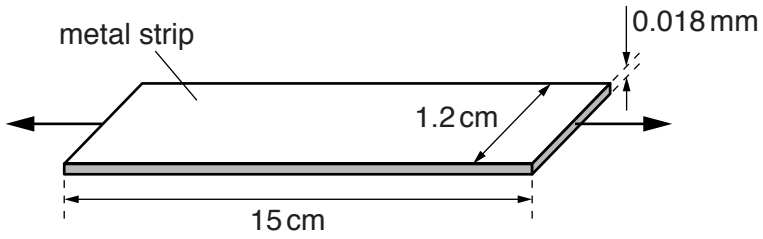


Fig. 8.2

The strip is 15 cm long, 1.2 cm wide and 0.018 mm thick. The breaking force for this strip is 16 N. The Young modulus of the metal is 7.1×10^{10} Pa.

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(i) Calculate the extension of the metal strip when it breaks. State one assumption made in your calculation.

extension = ... m **[3]**

assumption: .....

..... **[1]**

(ii) Calculate the breaking force of a rod of radius 0.60 cm made from the same metal.

breaking force = ... N **[2]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page. The question number(s) must be clearly shown in the margin.

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