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RECOGNISING ACHIEVEMENT

Monday 20 May 2013 – Afternoon

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

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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 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 **(a)** A student writes four incorrect statements shown in the table below. The error in each statement is circled. Write the correct answer for the circled unit or number; one has already been done for you.

Incorrect statement	Correct unit or number
The weight of a person is about 700 (**kg**).	N
The atmosphere exerts a pressure of about 1.0×10^5 (**$N\,m^2$**).	
A force of 1 N may be written as 1 kg (**$m^{-1}\,s^{-1}$**).	
1 GW is (**10**) times bigger than 1 MW.	

[2]

(b) Fig. 1.1 shows the apparatus used to determine the density of glass.

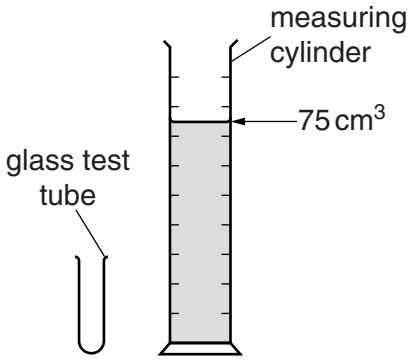


Fig. 1.1

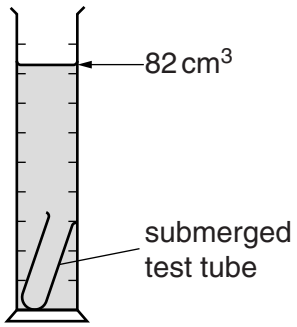


Fig. 1.2

The glass test tube has mass 1.6×10^{-2} kg. The measuring cylinder is partly filled with water. The test tube is gently pushed into the water until it is fully submerged as shown in Fig. 1.2. The level of the water inside the measuring cylinder increases from 75 cm^3 to 82 cm^3.

Calculate the density of the test tube glass in $kg\,m^{-3}$.

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

[Total: 4]

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2 **(a)** Explain why force is a *vector* quantity.

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

.....

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

(b) Fig. 2.1 shows the forces acting on a water drop on the windscreen of a stationary car.

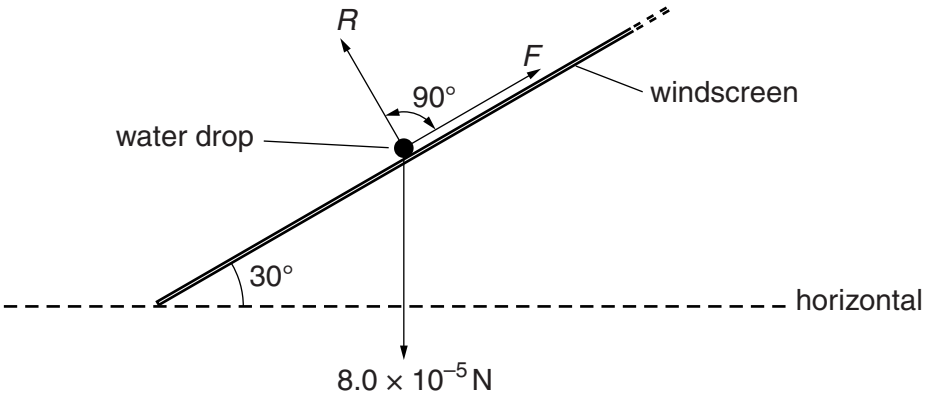


Fig. 2.1

The windscreen makes an angle of 30° to the horizontal. The weight of the water drop is 8.0×10^{-5} N. The normal contact force on the water drop is *R*. There is also a force *F* acting on the water drop as shown. The water drop is **stationary**.

(i) Use Fig. 2.1 to determine the component of the weight of the water drop

1 perpendicular to the windscreen

component = ... N

2 parallel to the windscreen.

component = ... N
[2]

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(ii) Determine the magnitude of *F*. Explain your answer.

