THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

PHYSICS A

The Newtonian World

G484

Candidates answer on the Question Paper

OCR Supplied Materials:
- Data, Formulae and Relationships Booklet

Other Materials Required:
- Electronic calculator

Tuesday 29 June 2010
Afternoon

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

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 **12** pages. Any blank pages are indicated.

Answer **all** the questions.

1 **(a)** A particular collision between two objects is *inelastic*. Place a tick (✓) at the end of each statement that applies to such a collision. **[2]**

Statement	
The magnitude of the impulse on each object is the same.	
Kinetic energy and momentum for the objects are conserved.	
Total energy is conserved.	
After the collision, the objects have the same momentum.	

(b) Fig. 1.1 shows a tennis ball before and after striking a wall at right angles.

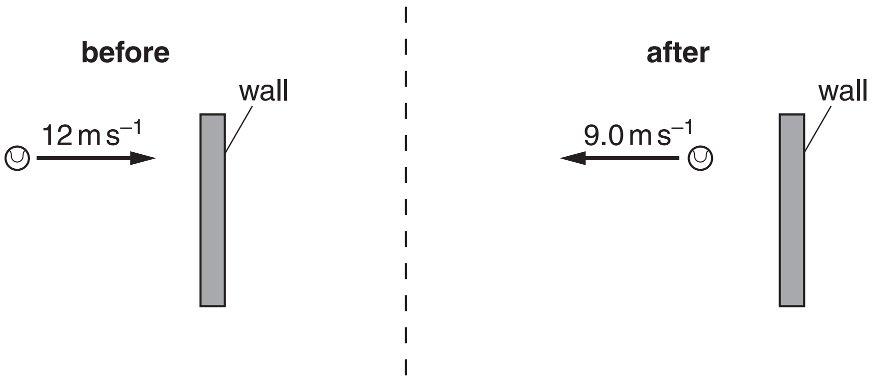

Fig. 1.1

The ball of mass 0.060 kg hits the wall at a speed of $12\,\mathrm{m\,s^{-1}}$. The ball is in contact with the wall for 0.15 s. It rebounds with a speed of $9.0\,\mathrm{m\,s^{-1}}$. Calculate

(i) the loss of kinetic energy during the collision

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

(ii) the magnitude of the average force exerted on the ball by the wall

average force on ball = ... N **[2]**

(iii) the magnitude of the average force exerted on the wall by the ball during this collision.

average force on wall = ... N **[1]**

(c) (i) State **three** assumptions of the kinetic model of ideal gases.

....

....

....

....

....

....

....

.... **[3]**

(ii) Use the kinetic theory of gases to explain how a gas exerts a pressure.

....

....

....

....

....

....

....

....

....

.... **[3]**

[Total: 13]

2 **(a)** Fig. 2.1 shows an aeroplane flying in a horizontal circle at constant speed. The weight of the aeroplane is W and L is the lift force acting at right angles to the wings.

Fig. 2.1

(i) Explain how the lift force L maintains the aeroplane flying in a **horizontal** circle.

....

....

....

.... **[2]**

(ii) The aeroplane of mass 1.2×10^5 kg is flying in a horizontal circle of radius 2.0 km.

The centripetal force acting on the aeroplane is 1.8×10^6 N. Calculate the speed of the aeroplane.

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

(b) Fig. 2.2 shows a satellite orbiting the Earth at a constant speed v. The radius of the orbit is r.

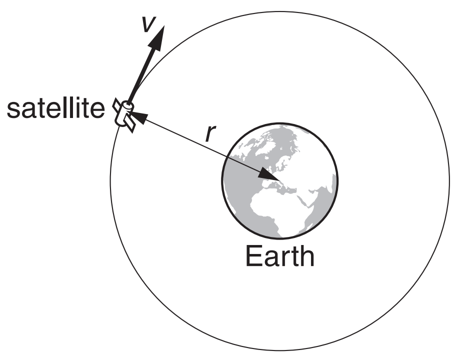

Fig. 2.2

Show that the orbital period T of the satellite is given by the equation

$$T^2 = \frac{4\pi^2 r^3}{GM}$$

where M is the mass of the Earth and G is the gravitational constant.

