OCR
Oxford Cambridge and RSA

Tuesday 23 May 2017 – 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

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* 6 6 8 7 0 7 7 0 3 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 at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

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.

Answer **all** the questions.

1 **(a)** Define *power*.

.....

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

(b) Fig. 1.1 shows a small electric motor used to lift an object.

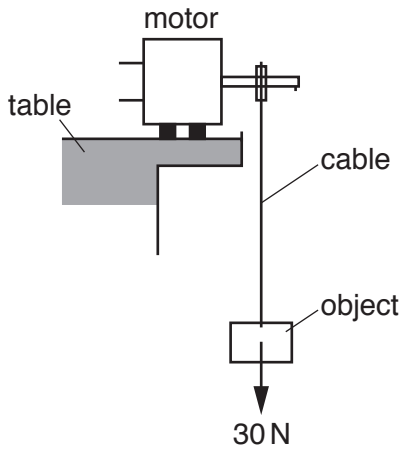

Fig. 1.1

The weight of the object is 30 N. The efficiency of the motor is 5.0%. The motor lifts the object vertically at a constant speed of 8.4 cm s^{-1}.

(i) State the tension in the cable. Justify your answer.

.....

.....

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

(ii) Calculate the rate at which work is done in lifting the object vertically against the force of gravity.

rate of work done = ...J s^{-1} **[2]**

(iii) Calculate the input power to the electric motor.

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

(iv) Explain why the tension in the cable is different when the object is accelerating upwards.

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

2 **(a)** The list below contains scalar and vector quantities.

pressure speed force power acceleration displacement

(i) Underline **all** of the vector quantities. **[1]**

(ii) List **two** quantities which when multiplied together give a quantity having the unit joule (J).

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

(iii) Name the quantity having the unit $kg\,m\,s^{-2}$.

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

(b) A hot air balloon rises with a vertical velocity of $7.0\,m\,s^{-1}$. A steady wind pushes the balloon with a horizontal velocity *v*.

Fig. 2.1 shows the velocity vectors for the balloon and the wind.

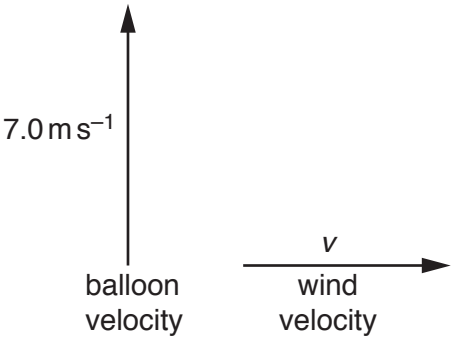

Fig. 2.1 (not to scale)

The magnitude of the resultant velocity of the balloon is $8.8\,m\,s^{-1}$.

(i) On Fig. 2.1, draw an arrow labelled **R** to show the approximate direction of the resultant velocity of the balloon. **[1]**

(ii) State why the magnitude of the resultant velocity of the balloon is not the sum of the speeds of the balloon and the wind.

.....

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

(iii) With the help of a vector triangle, determine the magnitude of the wind velocity v and the angle θ between the resultant velocity of the balloon and the horizontal.

v = ... $m\,s^{-1}$

θ = ...° **[4]**

(iv) Fig. 2.2 shows another balloon travelling with constant velocity $9.3\,m\,s^{-1}$.

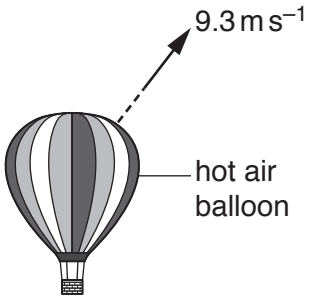

Fig. 2.2

Apart from the upthrust and the wind there are two other forces acting on the balloon.
State these two forces.
Draw labelled arrows on Fig. 2.2 to indicate their approximate directions.
State the direction of the resultant of these two forces.

