OCR

Tuesday 20 May 2014 – 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 *

* 1 3 1 1 2 3 1 4 5 2 *

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 **(a)** Define *velocity*.

.....

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

(b) The mass of an ostrich is 130 kg. It can run at a maximum speed of 70 kilometres per hour.

(i) Calculate the maximum kinetic energy of the ostrich when it is running.

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

(ii) Scientists have recently found fossils of a prehistoric bird known as Mononykus. Fig. 1.1 shows what the Mononykus would have looked like.



Fig. 1.1

According to a student, the Mononykus looks similar to our modern day ostrich. The length, height and width of the Mononykus were all **half** that of an ostrich.
Estimate the mass of the Mononykus. Explain your reasoning.

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.....

.....

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

[Total: 6]

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2 Fig. 2.1 shows an object held horizontally by a string.

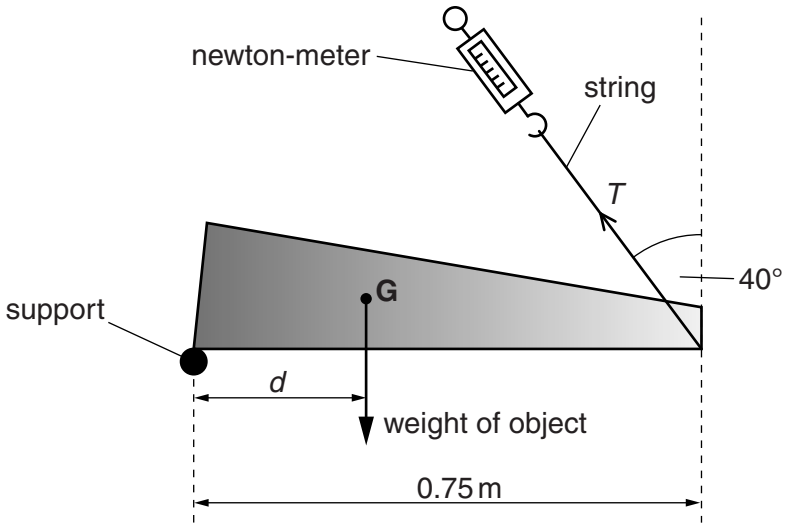


Fig. 2.1

One end of the object rests on a support and the other end is held by the string. The object is in equilibrium. Point **G** is the centre of gravity of the object. The mass of the object is 1.2 kg. The tension *T* in the string is 5.1 N. The string makes an angle of 40° with the vertical.

(a) Take moments about the support and calculate the distance *d.*

d = ... m **[3]**

(b) Explain why the force at the support cannot be vertically upwards.

.....

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

[Total: 4]

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3 **(a)** Fig. 3.1 shows the stress against strain graph for a metal **X** up to its breaking point.

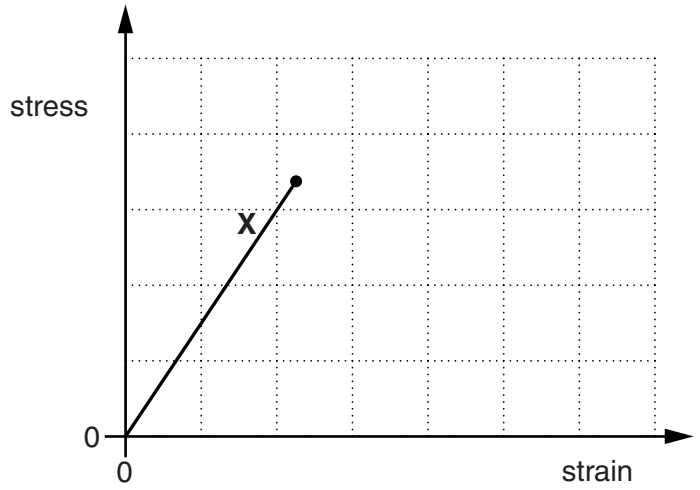


Fig. 3.1

(i) Use Fig. 3.1 to state the physical properties of this metal.

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

.....

.....

.....

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

(ii) On the axes of Fig. 3.1, sketch a graph for a ductile material, having a larger Young modulus value than the metal **X**, up to its breaking point. **[2]**

(b) Fig. 3.2 shows a stationary cable car.

