OCR
RECOGNISING ACHIEVEMENT

Thursday 20 June 2013 – Morning

A2 GCE PHYSICS A

G484/01 The Newtonian World

Candidates answer on the Question Paper.

OCR supplied materials:
- Data, Formulae and Relationships Booklet (sent with general stationery)

Other materials required:
- Electronic calculator

Duration: 1 hour 15 minutes

MODIFIED LANGUAGE

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 pages 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.

Turn over

Answer **all** the questions.

1 **(a)** **(i)** State in words Newton's second law of motion.

....

....

.... **[1]**

(ii) Show how this law leads to the expression $F = ma$ for an object of constant mass.

[2]

(b) The graph in Fig. 1.1 shows the variation with time of a force acting on an object of mass 2.5 kg.
The force is acting in the direction of the object's motion.

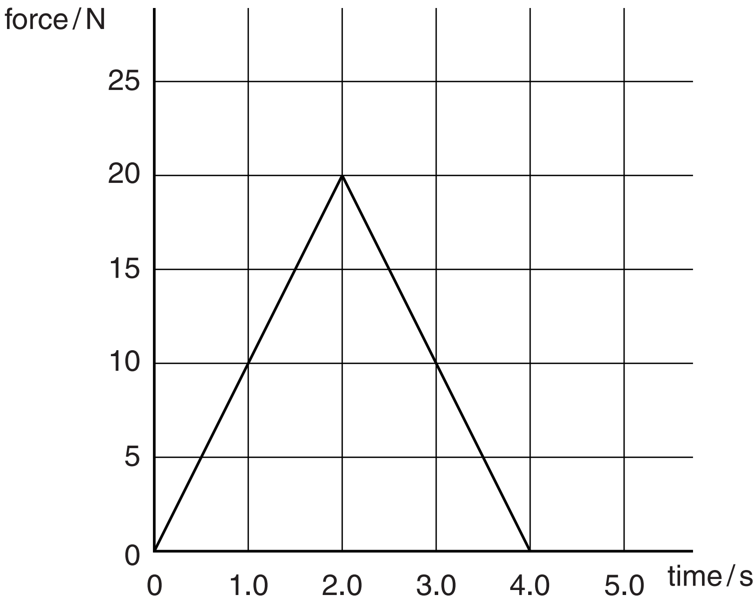

Fig. 1.1

Use Fig. 1.1 to

(i) determine the change in velocity of the object

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

(ii) calculate the mean acceleration of the object

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

(iii) describe how the acceleration of the object varies between 0 and 4.0 seconds.

....

....

....

.... **[2]**

[Total: 9]

2 **(a)** Fig. 2.1 shows the Earth in space.

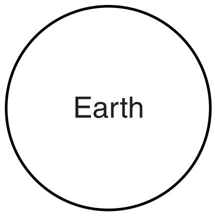

Fig. 2.1

(i) Draw lines on Fig. 2.1 to show the shape and direction of the gravitational field of the Earth. **[1]**

(ii) The gravitational field strength, g, is uniform close to the Earth's surface.
Describe the pattern of gravitational field lines close to the surface of the Earth.

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

....

....

....

.... **[2]**

(b) The planet Saturn has mass 5.7×10^{26} kg and radius 6.0×10^{7} m.

(i) Calculate the gravitational field strength g_s at Saturn's surface.

g_s = ... N kg^{-1} **[2]**

(ii) Saturn's second-largest moon, Rhea, has orbital radius 5.3×10^8 m and mass 2.3×10^{21} kg.
Calculate for Rhea

1 its orbital speed v

v = ... m s^{-1} **[3]**

2 its kinetic energy.

kinetic energy = ... J **[1]**

[Total: 9]

3 **(a)** An object is oscillating with simple harmonic motion.
Place a tick (✓) in the box against each true statement that applies to the acceleration of the object.

The acceleration …

… is in the opposite direction to the displacement.	
… is directly proportional to the amplitude squared.	
… increases as the displacement decreases.	
… increases as the speed of the object decreases.	

[2]

(b) The graph in Fig. 3.1 shows the variation of the velocity v of the object with time t.