.....

.....

.....

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

[Total: 5]

Question 3 begins on page 6

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3 **(a)** Define the *force constant* of a spring.

.....

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

(b) Fig. 3.1 shows a trolley attached by two **stretched** springs **A** and **B** to fixed supports.

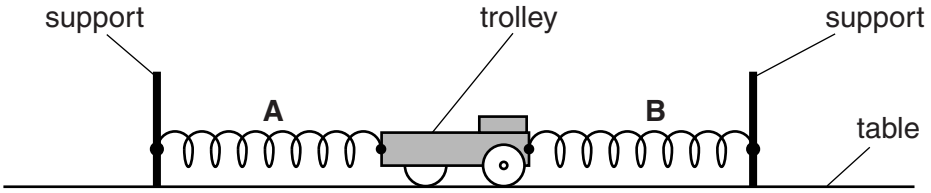


Fig. 3.1

The trolley is on a horizontal table and at rest. The springs **A** and **B** are identical.

(i) On Fig. 3.1, draw an arrow to show the direction of the force exerted by spring **A** on the trolley. Label this arrow **F**. **[1]**

(ii) The mass of the trolley is 0.80 kg. The force constant of each spring is 14 $N\,m^{-1}$. A student pulls the trolley to the left as shown in Fig. 3.2.

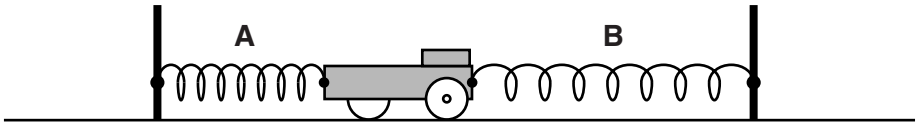


Fig. 3.2

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The extension of spring **A** is 0.30 m and the extension of spring **B** is 0.50 m. The student releases the trolley. Calculate the **initial** values of

1 the acceleration of the trolley

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

2 the ratio

$$\frac{\text{elastic potential energy for spring } \mathbf{B}}{\text{elastic potential energy for spring } \mathbf{A}}.$$

ratio = ... **[2]**

(iii) Explain why the acceleration of the trolley decreases as it travels a small distance to the right.

.....

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

(iv) State and explain how the acceleration in your answer to **(ii)1** would be different when a heavy object is fixed to the trolley.

.....

.....

.....

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

[Total: 10]

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4 Fig. 4.1 shows a metal ball held stationary above a tube containing oil.

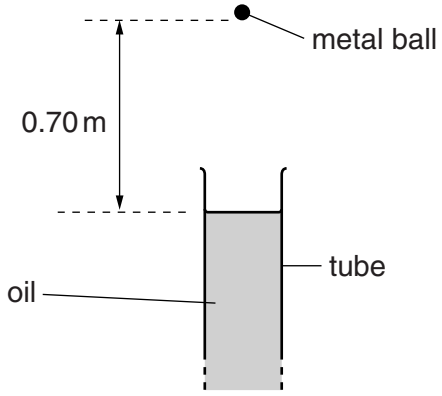


Fig. 4.1

(a) The ball is 0.70 m above the surface of the oil in the tube. Calculate the time taken for the ball to reach the surface of the oil when it is dropped from this height. Assume air resistance has negligible effect on the motion of the ball.

time = ... s **[3]**

(b) Fig. 4.2 shows the graph of velocity v against time t for the ball as it travels through the oil. The ball enters the oil at time $t = 0$.

