OCR
RECOGNISING ACHIEVEMENT

Monday 18 June 2012 – Morning

A2 GCE PHYSICS A

G484 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

G411820612

G4841

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.

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Answer **all** the questions.

1 **(a)** State the effect a net force has on the motion of an object.

.....

.....

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

(b) **(i)** Define the *impulse of a force*.

.....

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

(ii) A force *F* is applied to an object. The graph in Fig. 1.1 shows the variation of this force with time *t*.

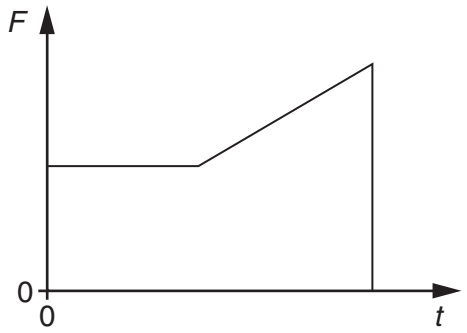


Fig. 1.1

The initial velocity of the object is zero and its mass is known. Explain how this graph can be used to determine the final velocity of the object.

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

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(c) A tennis ball is hit by a racket as shown in Fig. 1.2.

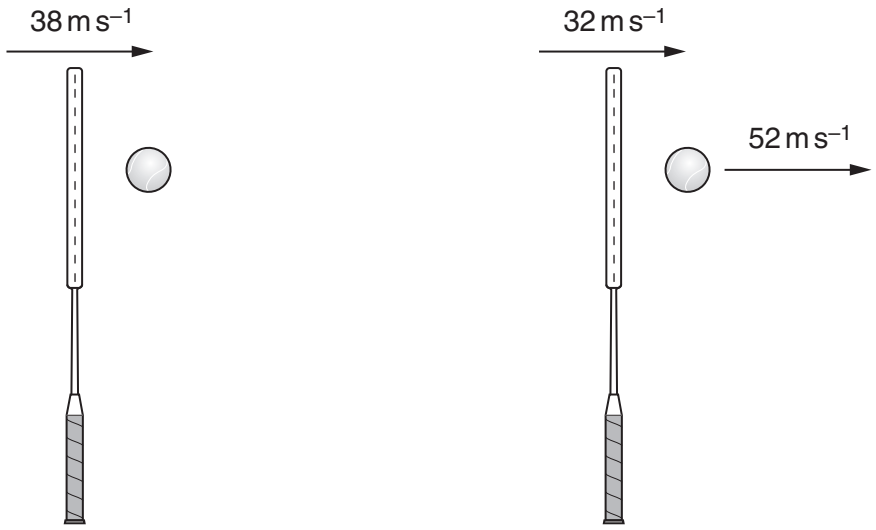


Fig. 1.2a **Fig. 1.2b**

Fig. 1.2

The mass of a tennis ball is 0.058 kg. During a serve the racket head and the ball are in contact for 4.2 ms. Just before contact, the racket head is travelling towards the ball at 38 m s^{-1} and the ball is stationary. Fig.1.2a shows the situation just before contact. Immediately after contact, the racket head is travelling in the same direction at 32 m s^{-1} and the ball is travelling away from the racket at 52 m s^{-1}. This is shown in Fig. 1.2b.

(i) Calculate the mean force provided by the racket on the ball.

mean force = ……N **[2]**

(ii) Estimate the mass of the racket.

mass = …….. kg **[2]**

(iii) Suggest why the value of the mass calculated in **(ii)** will be different from the actual mass of the racket.

.....

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

[Total: 9]

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2 **(a)** A body moves with simple harmonic motion. Define, in words, *simple harmonic motion*.

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

.....

.....

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

(b) A horizontal metal plate connected to a vibration generator is oscillating vertically with simple harmonic motion of period 0.080 s and amplitude 1.2 mm. There are dry grains of sand on the plate. Fig. 2.1 shows the arrangement.

