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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
- Ruler (cm/mm)
- Protractor

Thursday 27 May 2010
Afternoon

Duration: 1 hour

OCE/23014

G4831

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but must clearly show your Candidate Number, Centre Number and question number(s).

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 **(a)** Complete the table of Fig. 1.1 by stating the value or name of each of the remaining three prefixes.

prefix	value
micro (μ)	10^{-6}
mega (M)	
	10^{-9}
tera (T)	

Fig. 1.1

[3]

(b) Circle all the scalar quantities in the list below.

density **weight** **velocity** **volume** **acceleration**

[1]

(c) The distance between the Sun and the Earth is 1.5×10^{11} m. Calculate the time in minutes for light to travel from the Sun to the Earth. The speed of light is $3.0 \times 10^{8}\,m\,s^{-1}$.

time = ... min **[2]**

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(d) The terminal velocity of a raindrop falling vertically through air is $4.0\,m\,s^{-1}$.

(i) In terms of the forces acting on the raindrop, explain why it is at terminal velocity.

.....

.....

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

(ii) Fig. 1.2 shows a velocity vector diagram for the falling raindrop in a horizontal crosswind of speed $1.5\,m\,s^{-1}$.

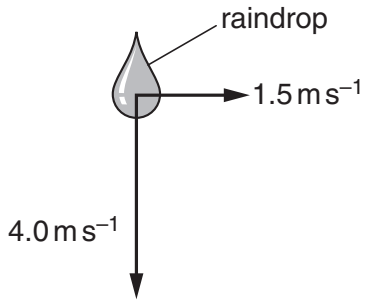


Fig. 1.2

1 On Fig. 1.2, draw an arrow on the raindrop to show the **direction** in which it will travel.

2 Calculate the magnitude of the resultant velocity of the raindrop. Use the space below for your working.

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

[Total: 11]

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2 **(a)** According to Aristotle (384 – 322 B.C.)

‘heavier objects fall faster than lighter ones’.

Explain how one experiment carried out by Galileo (1564 – 1642) overturned Aristotle’s ideas of motion.

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.....

.....

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

(b) Fig. 2.1 shows an arrangement used in the laboratory to determine the acceleration *g* of free fall.

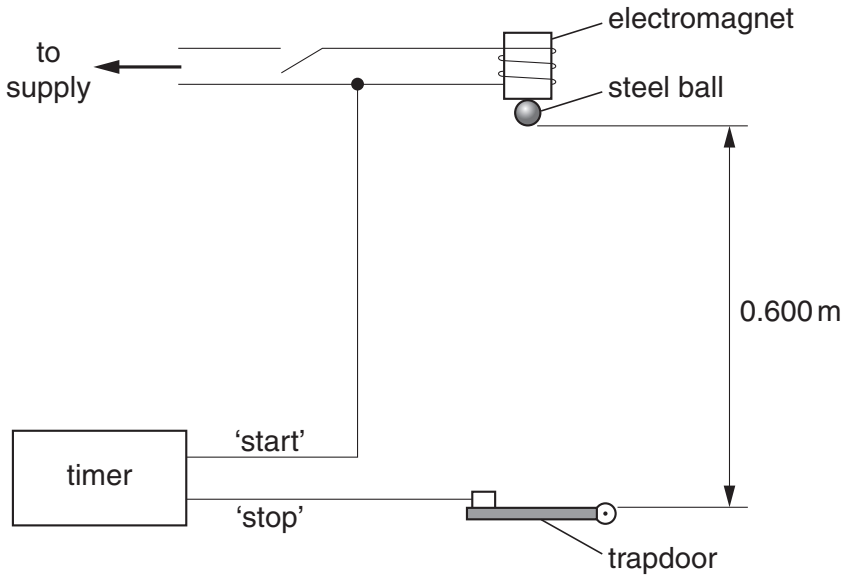


Fig. 2.1

The steel ball is held at rest by an electromagnet. When the electromagnet is switched off, the electronic timer is started and the ball falls. The timer is stopped when the ball opens the trapdoor. The distance between the bottom of the ball and the top of the trapdoor is 0.600 m. The timer records a time of fall of 0.356 s.

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(i) Show that the value for the acceleration g of free fall obtained from this experiment is $9.47\,m\,s^{-2}$.

[2]

(ii) State **one** reason why the experimental value in **(i)** is less than $9.81\,m\,s^{-2}$.