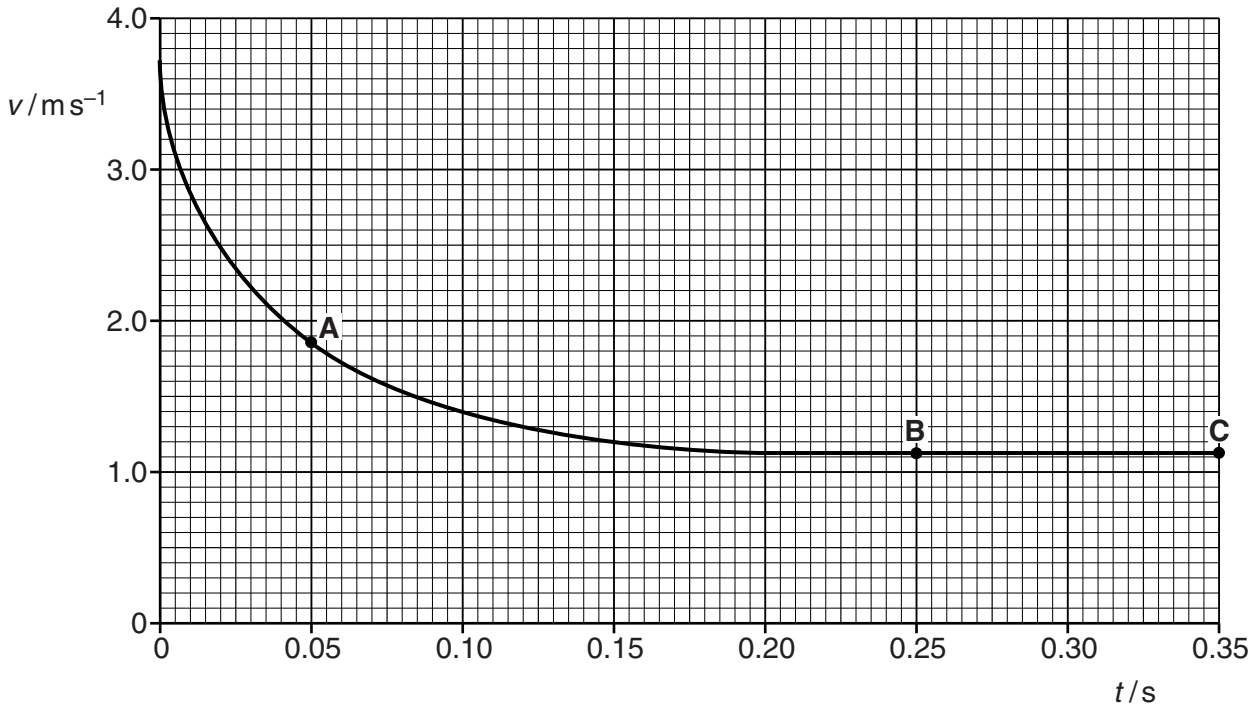


Fig. 4.2

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(i) Complete the sentence below.

The gradient of the graph is equal to the ..... of the ball and

the area under the graph is equal to the ..... . **[1]**

(ii) Use Fig. 4.2 to determine the magnitude of the deceleration of the ball at time $t = 0.05\,s$ (point **A**). Show your working.

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

(iii) In terms of the **forces** acting on the ball, describe and explain its motion when

1 time $t = 0.05\,s$ (point **A**)

.....

.....

.....

.....

.....

2 time $t = 0.25\,s$ (point **B**).

.....

.....

.....

.....

.....

[4]

(iv) Describe the energy transfers taking place between $t = 0.25\,s$ and $t = 0.35\,s$ (point **B** to **C**).

.....

.....

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

[Total: 12]

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5 **(a)** State what is meant by the *centre of gravity* of an object.

.....

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

(b) Define *moment of a force*.

.....

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

(c) Fig. 5.1 shows a baby's mobile toy.