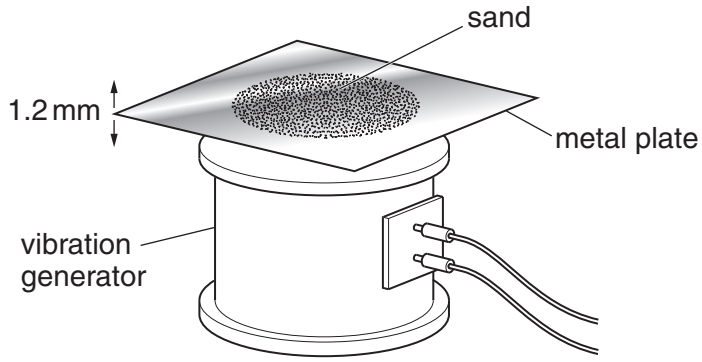


Fig. 2.1

(i) Calculate the maximum speed of the oscillating plate.

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

(ii) The frequency of the vibrating plate is kept constant and its amplitude is slowly increased from zero. The grains of sand start to lose contact with the plate when the amplitude is A_0. State and explain the necessary conditions when the grains of sand first lose contact with the plate. Hence calculate the value of A_0.

.....

.....

.....

A_0 = ...m **[4]**

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(c) The casing of a poorly designed washing machine vibrates violently when the drum rotates during the spin cycle. Fig. 2.2 shows how the amplitude of vibration of the casing varies with the frequency of rotation of the drum.

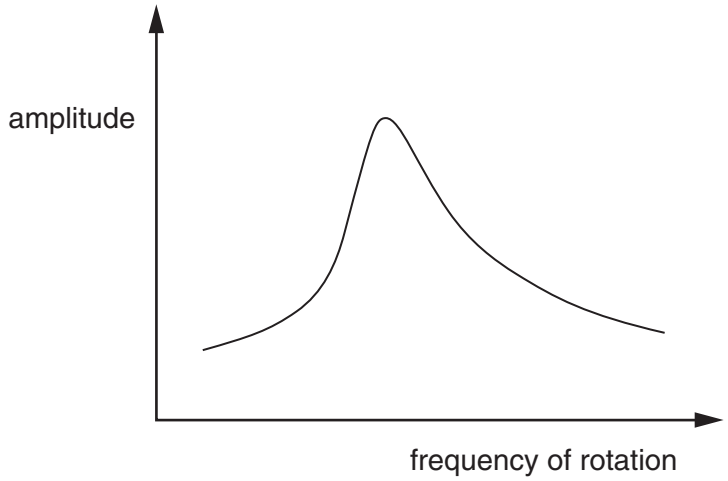


Fig. 2.2

(i) State the name of this effect and describe the conditions under which it occurs.

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.....

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

(ii) The design of the washing machine is improved to reduce the effect by adding a damping mechanism to the inside of the machine. Sketch on Fig. 2.2 the new graph of amplitude against frequency of rotation expected for this improved design. **[2]**

[Total: 12]

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3 Fig. 3.1 shows apparatus used to investigate circular motion. The bung is attached by a continuous nylon thread to a weight carrier supporting a number of slotted masses which may be varied. The thread passes through a vertical glass tube. The bung can be made to move in a nearly horizontal circle at a steady high speed by a suitable movement of the hand holding the glass tube. A constant radius *r* of rotation can be maintained by the use of a reference mark on the thread.

