OCR
RECOGNISING ACHIEVEMENT

# Friday 11 January 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

*G411560113*

*G 4 8 1 0 1*

| 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.

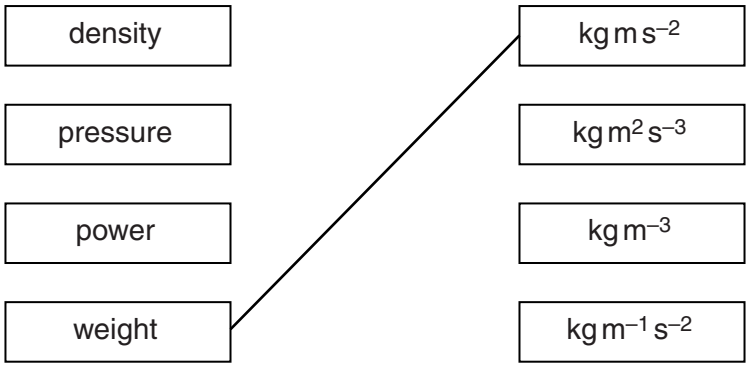
This means for example you should:
- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- organise information clearly and coherently, using specialist vocabulary when appropriate.

- This document consists of **16** pages. Any blank pages are indicated.

© OCR 2013 [J/500/8054]
OCR is an exempt Charity

Answer **all** the questions.

**1** Draw a line from each quantity on the left-hand side to the correct unit on the right-hand side. One quantity (weight) has already been matched to its unit.




**[2]**

**[Total: 2]**

**2** **(a)** Speed is a scalar quantity and velocity is a vector quantity. State one difference and one similarity between speed and velocity.

difference: .....

.....

similarity: .....

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

**(b)** Fig. 2.1 shows a toy locomotive on a circular track.

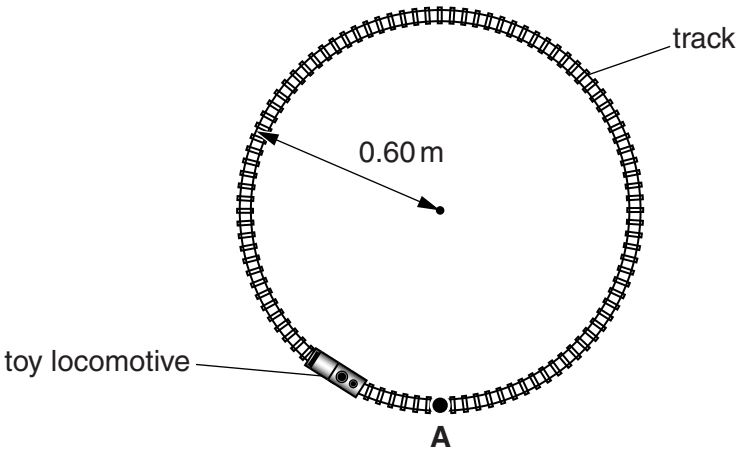



**Fig. 2.1**

© OCR 2013

The locomotive travels at constant speed round the track in a clockwise direction. It takes 12 s to travel completely round the track. At time $t = 0$, the locomotive is at point **A**.

**(i)** Calculate the speed of the locomotive.

speed = ..... $m\,s^{-1}$ **[2]**

**(ii)** Calculate the magnitude of the displacement $s$ of the locomotive from point **A** after it has travelled one quarter of the way round the track.

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

**(iii)** Explain why the average velocity of the locomotive is zero after a time of 12 s.

.....

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

**(iv)** Explain why the velocity of the locomotive changes even though its speed is constant.

.....

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

**[Total: 8]**

© OCR 2013

**3** A car of mass 1200 kg is travelling at 18 m s$^{-1}$ along a horizontal road. A constant braking force of 3600 N brings it to rest.

