OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

PHYSICS A

Mechanics

G481

Candidates answer on the question paper.

OCR supplied materials:
- Data, Formulae and Relationships Booklet

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

Wednesday 12 January 2011
Morning

Duration: 1 hour

OCE/17466

G4831

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. Pencil may be used for graphs and diagrams only.
- 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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- 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.



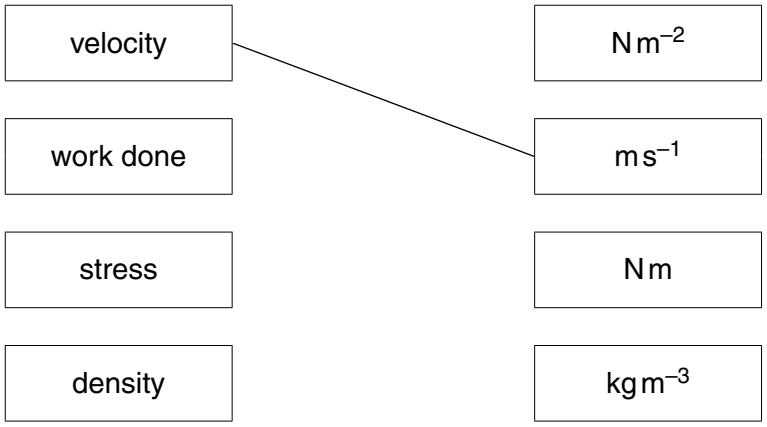
Where you see this icon you will be awarded marks for the quality of written communication in your answer.

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.

© OCR 2011 [J/500/8054]
OCR is an exempt Charity

Answer **all** the questions.

1 **(a)** Draw a straight line from each quantity on the left hand side to its correct unit on the right hand side; one has already been done for you.



[2]

(b) Fig. 1.1 shows a metal cube which rests on a table.

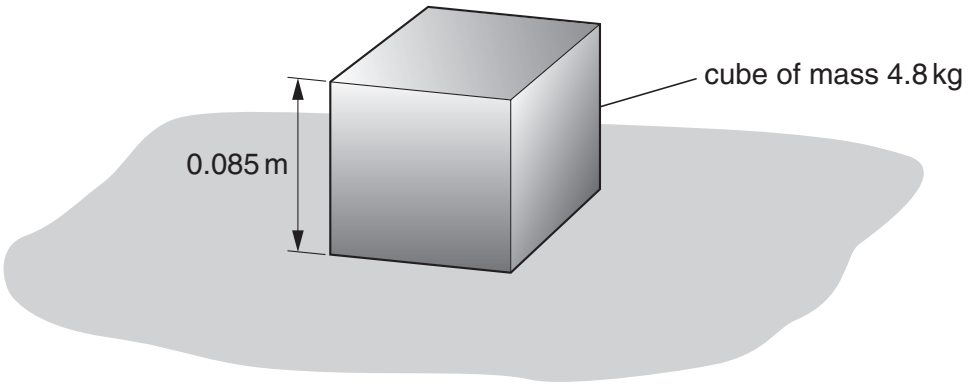


Fig. 1.1

The mass of the metal cube is 4.8 kg. Each side of the cube has length 0.085 m. The cube exerts pressure on the table.

(i) Complete the sentence below:

The force acting on the table is due to the …… of the metal cube. **[1]**

(ii) Calculate the pressure exerted on the table by the metal cube.

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

© OCR 2011

(iii) The metal cube shown is replaced by a second cube made of the same material but with each side of double the length of the original cube.

Complete the sentences below for the second cube when compared with the original cube.

The mass of the second cube is …… times greater than the original cube.

The cross-sectional area of the base is …… times greater than the original cube.

Hence, the pressure exerted by this cube is …… times greater than the original cube.

[3]

[Total: 8]

© OCR 2011

2 A driver travelling in a car on a straight and level road sees an obstacle in the road ahead and applies the brakes until the car stops. The initial speed of the car is 20 m s^{-1}. The reaction time of the driver is 0.50 s.

Fig. 2.1 shows the velocity against time graph for the car.

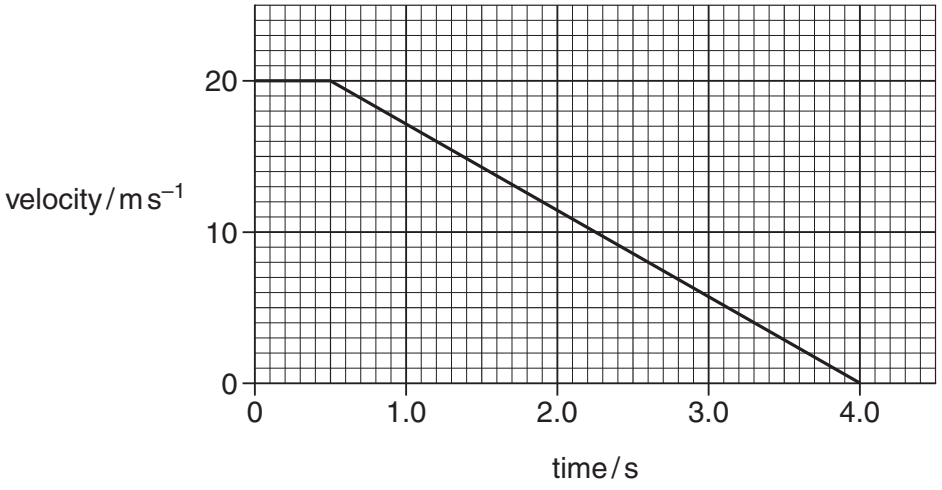


Fig. 2.1

(a) Define *thinking distance*.