.....

.....

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

(iii) On Fig. 2.2 sketch a graph to show the variation of the vertical distance s fallen by the ball with time t.

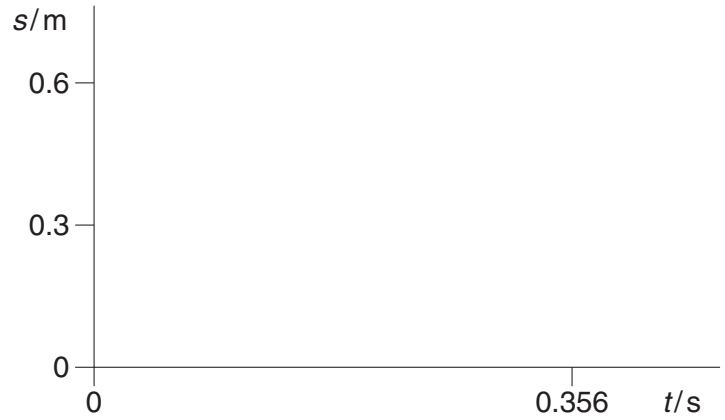


Fig. 2.2

[1]

[Total: 7]

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3 **(a)** Define the *newton*.

.....

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

(b) Fig. 3.1 shows a spaceship on the surface of the Earth.

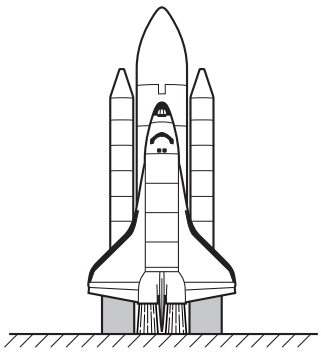


Fig. 3.1

The mass of the spaceship is 1.9×10^6 kg. During lift off, the spaceship rockets produce a vertical upward force of 3.1×10^7 N.

(i) Calculate the weight of the spaceship.

weight = ... N **[1]**

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(ii) Calculate the initial vertical acceleration as the spaceship lifts off.

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

(iii) The vertical upward force on the spaceship stays constant. Explain why the acceleration of the spaceship increases after lift off.

.....

.....

.....

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

[Total: 5]

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

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

.....

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

(b) Fig. 4.1 shows a side view of a roller coaster.

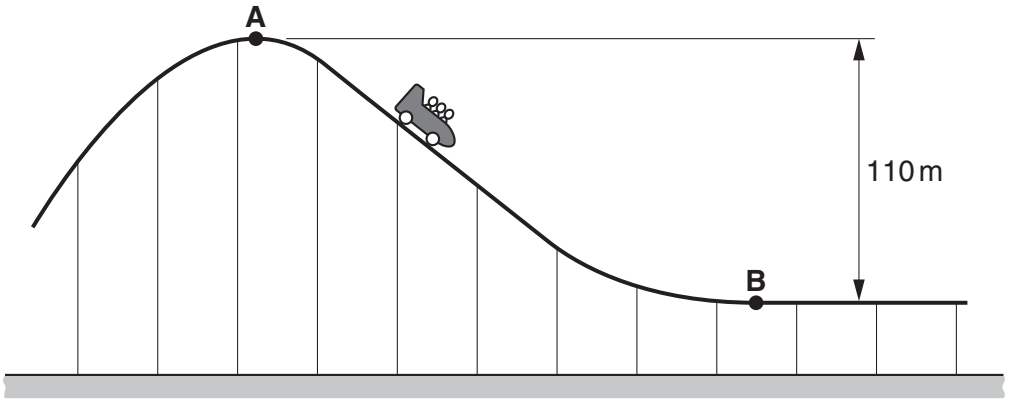


Fig. 4.1

The carriage and its passengers start at rest at **A**. At **B**, the bottom of the ride, the maximum speed of the carriage is $20\,m\,s^{-1}$. The vertical distance between **A** and **B** is 110 m. The length of the track between **A** and **B** is 510 m. The mass of the carriage and the passengers is 4000 kg.

(i) Complete the sentence below.

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

As the carriage travels from **A** to **B**, ……..…… energy

is transferred to …… energy and heat. **[2]**

(ii) By considering this energy transfer from **A** to **B**, determine the average frictional force acting on the carriage and passengers between **A** and **B**.