**(a)** Calculate the magnitude of the deceleration of the car.

deceleration = ..... m s$^{-2}$ **[1]**

**(b)** Calculate the distance travelled by the car during the deceleration.

distance = ..... m **[3]**

**(c)** The same car travels **down** a slope at the same speed of 18 m s$^{-1}$, see Fig. 3.1.

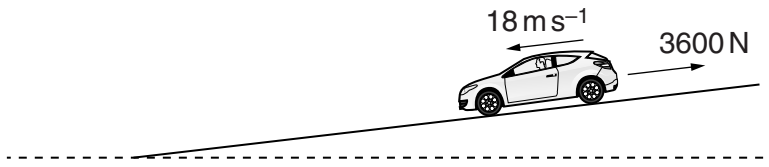



**Fig. 3.1**

© OCR 2013

The car is brought to rest by applying the brakes. The same resistive force of 3600 N acts on the car. Explain whether the distance travelled by the car before it stops is greater than, smaller than or the same as your answer to **(b)**.

.....

.....

.....

.....

.....

.....

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

**(d)** Many cars are fitted with Global Positioning System (GPS) devices.

Describe how geostationary satellites are used to track the location of cars on the Earth's surface.



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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

**[Total: 11]**

© OCR 2013

**4** **(a)** Define *acceleration*.

.....

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

**(b)** State the **two** factors that affect the acceleration of an object.

.....

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

**(c)** Fig. 4.1 shows the variation of velocity $v$ with time $t$ for a small rocket.

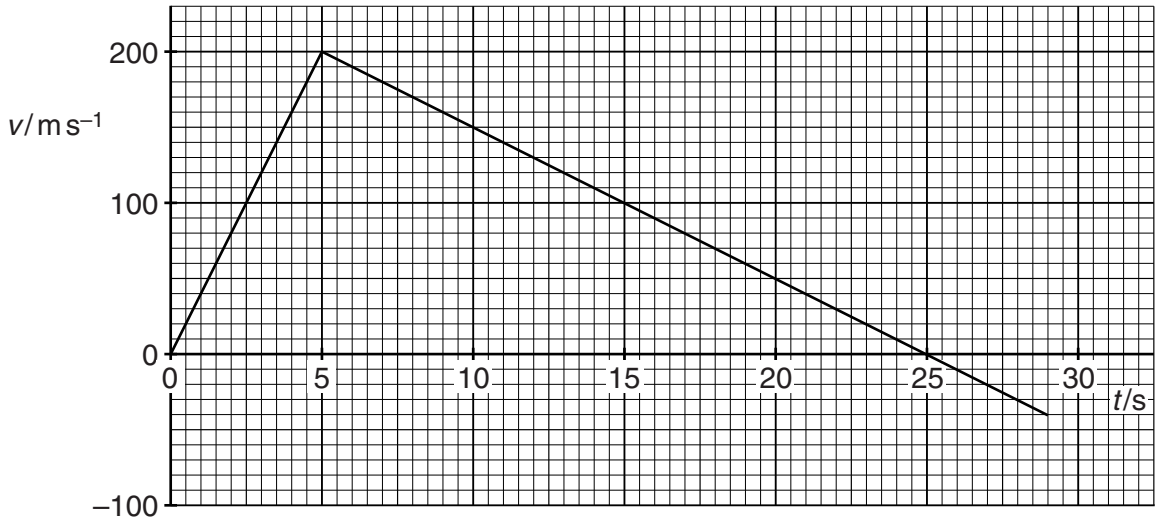



**Fig. 4.1**

The rocket is initially at rest and is fired vertically upwards from the ground. All the rocket fuel is burnt after a time of 5.0 s when the rocket has a vertical velocity of 200 m s$^{-1}$. Assume that air resistance has a negligible effect on the motion of the rocket.

© OCR 2013

**(i)** Without doing any calculations, describe the motion of the rocket

**1** from $t = 0$ to $t = 5.0\,s$

.....

.....

**2** from $t = 5.0\,s$ to $t = 25\,s$.

.....

.....

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

**(ii)** Calculate the maximum height reached by the rocket.

height = ..... m **[3]**

**(iii)** Explain why the rocket has a speed greater than $200\,m\,s^{-1}$ as it hits the ground.

.....

.....

.....

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

**[Total: 9]**

© OCR 2013

**5** **(a)** State how the magnitude of the drag force on an object is affected by its speed.

.....