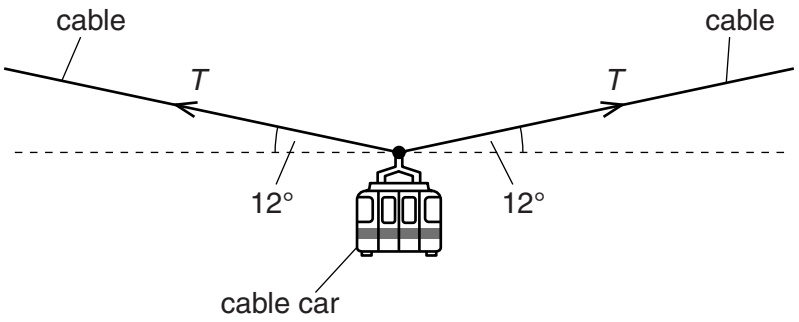


Fig. 3.2

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The cable on both sides of the car is at an angle of 12° to the horizontal. The radius of the cable is 2.6×10^{-2} m. The stress in the cable is 1.8×10^{7} Pa. The Young modulus of the material of the cable is 2.0×10^{11} Pa.

(i) Calculate the strain experienced by the cable.

strain = ... **[2]**

(ii) Calculate the tension T in the cable.

T = ... N **[2]**

(iii) Calculate the weight of the cable car.

weight = ... N **[3]**

[Total: 11]

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4 **(a)** Fig. 4.1 shows the path of a tennis ball after bouncing on the ground at **A** and hitting a vertical wall at **B**.

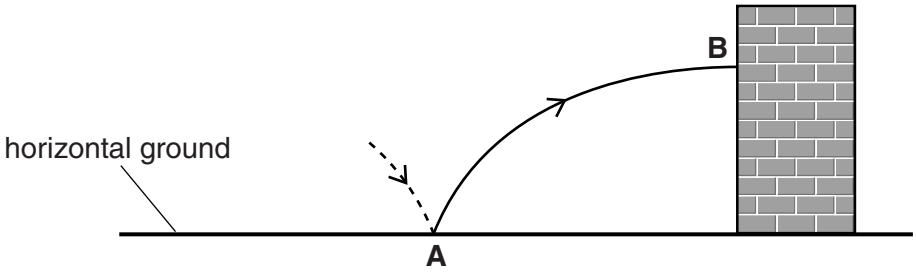


Fig. 4.1

The ball is travelling horizontally as it hits the wall at **B**. Air resistance has negligible effect on the motion of the ball.

(i) Explain why the horizontal component of the velocity of the ball remains constant as it moves from **A** to **B**.

.....

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

(ii) The ball loses some of its kinetic energy when it hits the wall at **B**. It leaves the wall horizontally.

1 On Fig. 4.1, sketch the path of the ball between bouncing at the wall and hitting the ground.

2 Explain how the time taken for the ball to travel from **A** to **B** compares with the time it takes to travel from **B** to the ground.

.....

.....

.....

[3]

(b) A student is given a metre rule, a stopwatch and a tennis ball.
Explain how this equipment can be used to determine an **approximate** value for the acceleration *g* of free fall.

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

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(c) Fig. 4.2 shows a tennis ball moving up a smooth ramp at time $t = 0$.

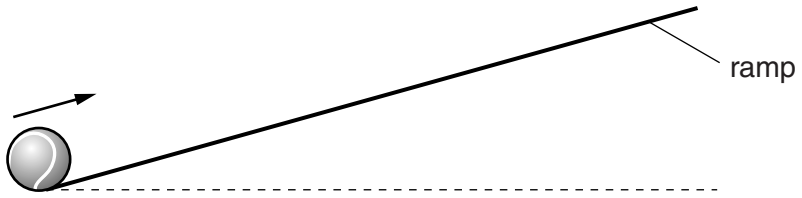


Fig. 4.2

Fig. 4.3 shows a graph of velocity v against time t for this ball.

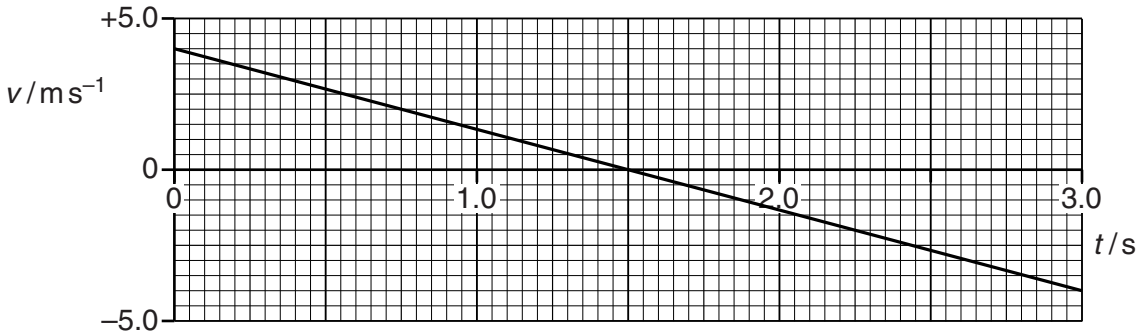


Fig. 4.3

(i) Describe, without calculation, the motion of the ball between $t = 0$ and $t = 3.0$ s.