[3]

(c) The satellites used in television communication systems are usually placed in geostationary orbits.

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

(i) State two features of geostationary orbits.

1. ....

....

2. ....

.... **[2]**

(ii) Calculate the radius of orbit of a geostationary satellite.

The mass of the Earth is 6.0×10^{24} kg.

radius = ... m **[3]**

[Total: 12]

3 **(a)** State two conditions concerning the **acceleration** of an oscillating object that must apply for simple harmonic motion.

1. ....

....

2. ....

....

.... **[2]**

(b) Fig. 3.1 shows how the potential energy, in mJ, of a simple harmonic oscillator varies with displacement.

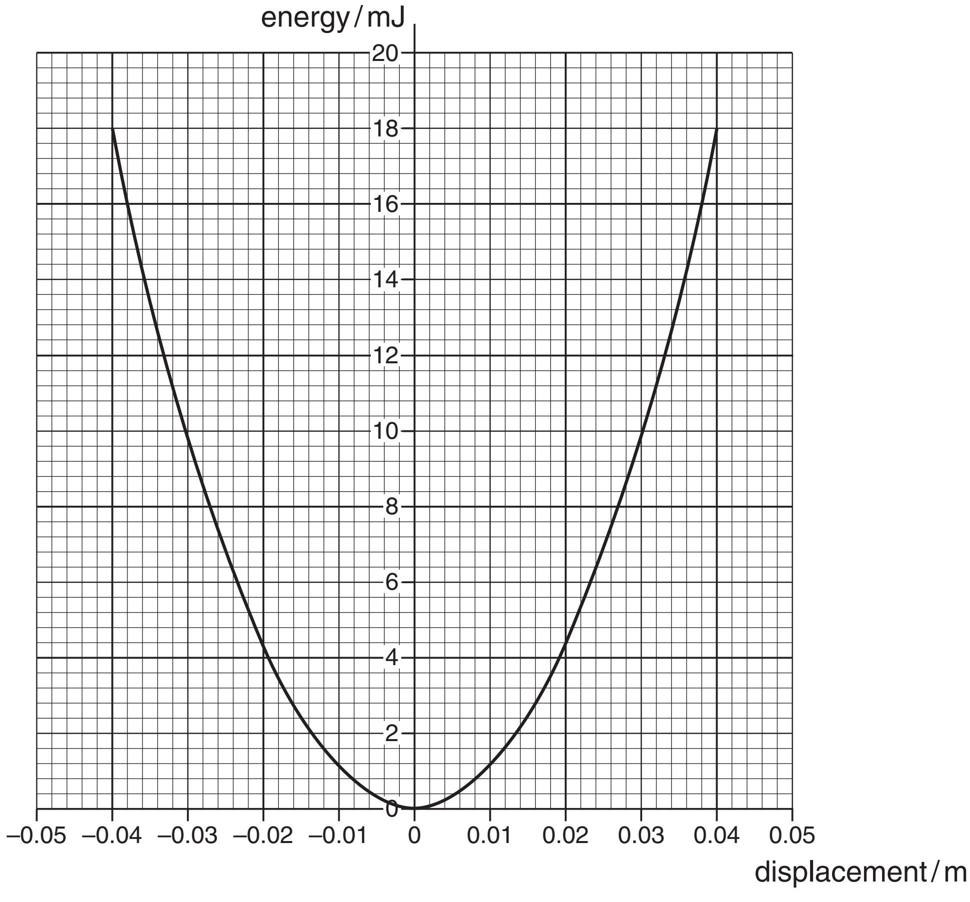

Fig. 3.1

On Fig. 3.1 sketch graphs to show the variation of

(i) kinetic energy of the oscillator with displacement – label this graph **K** **[2]**