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

[Total: 6]

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5 **(a)** Define *braking distance* of a car.

.....

.....

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

(b) Other than the speed of the car, state two factors that affect the braking distance of a car. Describe how the braking distance is affected by each factor.

1. .....

.....

.....

.....

2. .....

.....

.....

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

(c) Describe and explain how seat belts in cars reduce impact forces on the driver in an accident.

.....

.....

.....

.....

.....

.....

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

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(d) Fig. 5.1 shows the variation of braking distance with speed v of a car.

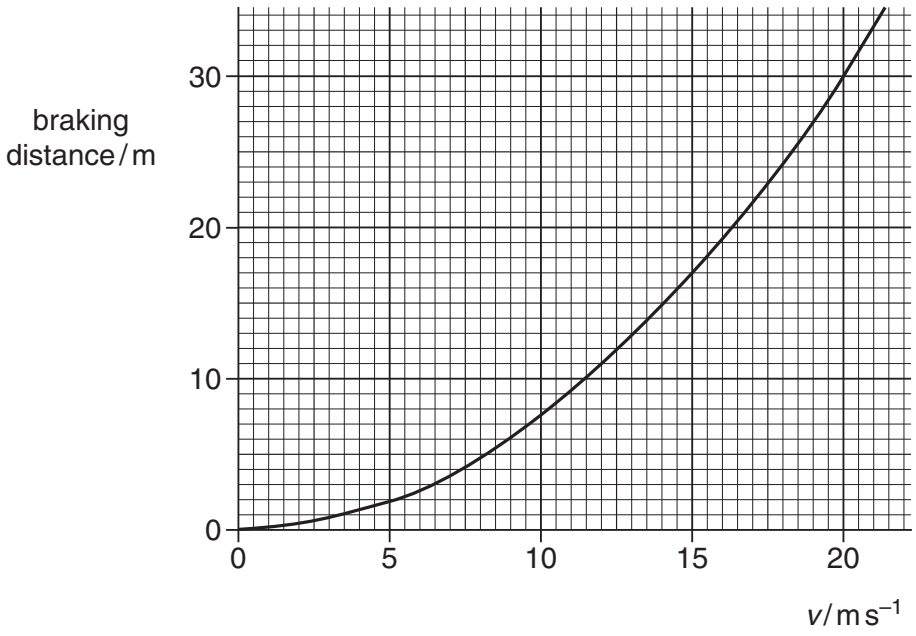


Fig. 5.1

(i) The car is travelling on a level straight road at a speed of $20\,m\,s^{-1}$. The reaction time of the driver is 0.50 s.

1 Calculate the thinking distance.

thinking distance = ... m

2 Hence, determine the stopping distance of the car.

stopping distance = ... m

[3]

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(ii) In Fig. 5.1, the braking distance is directly proportional to the square of the speed. Determine the braking distance of the car when travelling at a speed of $32\,m\,s^{-1}$.

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

[Total: 13]

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6 **(a)** Fig. 6.1 shows two equal but opposite forces acting on an object.

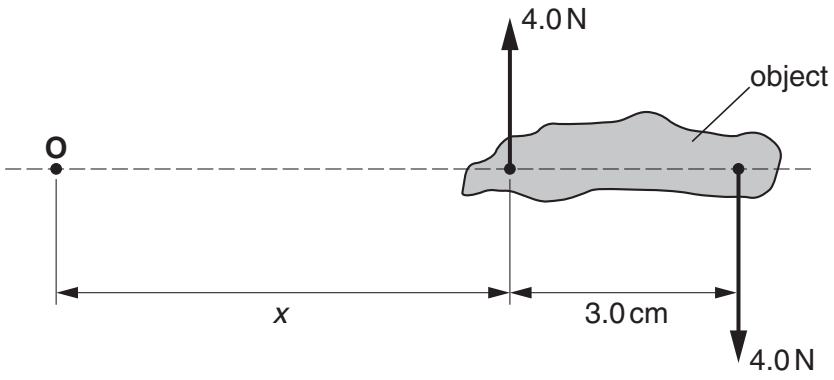


Fig. 6.1

The point **O** is at a distance *x* from the nearer of the two forces.

(i) The separation between the two parallel forces is 3.0 cm. Determine the torque of the couple exerted on the object.

torque = ... N m **[2]**

(ii) Calculate the total moment of the forces about the point **O** and state the significance of this value.