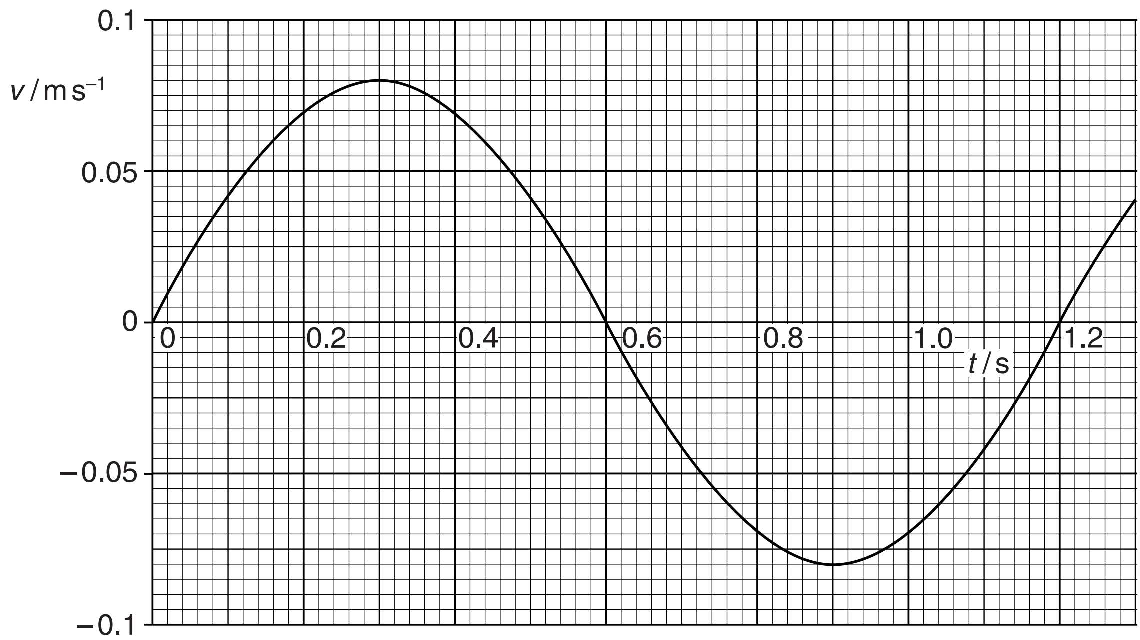

Fig. 3.1

Use this graph to determine

(i) the frequency of the motion

frequency = ... Hz **[1]**

(ii) the amplitude of the motion

amplitude = ... m **[2]**

(iii) the maximum acceleration of the object.

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

(c) **(i)** Explain what is meant by *resonance* of a mechanical system. Use a suitably labelled graph to help you.

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.... **[4]**

(ii) State and explain an everyday example of resonance.

....

....

....

....

.... **[2]**

[Total: 13]

4 A room measures 4.5 m × 4.0 m × 2.4 m. The air in the room is heated by a gas-powered heater from 12 °C to 21 °C. The density of the air is assumed to remain constant. The density is 1.3 kg m^{-3}.

(a) Calculate the thermal energy required to raise the temperature of the air in the room. The specific heat capacity of air is 990 J kg^{-1} K^{-1}.

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

(b) The heater has an output power of 2.3 kW. The heating gas has a density 0.72 kg m^{-3}. Each cubic metre of heating gas provides 39 MJ of thermal energy.

Use your answer to **(a)** to calculate

(i) the time required to raise the temperature of the air from 12 °C to 21 °C

time = ... s **[2]**

(ii) the mass of heating gas used in this time.

mass = ... kg **[2]**

(c) Suggest **two** reasons why the time required and the mass of heating gas will in practice be greater than the values calculated in **(b)**.

....

....

....

....

.... **[2]**

[Total: 9]

5 **(a)** A gas molecule of mass m travelling perpendicular to the wall of a container hits the wall with speed v.
Explain why the molecule rebounds with speed v and undergoes a change of momentum of $2mv$.

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

....

....

....

....

.... **[2]**

(b) A constant mass of gas occupies a container of constant volume.
Use the kinetic theory of gases to explain the increase in the force exerted on the walls of the container by the gas when its temperature is raised.

....

....

....

....

....

.... **[3]**

(c) **(i)** The pressure of the air in the tyres of a car before a journey is 2.2×10^5 Pa at 18 °C.
After travelling some distance, the temperature of the air in the tyres rises to 54 °C.
Calculate the new pressure of the air. Assume the volume of air in the tyre stays constant.

pressure = ... Pa **[2]**

(ii) Calculate the change in the total area of contact of the tyres with the road as a result of the rise in temperature. Assume that the total mass of the car in **(i)** stays constant at 1200 kg.

change in area = ... m^2 **[3]**

[Total: 10]

Question 6 begins on page 12

6 **(a)** **(i)** State, in words, Boyle's law.

....

....

.... **[2]**

(ii) Fig. 6.1 is a graph showing the relationship between the quantities involved in Boyle's law.
Label the axes appropriately. **[1]**

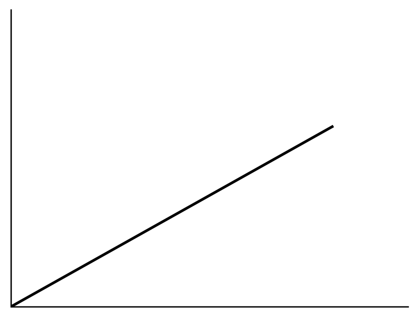

Fig. 6.1

(b) A gas cylinder of internal volume $0.050\,m^3$ contains compressed air at $21\,°C$ and pressure $1.2 \times 10^7\,Pa$. The molar mass of air is $0.029\,kg\,mol^{-1}$.

(i) Calculate

1 the number of moles of air in the cylinder

number of moles = ...

2 the mass of air in the cylinder.

mass = ... kg
[3]

(ii) An additional 1.5 m^3 of air at 21 °C and at atmospheric pressure, 1.0×10^5 Pa, is pumped into the cylinder.
Calculate the new pressure of air in the cylinder, assuming no change in temperature during the process.

pressure = ... Pa **[4]**

[Total: 10]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

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

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