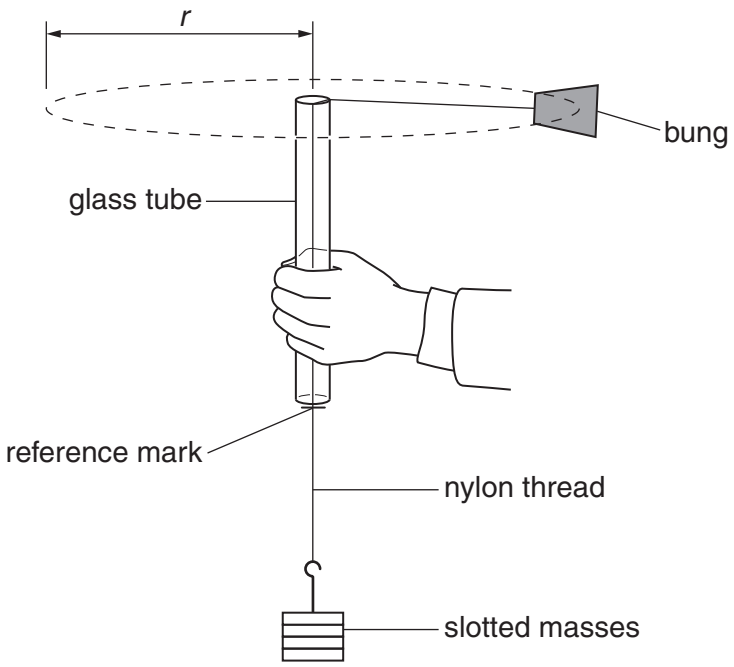


Fig. 3.1

(a) (i) Draw an arrow labelled **F** on Fig. 3.1 to indicate the direction of the resultant force on the bung.

[1]

(ii) Explain how the speed of the bung remains constant even though there is a resultant force *F* acting on it.

.....

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

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(b) (i) Two students carry out an experiment using the apparatus in Fig. 3.1 to investigate the relationship between the force F acting on the bung and its speed v for a constant radius. Describe how they obtain the values of F and v.

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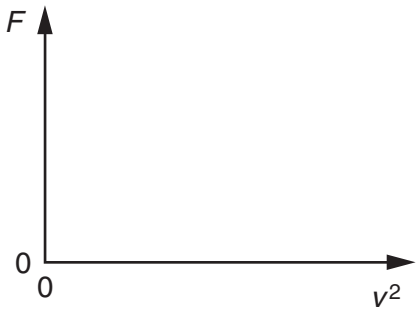
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..... **[5]**

(ii) 1 Sketch, on Fig. 3.2, the expected graph of F against v^2.



[1]

Fig. 3.2

2 Explain how the graph can be used to determine the mass m of the bung.

.....

.....

.....

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

[Total: 11]

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4 **(a)** **(i)** Define *specific heat capacity*.

.....

.....

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

(ii) Describe the difference between the *latent heat of fusion* and the *latent heat of vaporisation*.

.....

.....

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

(b) The graph in Fig. 4.1 shows the variation of temperature with time for a fixed mass of substance when heated by a constant power source. At **A** the substance is a solid; at **E** the substance is a vapour.