.....

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

(b) What does the area under a velocity against time graph represent?

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

(c) Use your answer to **(b)** and Fig. 2.1 to determine

(i) the thinking distance

thinking distance = ... m **[1]**

© OCR 2011

(ii) the braking distance.

braking distance = ... m **[2]**

(d) The total mass of the car is 910 kg. Use Fig. 2.1 to determine

(i) the magnitude of the deceleration of the car

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

(ii) the braking force acting on the car as it decelerates.

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

(e) Suppose the initial speed of the car is twice that shown in Fig. 2.1. The braking force remains the same. State and explain by what factor the **braking** distance would increase.

.....

.....

.....

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

© OCR 2011

(f) One of the safety features in a car is the air bag for the driver. Briefly describe how the air bag is triggered and how it minimises the impact force on the driver.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

[Total: 15]

© OCR 2011

3 **(a)** Define *work done* by a force.

.....

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

(b) Fig. 3.1 shows a car travelling up a slope at a constant speed.

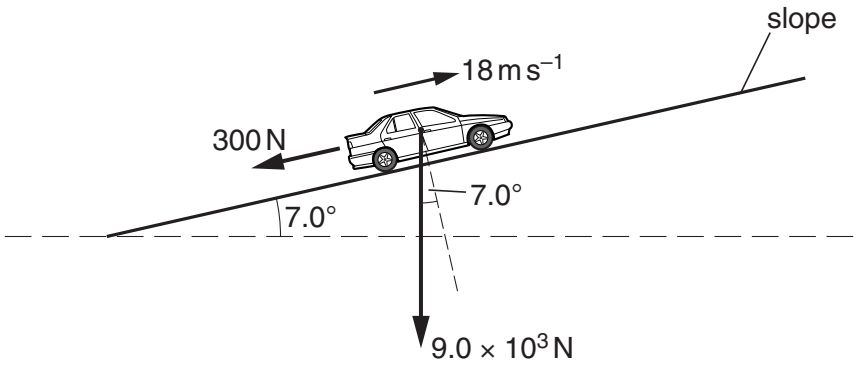


Fig. 3.1

The angle between the slope and the horizontal is 7.0°. The weight of the car is 9.0×10^3 N. The car travels up the slope at a constant speed of 18 m s^{-1}. A resistive force of 300 N acts on the car down the slope.

(i) What is the net force acting on the car? Explain your answer.

.....

.....

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

(ii) Calculate the component of the weight of the car acting down the slope.

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

© OCR 2011

(iii) Calculate the work done per second against the resistive force.

work done per second = ... Js^{-1} **[1]**

(iv) Calculate the power developed by the car as it travels up the slope.

power = ... W **[3]**

[Total: 9]

© OCR 2011

4 **(a)** Write a word equation for *kinetic energy*.

kinetic energy =

[1]

(b) A bullet of mass 3.0×10^{-2} kg is fired at a sheet of plastic of thickness 0.015 m. The bullet enters the plastic with a speed of 200 m s^{-1} and emerges from the other side with a speed of 50 m s^{-1}.

Calculate

(i) the loss of kinetic energy of the bullet as it passes through the plastic

loss of kinetic energy = ... J **[3]**

(ii) the average frictional force exerted by the plastic on the bullet.

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

[Total: 6]

© OCR 2011

5 Use your knowledge of physics to state if each statement is correct or incorrect. You then need to explain the reason for your answer. An example has been done for you:

In a vacuum, a 2.0 kg object will fall faster towards the ground than an object of mass 1.0 kg.

This statement is **incorrect**.
Explanation: **All objects falling towards the Earth in a vacuum have the same acceleration**.

(a) The mass of a particle (e.g. electron) remains constant as its speed approaches the speed of light.

This statement is .....

Explanation: .....

.....

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

(b) A ball is thrown vertically upwards. Air resistance has negligible effect on its motion. During the flight, the total energy of the ball remains constant.

This statement is .....

Explanation: .....

.....

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

(c) An object falling through air has a terminal velocity of 30 m s^{-1}. At terminal velocity, the weight of the object is equal to the acceleration of free fall.

This statement is .....

Explanation: .....

.....

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

(d) The technique of 'triangle of vectors' is used by a global positioning system (GPS) to locate the position of cars.



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

This statement is .....

Explanation: .....

.....

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

[Total: 8]

© OCR 2011

6 **(a)** Explain in terms of forces what is meant by a *couple*.

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

.....

.....

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

(b) **(i)** Define *moment of a force*.

.....