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

3 Fig. 3.1 shows a block of wood on a smooth slope.

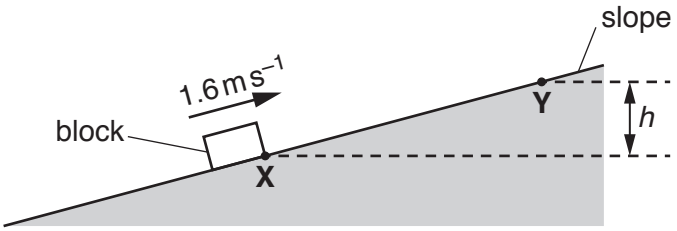

Fig. 3.1

At time $t = 0$ the block is at point **X** and has a velocity of $1.6\,m\,s^{-1}$ up the slope. The block comes to rest at point **Y**. It then slides back down the slope. The magnitude of the deceleration of the block from **X** to **Y** is $2.5\,m\,s^{-2}$.
The mass of the block is 310 g.

(a) Calculate the time t for the block to travel from **X** to **Y**.

$t =$ .....s **[2]**

(b) Calculate the distance between points **X** and **Y**.

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

(c) Calculate the kinetic energy E_k of the block at the **midpoint** between **X** and **Y**.

E_k = ... J **[3]**

(d) Calculate the vertical height h gained by the block as it travels from **X** to **Y**.

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

4 **(a)** **(i)** State what is meant by the *force constant* of a wire.

.....

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

(ii) A student is investigating wires **A** and **B** made from the same material. The wires have the same length. Wire **A** is thicker than wire **B**.
Explain which of these wires has a greater value of force constant.

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

(b) A compression spring is attached to a block of metal. The block and the spring fall vertically towards the horizontal ground as shown in Fig. 4.1.

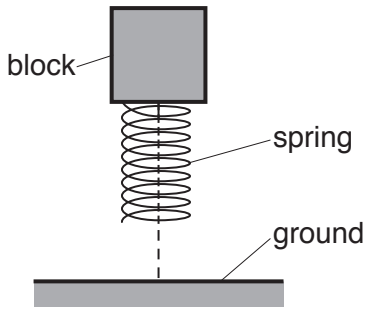

Fig. 4.1

The spring has negligible mass.
At time $t = 0$ the spring touches the ground. Fig. 4.2 shows the variation of the compression x of the spring with time t.

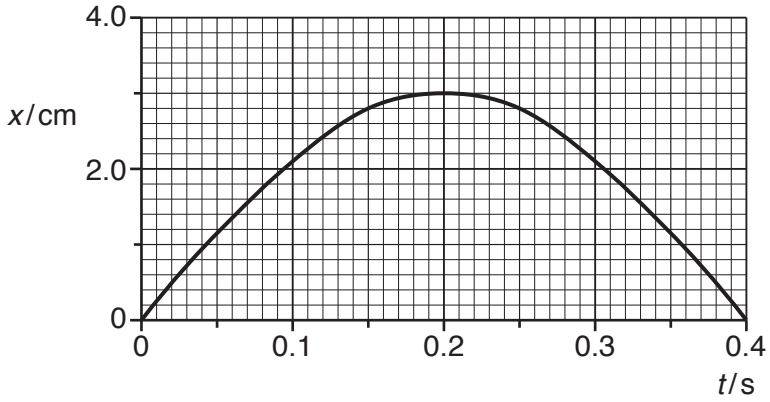

Fig. 4.2

(i) Explain how you can use the graph in Fig. 4.2 to determine the maximum speed of the block.

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

(ii) The force constant of the spring is $24\,N\,m^{-1}$.
Use Fig. 4.2 to determine the maximum elastic potential energy E for the spring between $t = 0$ and $0.4\,s$.

$E =$ ..... J **[3]**

(iii) Describe the energy changes of the block and the spring from $t = 0$ to $t = 0.2\,s$.

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

5 **(a)** Define *moment of a force.*

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

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

(b) Fig. 5.1 shows a **uniform** beam at rest in a horizontal position.