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

**(b)** Describe the experiments Galileo carried out which overturned Aristotle's ideas of motion.

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

© OCR 2013

**(c)** A skydiver is falling towards the ground at a terminal velocity of $50\,m\,s^{-1}$.

**(i)** State the **two** main forces acting on the skydiver and how they are related at terminal velocity.

.....

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

**(ii)** The skydiver opens her parachute. After some time, the skydiver reaches a lower terminal velocity of $4.0\,m\,s^{-1}$. Describe and explain how the magnitude of the deceleration of the skydiver changes as her velocity reduces from $50\,m\,s^{-1}$ to $4.0\,m\,s^{-1}$.

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

**[Total: 9]**

© OCR 2013

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

.....

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

**(b)** Fig. 6.1 shows a water slide.

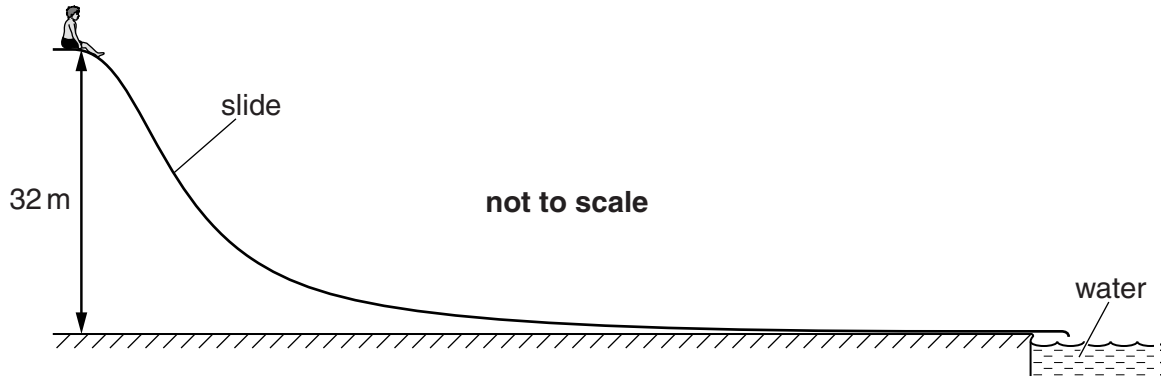



**Fig. 6.1**

The top of the slide is 32 m above the bottom of the slide. The total distance along the slide is 120 m. A person of weight 700 N, initially at rest at the top, slides down. His speed at the end of the slide is 15 m $s^{-1}$.

**(i)** Calculate his kinetic energy at the end of the slide.

kinetic energy = ..... J **[2]**

© OCR 2013

**(ii)** Calculate the average resistive force acting on him as he travels down to the end of the slide.

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

**[Total: 6]**

© OCR 2013

**7** **(a)** Fig. 7.1 shows several forces acting on an object that is free to move.

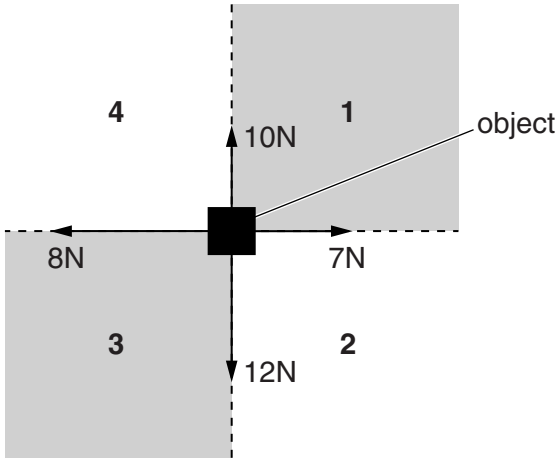



**Fig. 7.1**

Using simple calculations, deduce whether the object will move into region **1**, **2**, **3** or **4**. Briefly explain your reasoning.

.....

.....

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

**(b)** State the *principle of moments*.

.....

.....