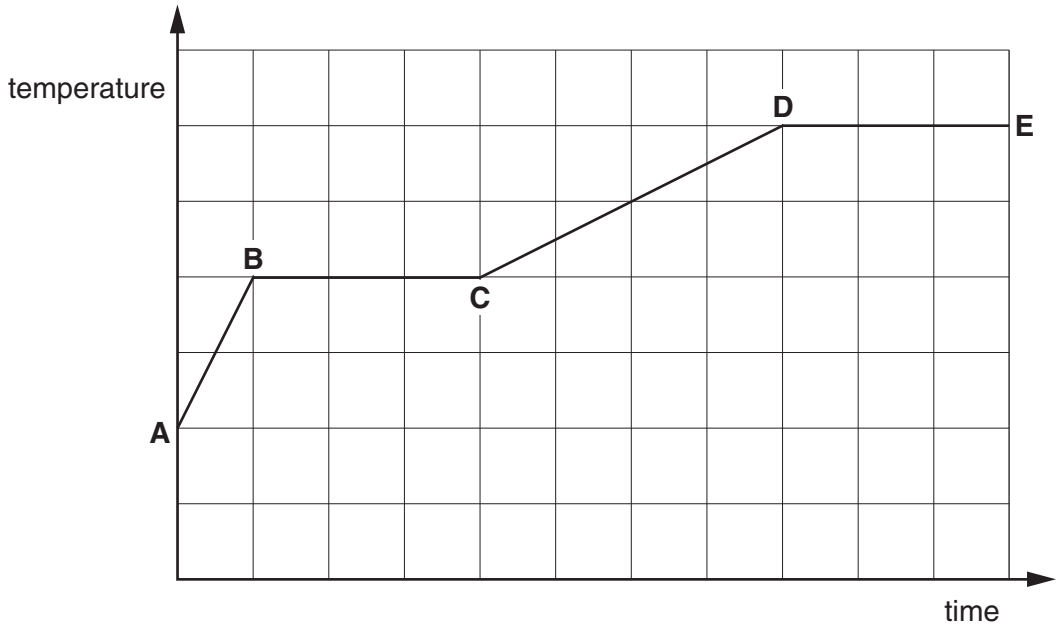


Fig. 4.1

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(i) Describe the changes taking place in the kinetic energy and potential energy of the molecules for the following sections:

A to **B**

.....

.....

.....

B to **C**

.....

.....

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

(ii) State and explain what you can conclude from Fig. 4.1 about the specific heat capacity of the substance in the solid state compared with the specific heat capacity of the substance in the liquid state.

.....

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.....

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

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(c) The electric heating element of a bathroom shower has a power rating of 5.0 kW. An attempt is made to test the accuracy of this value by measuring the rate of flow of the water and the temperature of the water before and after passing the element.

The results of the test and other required data are as follows:

temperature of water supply to the shower = 17.4 °C
temperature of water after being heated by the element = 36.7 °C
rate of flow of water = 3.60×10^{-3} m^3 min^{-1}
density of water = 1000 $kg\,m^{-3}$
specific heat capacity of water = 4200 $J\,kg^{-1}\,K^{-1}$

(i) Show that the power of the heating element is approximately 5 kW.

[4]

(ii) State and explain a possible source of uncertainty that might affect the reliability of the test.

.....

.....

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

[Total: 12]

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5 **(a)** State a conclusion about the movement of gas molecules provided by observations of Brownian motion.

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

.....

.....

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

(b) Fig. 5.1 shows a gas contained in a cylinder enclosed by a piston. The volume of the gas inside the cylinder is 120 cm^3. The pressure inside the cylinder is 350 kPa.

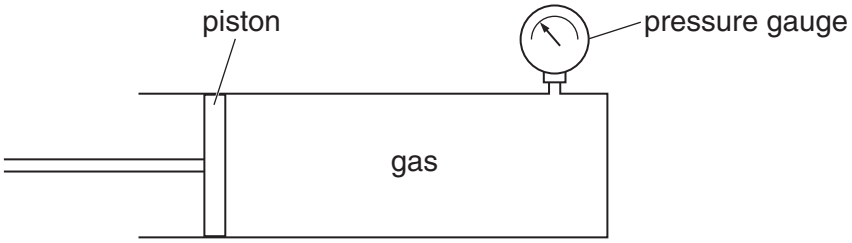


Fig. 5.1

(i) State a necessary condition for Boyle's law to apply to a fixed quantity of gas.

.....

.....

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

(ii) The piston in Fig. 5.1 is moved quickly so that the gas occupies a volume of 55 cm^3. Use Boyle's law to calculate the new pressure of the gas.

pressure = ……kPa **[2]**

(iii) In practice, the quick movement of the piston during compression of the gas causes an increase in the temperature of the gas. Explain this increase in temperature in terms of the **movement of the piston** and **the motion of the gas molecules**.

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

[Total: 6]

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6 (a) (i) State Newton's law of gravitation.

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

(ii) Define *gravitational field strength, g*.

.....

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

(b) Titan, a moon of Saturn, has a circular orbit of radius 1.2×10^6 km. The orbital period of Titan is 16 Earth days.

(i) Calculate the speed of Titan in its orbit.

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

(ii) Show that the mass of Saturn is about 5×10^{26} kg.

[3]

(c) Rhea is another moon of Saturn with a smaller orbital radius than Titan.
Determine the ratio

$$\frac{\text{orbital period } T_R \text{ of Rhea}}{\text{orbital period } T_T \text{ of Titan}}$$ in terms of their orbital radii r_R , and r_T .

ratio = ... **[2]**

[Total: 10]

END OF QUESTION PAPER

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ADDITIONAL PAGE

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

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