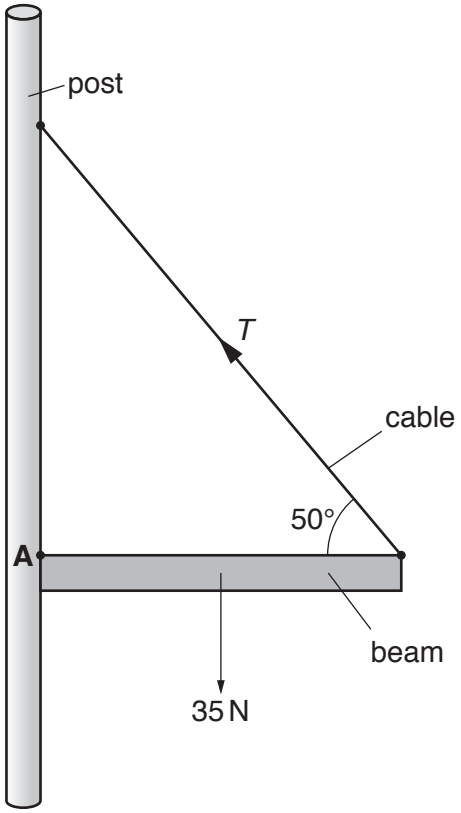

Fig. 5.1

The beam has weight 35 N, length 0.82 m and cross-sectional area 12 cm^2.
Fig. 5.1 shows one end of the beam hinged to a vertical post at point **A**. A cable is attached to the other end. The angle between cable and beam is 50°.

(i) Calculate the density ρ of the beam.

ρ = ... $kg\,m^{-3}$ **[3]**

(ii) Take moments about **A** to calculate the tension T in the cable.

$T =$ .....N **[3]**

(iii) On Fig. 5.1 draw an arrow to represent the force acting on the beam at the hinge **A**. **[2]**

6 **(a)** One end of a thin metal wire is secured to the ceiling and a mass is hung from its other end.

Describe how you can determine the stress in the wire using laboratory equipment.

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

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

(b) Fig. 6.1 shows the stress against strain graphs for two materials **A** and **B**.

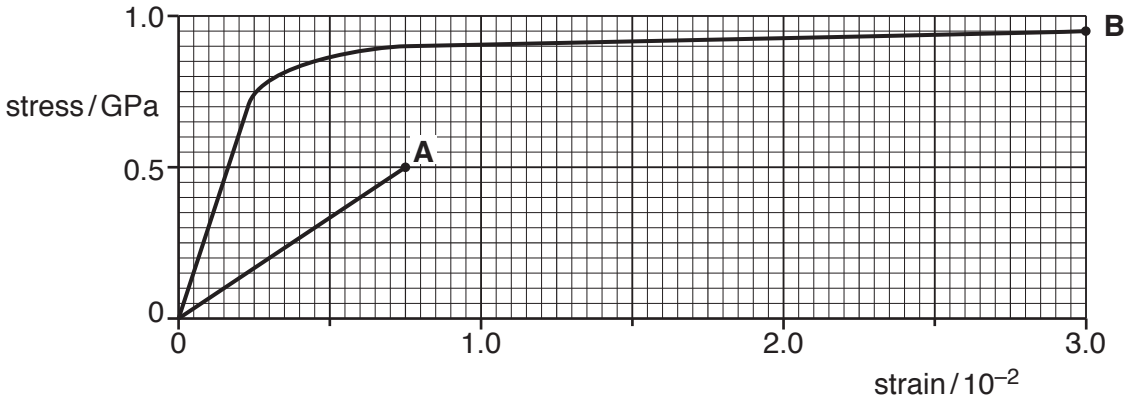

Fig. 6.1

(i) Describe the properties of each of the materials **A** and **B**.

material **A**: .....

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material **B**: .....

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.....

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

(ii) Determine the Young modulus *E* of material **B**.

E = ...Pa **[3]**

END OF QUESTION PAPER

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 margin(s).