.....

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

(b) State two conditions necessary for an object to be in equilibrium.

.....

.....

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

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(c) A concrete paving slab has mass 45 kg and dimensions 0.600 m × 0.600 m × 0.050 m.

(i) Calculate the density of the concrete.

density = ... $kg\,m^{-3}$ **[2]**

(ii) Fig. 6.2 shows the concrete paving slab in equilibrium.

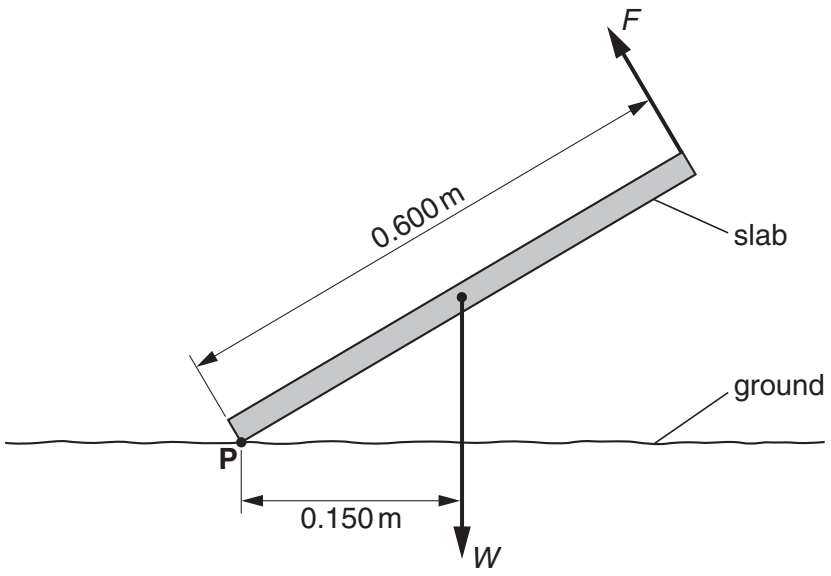


Fig. 6.2

Two forces acting on the slab are shown. The weight of the slab is *W*. The force *F* is applied at right angles to the end of the slab. By taking moments about **P**, determine the size of the force *F*.

F = ... N **[3]**

[Total: 12]

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

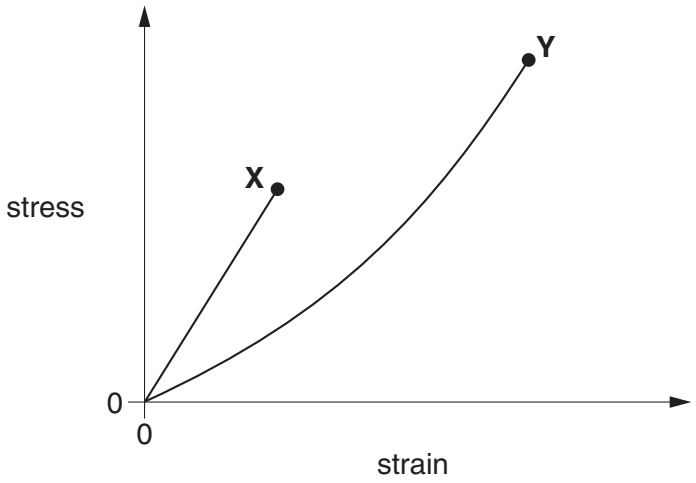


Fig. 7.1

Put a tick (✓) in the appropriate column if the statement applies to the material.

Statement	**X**	**Y**
This material is brittle.		
This material has greater breaking stress.		
This material obeys Hooke's Law.		

[1]

(b) Kevlar is one of the strongest man-made materials. It is used in reinforcing boat hulls, aircraft, tyres and bullet-proof vests. Sudden impacts cause this material to undergo plastic deformation.

(i) Explain what is meant by *plastic deformation*.

.....

.....

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

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(ii) One particular type of Kevlar has breaking stress 3.00×10^9 Pa and Young modulus 1.30×10^{11} Pa. For a Kevlar thread of cross-sectional area 1.02×10^{-7} m^2 and length 0.500 m, calculate

1 the maximum breaking force

force = ... N

2 the extension of the thread when the stress is 1.20×10^9 Pa.

extension = ... m
[4]

[Total: 6]

END OF QUESTION PAPER

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