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

(ii) Calculate the maximum distance D travelled by the ball up the ramp.

$D =$ ..... m **[2]**

[Total: 12]

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5 **(a)** A student holds a golf ball and a table tennis ball out of an upper window of a tall building. The balls are released at the same time. Both balls have the same size. The golf ball has a **greater mass** than the tennis ball. One of the balls reaches a greater terminal velocity.

(i) State and explain the acceleration of the golf ball immediately after it is released.

.....

.....

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

(ii) By referring to the forces acting on the golf ball, explain what is meant by *terminal velocity*.

.....

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

(iii) Explain which of the two balls reaches the greater terminal velocity.

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

(b) Fig. 5.1 shows a graph of drag D against speed v for a lorry.

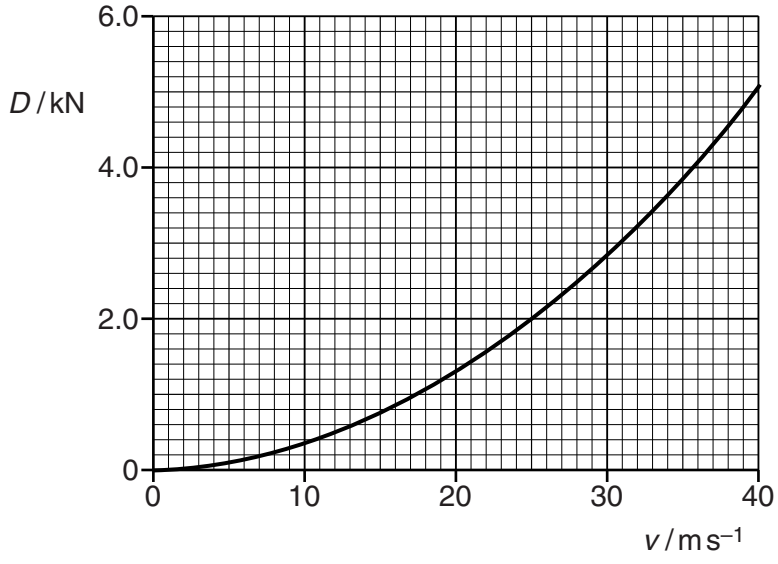


Fig. 5.1

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The lorry has mass 8000 kg. Its engine provides a **constant** forward force of 3200 N.

(i) Calculate the instantaneous acceleration of the lorry when travelling on a level road at a speed of 25 m s^{-1}.

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

(ii) Explain why this lorry cannot travel at a speed of 40 m s^{-1} on a level road.

.....

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

(c) The lorry driver wears a seat belt. Describe and explain how a seat belt reduces the force on a driver during the impact in an accident.

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

[Total: 13]

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

.....

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

(b) A crate is pushed along a rough horizontal surface at a constant speed. State what happens to the work done on the crate.

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

.....

.....

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

(c) Define the *watt*.

.....

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

(d) Fig. 6.1 shows an electric crane lifting a mechanical digger.