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

(ii) Fig. 6.1 shows three forces acting on a rod.

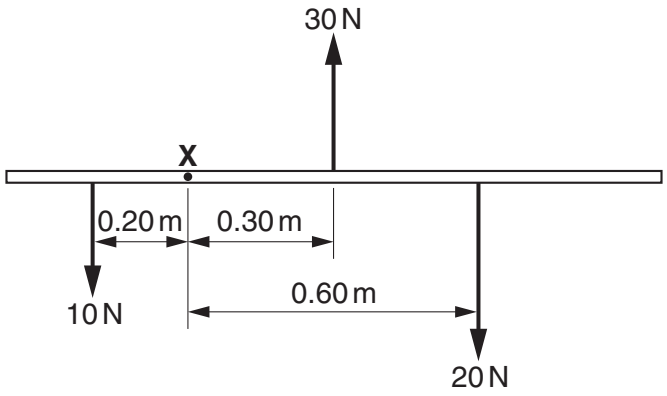


Fig. 6.1

By taking moments about point **X**, show that the rod is not in equilibrium when acted upon by these forces.

.....

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

[Total: 4]

© OCR 2011

7 **(a)** Fig. 7.1 shows stress against strain graphs for materials **X**, **Y** and **Z** up to their breaking points.

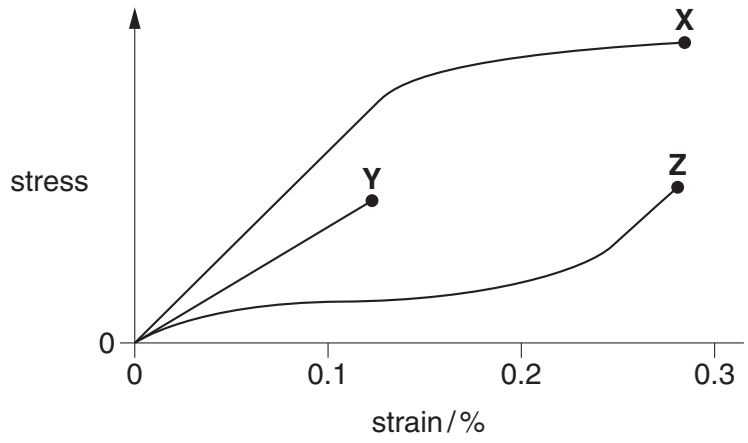


Fig. 7.1

(i) State which of these three materials is brittle.

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

(ii) State one similarity between the properties of materials **X** and **Y** for strains less than 0.05%.

.....

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

(iii) State and explain which material has the greatest value for the Young modulus.

.....

.....

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

© OCR 2011

(b) Engineers are testing a new material to be used as support cables for a bridge. In a laboratory test, the breaking force for a sample of the material of diameter 0.50 mm is 240 N. Estimate the breaking force for a cable of diameter 15 mm made from the same material.

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

[Total: 6]

Please turnover for Question 8.

© OCR 2011

8 A small block of wood is held at a horizontal distance of 1.2 m from a metal ball. The metal ball is fired horizontally towards the block at a speed of 8.0 m s^{-1}. At the same instant the ball is fired, the block is released and it falls vertically under gravity.

Fig. 8.1 shows the paths of the metal ball and the block. The ball collides with the block. Air resistance is negligible.

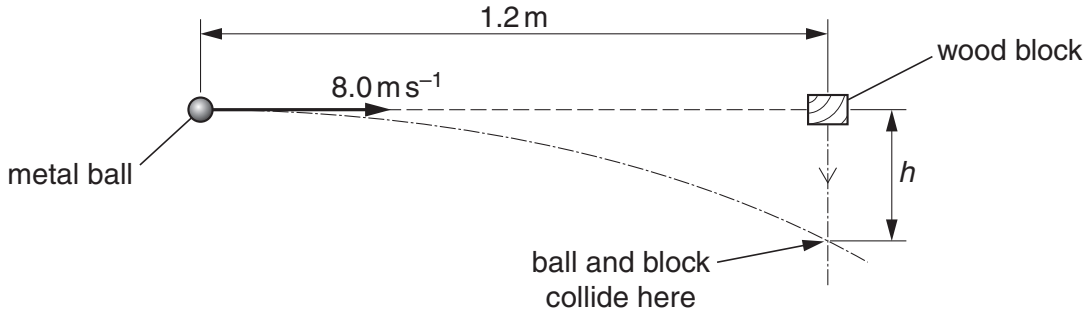


Fig. 8.1

(a) Show that the time between firing the ball and it colliding with the block is 0.15 s.

[1]

(b) Calculate the vertical distance *h* fallen by the wooden block when it collides with the metal ball.

h = ... m **[2]**

© OCR 2011

(c) Briefly explain why the metal ball will always collide with the wood block, even if the speed of the ball or the horizontal distance is changed.

.....

.....

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

[Total: 4]

END OF QUESTION PAPER

© OCR 2011

PLEASE DO NOT WRITE ON THIS PAGE

OCR
RECOGNISING ACHIEVEMENT

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© OCR 2011