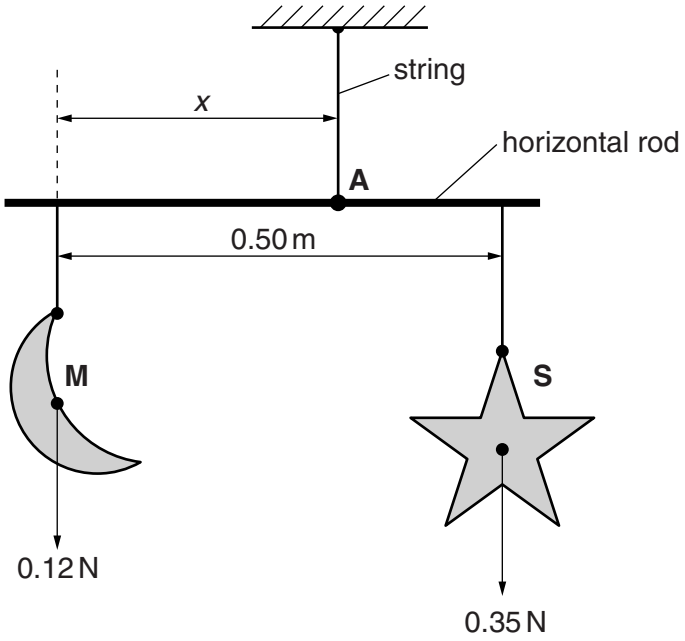


Fig. 5.1

The toy consists of a horizontal rod from which two objects shaped as a crescent moon **M** and a star **S** are suspended from lengths of string. The weight of the rod is negligible and it is pivoted about an axis passing through point **A** perpendicular to the plane of the diagram. The weights of **M** and **S** and the separation between the strings are shown in Fig. 5.1. The distance between the string on the left and point **A** is *x*. The arrangement shown in Fig. 5.1 is in equilibrium.

(i) State **two** conditions necessary for the rod to be in equilibrium.

.....

.....

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

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(ii) By taking moments about **A** determine the distance x.

x = ... m **[3]**

(iii) Determine the magnitude of the tension in the string attached to **A**.

tension = ... N **[1]**

[Total: 8]

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6 **(a)** Power can be measured in watts. Define the *watt*.

.....

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

(b) An electric motor-driven crane is used to raise a load of bricks of mass 700 kg through a vertical height of 8.5 m in a time of 45 s. The efficiency of the motor-driven crane is 30%. Calculate

(i) the gravitational potential energy E_p gained by the bricks

E_p = ... J **[1]**

(ii) the output power of the motor-driven crane

output power = ... W **[1]**

(iii) the input power to the motor-driven crane.

input power = ... W **[1]**

[Total: 4]

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7 **(a)** A car of mass m is at rest. A constant net force F acts on the car and it moves a distance x in the direction of the force. The final velocity of the car is v.

(i) Write down the equation

1 for the work done by the force F

2 relating force F and acceleration a.

[1]

(ii) Hence show that the kinetic energy of the car is given by the equation $E_k = \frac{1}{2} mv^2$.

[3]

(b) The braking distance of an empty van travelling at a steady speed on a level road is 50 m. The van is now fully loaded with goods and travels at the same speed on the same road.

Explain whether or not the braking distance would be the same. Assume that the driver applies the same braking force.

.....

.....

.....

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.....

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

[Total: 7]

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8 **(a)** Fig. 8.1 shows the stress against strain graph obtained from a test on a sample of wire of a ductile material.