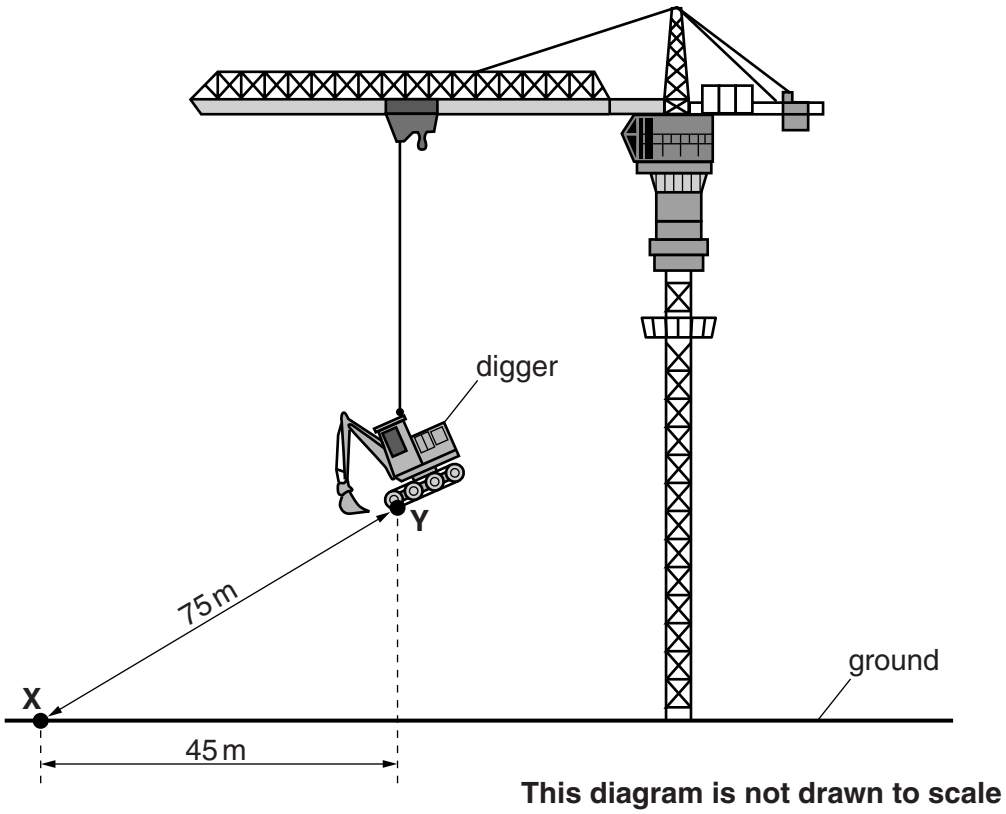


Fig. 6.1

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The mass of the digger is 5200 kg. The crane takes 1.5 minutes to lift the digger from **X** to **Y**.

(i) Calculate the rate of work done to lift the digger from **X** to **Y**.

rate of work done = ... $J\,s^{-1}$ **[3]**

(ii) The total input power to the motors of the crane is 170 kW. Calculate the efficiency of the lifting operation.

efficiency = ... % **[1]**

[Total: 7]

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7 A light spring of unextended length 2.0 cm is hung from a fixed point. An object of weight 3.0 N is hung from the other end of the spring. Fig. 7.1 shows the length of the spring when the object is in equilibrium.

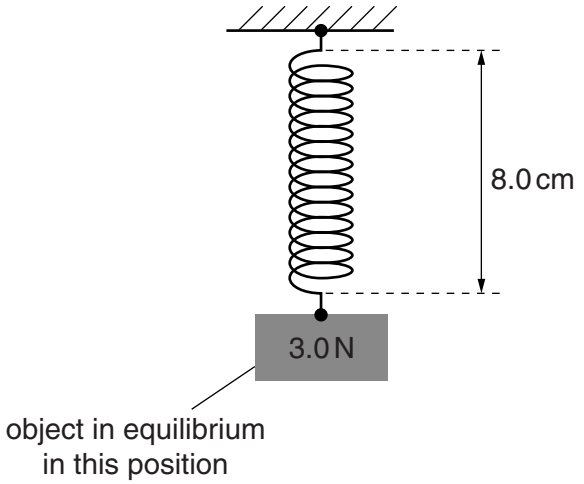


Fig. 7.1

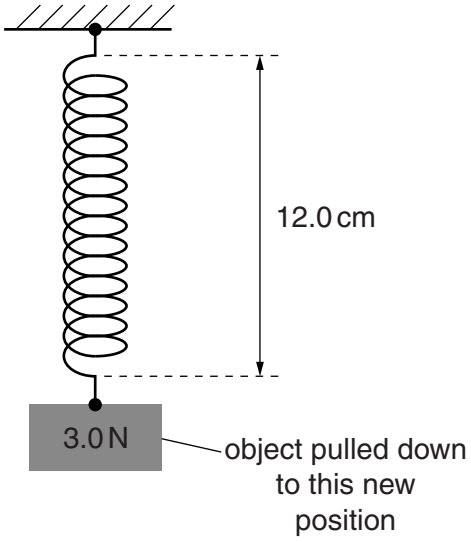


Fig. 7.2

(a) Show that the force constant of the spring is 50 N m^{-1}.

[1]

(b) The object is pulled vertically downwards. Fig. 7.2 shows the new length of the spring.

(i) Calculate the change in the elastic potential energy ΔE in the spring.

ΔE = ... J **[3]**

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(ii) The object is released from its position shown in Fig. 7.2. Calculate the initial upward acceleration *a* of the object.

a = ... $m s^{-2}$ **[3]**

[Total: 7]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

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

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