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

© OCR 2013

**(c)** Fig. 7.2 shows the forces acting on a suitcase with wheels as it is held stationary.

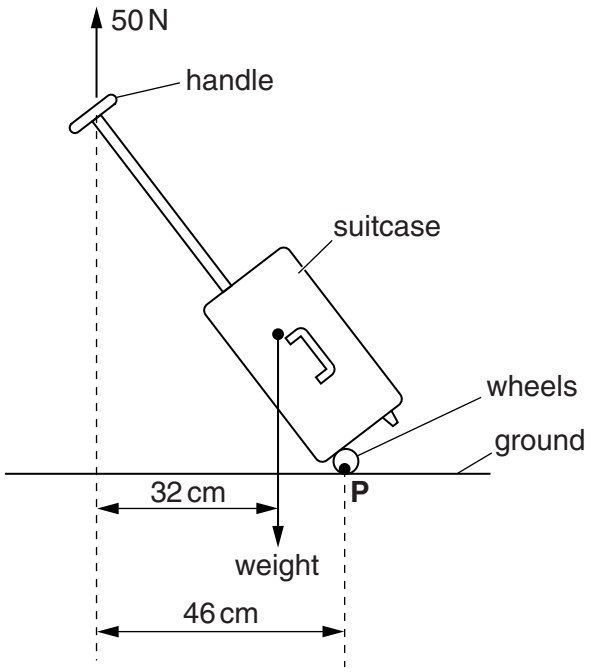



**Fig. 7.2**

A vertical force of 50 N is applied to the top of the handle in order to keep the suitcase stationary in the position shown in Fig. 7.2. The line of action of this force acts at a perpendicular distance of 46 cm from **P**, the point of contact with the ground. The line of action of the weight of the suitcase acts at a perpendicular distance of 32 cm from the top of the handle.

By taking moments about **P**, calculate the mass *m* of the suitcase.

*m* = ..... kg **[3]**

**[Total: 6]**

© OCR 2013

**8** A sample of wire is tested in the laboratory. Fig. 8.1 shows the force, $F$ against extension, $x$ graph for this wire.

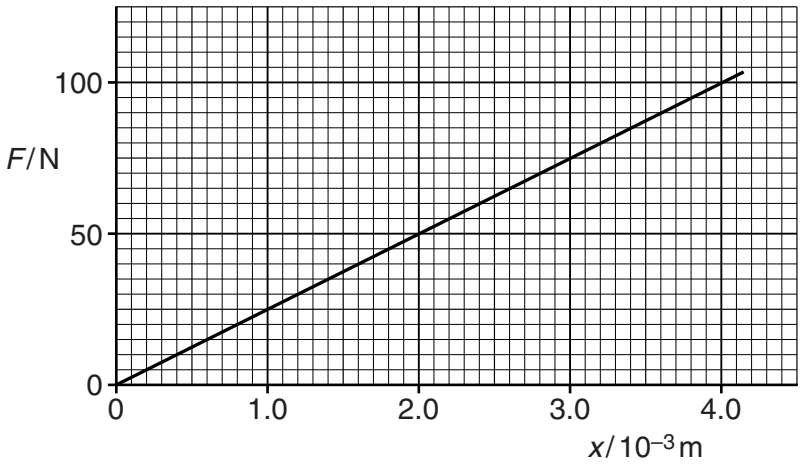



**Fig. 8.1**

**(a)** Explain how the graph shows that the wire obeys Hooke's law.

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

.....

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

**(b)** State what the gradient of the graph represents.

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

**(c)** The initial length of the wire is 1.60 m. The radius of the wire is $2.8 \times 10^{-4}$ m. Use the graph and this information to determine the Young modulus of the material of the wire.

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

© OCR 2013

**(d)** The test is repeated for another wire made from the same material, having the same length but **half** the diameter. Explain how the force against extension graph for this wire will differ from the graph of Fig. 8.1.

.....

.....

.....

.....

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

**(e)** It is very dangerous if the wire under stress suddenly breaks. The elastic potential energy of the strained wire is converted into kinetic energy. Show that the 'whiplash' speed $v$ of the wire is directly proportional to the extension $x$ of the wire.

.....

.....

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

**[Total: 9]**

**END OF QUESTION PAPER**

© OCR 2013

## ADDITIONAL ANSWER SPACE

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

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 2013