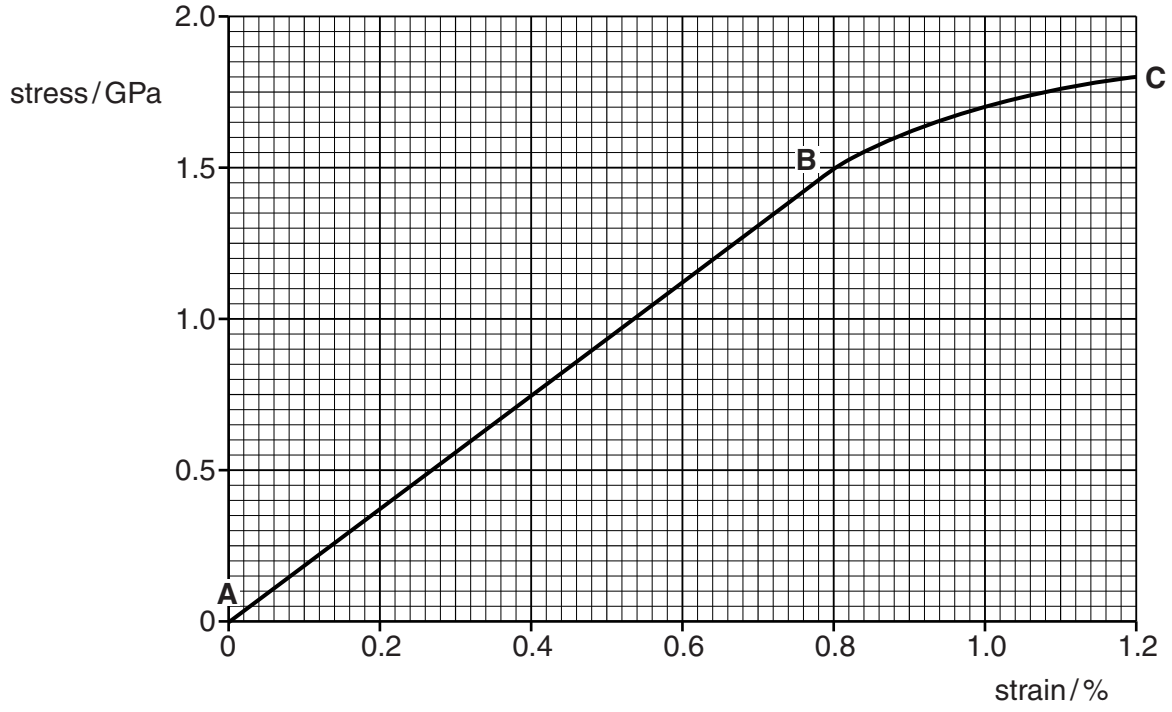


Fig. 8.1

(i) Use Fig. 8.1 to determine the Young modulus of the material.

Young modulus = ... Pa **[3]**

(ii) Use Fig. 8.1 to describe the behaviour of the material

1 in section **AB**

.....

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

2 in section **BC**.

.....

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

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(iii) State and explain the effect on the linear section **AB** of the graph when a sample of the same wire, but of twice the original length is used.

.....

.....

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

(b) Fig. 8.2 shows a force against extension graph for an elastic material. The work done on this material during loading (upward arrow) is equal to the energy returned by the material when the load is removed (downward arrow).

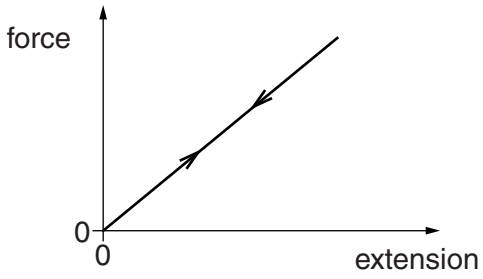


Fig. 8.2

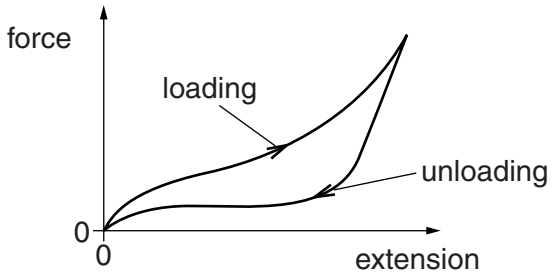


Fig. 8.3

Fig. 8.3 shows the force against extension graph for a material used to make aeroplane tyres. Aeroplane tyres experience sudden impact forces during landing.

Identify the type of material from Fig. 8.3. Describe the properties of this material and suggest why this material is suitable for aeroplane tyres.

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

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

[Total: 10]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

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

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