(ii) the total energy of the oscillator with displacement – label this graph **T**. **[1]**

(c) Use Fig. 3.1 to determine

(i) the amplitude of the oscillations

amplitude = ... m **[1]**

(ii) the maximum speed of the oscillator of mass 0.12 kg

maximum speed = ... m s^{-1} **[2]**

(iii) the frequency of the oscillations.

frequency = ... Hz **[2]**

(d) Resonance can either be useful or a problem. Describe one example where resonance has a useful application and one example where resonance is a problem or nuisance. For each example identify what is oscillating and what causes these oscillations.

(i) useful application

....

....

....

....

.... **[2]**

(ii) problem

....

....

....

....

.... **[2]**

[Total: 14]

4 Fig. 4.1 shows smoke particles suspended in air. The arrows indicate the directions in which the smoke particles are moving at a particular instant. The lengths of the arrows indicate the different speeds of the particles.

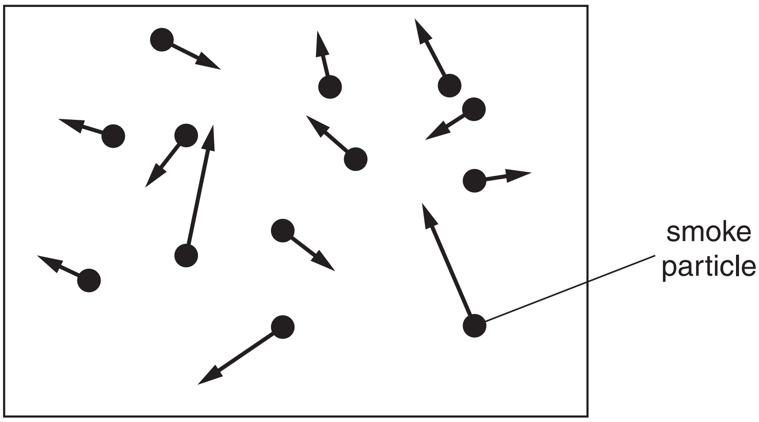

Fig. 4.1

(a) **(i)** State the name given to this type of random motion of smoke particles in air.

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

....

.... **[1]**

(ii) State **two** conclusions about the air molecules that may be deduced from the observed motion of the smoke particles.

....

....

....

.... **[2]**

(b) (i) The radius of an inflated football is 0.11 m. The temperature of the air inside the ball is 17 °C. Calculate the mass of air in the ball when the pressure inside it is 2.6×10^5 Pa.

The mass of one mole of air is 0.028 kg.

mass of air = ... kg **[4]**

(ii) The football is left in a room at a temperature of 0 °C until it reaches thermal equilibrium.

1 Explain the term *thermal equilibrium*.

....

....

.... **[1]**

2 Calculate the pressure exerted by the air inside the football when the temperature drops to 0 °C.

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

[Total: 10]

5 A car of mass 970 kg is travelling at 27 m s^{-1} when the brakes are applied. The car is brought to rest in a distance of 40 m.

(a) (i) Calculate the kinetic energy of the car when it is travelling at 27 m s^{-1}.

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

(ii) Hence calculate the average braking force on the car stating any assumption that you make.

average braking force = ... N

assumption ....

.... **[3]**

(b) The car has four brake discs each of mass 1.2 kg. The material from which the discs are made has a specific heat capacity of 520 J kg^{-1} K^{-1}.

(i) Calculate the temperature rise of each disc after braking from a speed of 27 m s^{-1}. Assume all the kinetic energy of the car is converted into internal energy of the brake discs equally during braking.

temperature rise = ... °C **[2]**

(ii) State and explain **two** reasons why the actual temperature rise will be different.

....

....

....

....

....

....

....

.... **[4]**

(iii) Suggest one modification to the design of the disc braking system that could reduce the temperature rise of the discs.

....

....

.... **[1]**

[Total: 11]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE