Past Paper 10

Time Allowed: 1 hour **Total Marks: 60**

1 **(a)** State Newton's second and third laws of motion.

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

(i) second law

....

....

.... **[1]**

(ii) third law

....

....

.... **[1]**

(b) A golfer uses a golf club to hit a stationary golf ball off the ground. Fig. 1.1 shows how the force *F* on the golf ball varies with time *t* when the club is in contact with the ball.

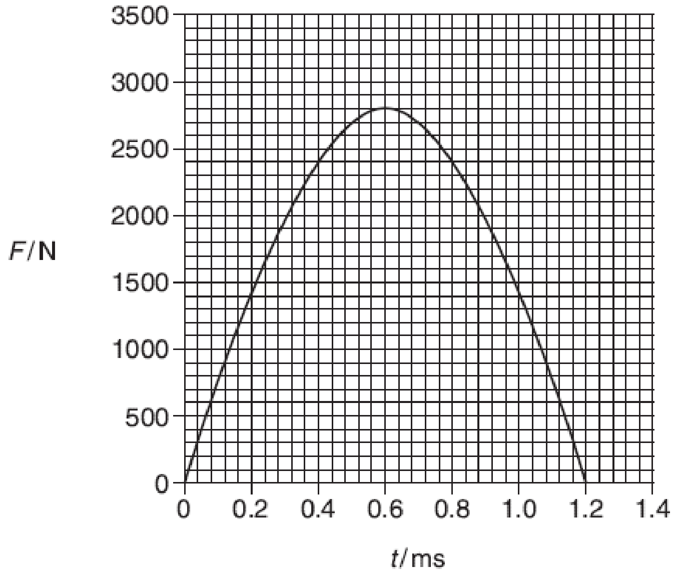

Fig. 1.1

(i) Estimate the area under the graph.

area = ... N s **[2]**

(ii) Name the physical quantity represented by the area under the graph in **(i)**.

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

.... **[1]**

(iii) Show that the speed of a golf ball, of mass 0.046 kg, as it leaves the golf club is about 50 m s^{-1}.

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

(iv) The ground is level. The ball leaves the ground at a velocity of 50 m s^{-1} at an angle of 42° to the horizontal. Determine the horizontal distance travelled by the ball before it hits the ground.

State **one** assumption that you make in your calculations.

distance = ... m

assumption ....

.... **[5]**

[Total: 12]

2 **(a)** Fig. 2.1 shows the London Eye.

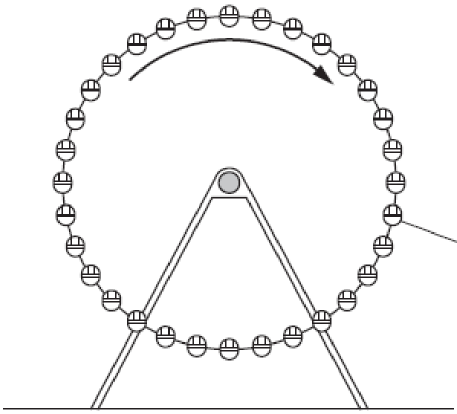

Fig. 2.1

It has 32 capsules equally spaced around the edge of a large vertical wheel of radius 60 m. The wheel rotates about a horizontal axis such that each capsule has a constant speed of $0.26\,\mathrm{m\,s^{-1}}$.

(i) Calculate the time taken for the wheel to make one complete rotation.

time = ... s **[1]**

(ii) Each capsule has a mass of 9.7×10^{3} kg. Calculate the centripetal force which must act on the capsule to make it rotate with the wheel.

centripetal force = ... N **[2]**

(b) Fig. 2.2 shows the drum of a spin-dryer as it rotates. A dry sock **S** is shown on the inside surface of the side of the rotating drum.

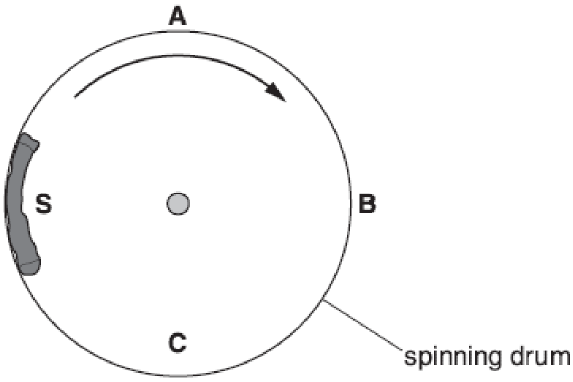

Fig. 2.2

(i) Draw arrows on Fig. 2.2 to show the direction of the centripetal force acting on **S** when it is at points **A**, **B** and **C**. **[1]**

(ii) State and explain at which position, **A**, **B** or **C** the normal contact force between the sock and the drum will be

1 the greatest

....

....

....

.... **[2]**

2 the least.

....

....

.... **[1]**

[Total: 7]

3 Fig. 3.1 represents the planet Jupiter. The centre of the planet is labelled as **O**.

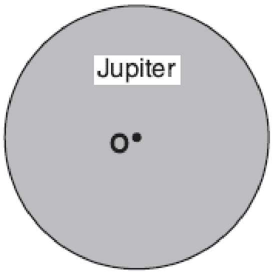

Fig. 3.1

(a) Draw gravitational field lines on Fig. 3.1 to represent Jupiter's gravitational field. **[2]**

(b) Jupiter has a radius of 7.14×10^{7} m and the gravitational field strength at its surface is $24.9\,\text{N kg}^{-1}$.

(i) Show that the mass of Jupiter is about 2×10^{27} kg.

[3]

(ii) Calculate the average density of Jupiter.

density = ... kg m^{-3} **[2]**

[Total: 7]

4 Fig. 4.1 shows a mass suspended from a spring.

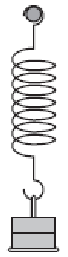

Fig. 4.1

(a) The mass is in equilibrium. By referring to the forces acting on the mass, explain what is meant by *equilibrium*.

....

....

.... **[2]**

(b) The mass in **(a)** is pulled down a vertical distance of 12 mm from its equilibrium position. It is then released and oscillates with simple harmonic motion.

(i) Explain what is meant by *simple harmonic motion*.

....

....

....

.... **[2]**

(ii) The displacement x, in mm, at a time t seconds after release is given by

$$x = 12 \cos (7.85\, t).$$

Use this equation to show that the frequency of oscillation is 1.25 Hz.

[2]

(iii) Calculate the maximum speed V_{max} of the mass.

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

(c) Fig. 4.2 shows how the displacement *x* of the mass varies with time *t*.

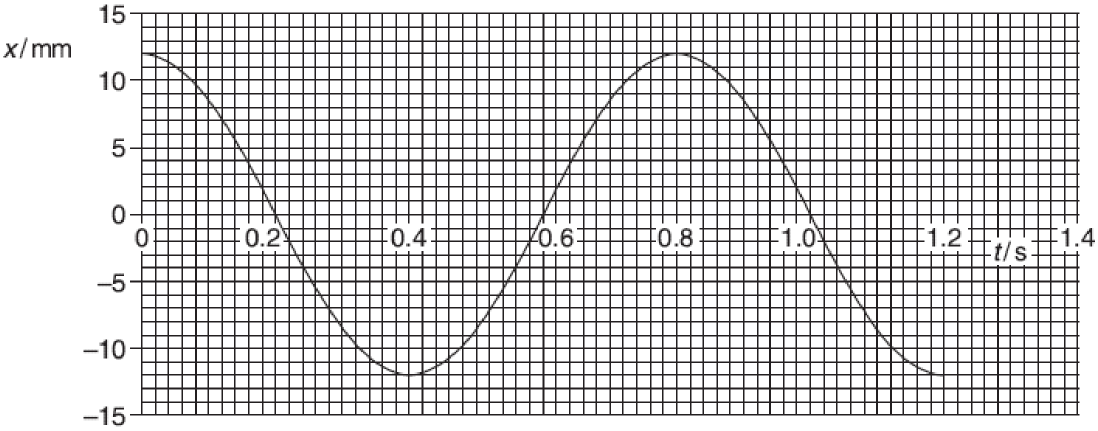

Fig. 4.2

Sketch on Fig. 4.3 the graph of velocity against time for the oscillating mass.

Put a suitable scale on the velocity axis. **[3]**

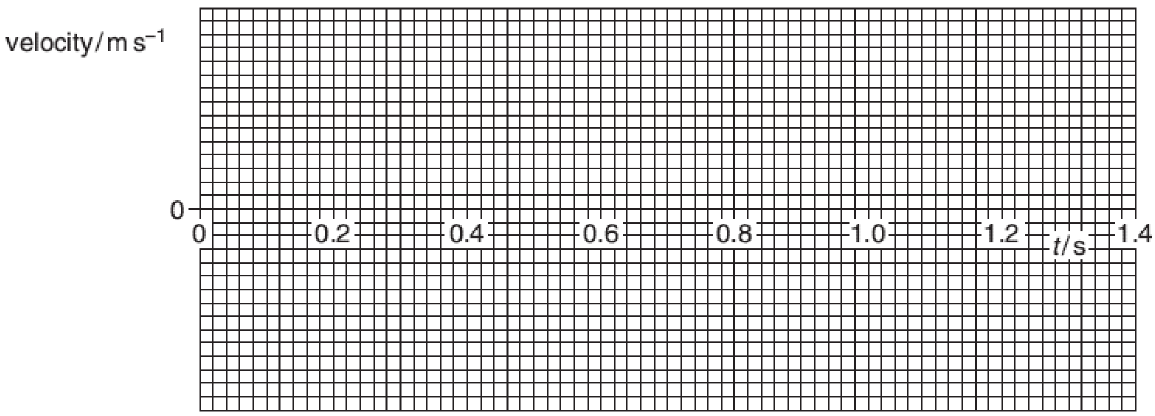

Fig. 4.3

[Total: 11]

5 **(a)** The table shows the specific heat capacities c of alcohol and water.

	c / J kg^{-1} K^{-1}
alcohol	2460
water	4180

(i) An alcohol thermometer is placed in 80 g of water at 20 °C. The mass of alcohol in the thermometer is 0.050 g. The water is then heated from 20 °C to 60 °C.

Calculate the ratio

$$\frac{\text{energy required to warm the water from 20 °C to 60 °C}}{\text{energy required to warm the alcohol from 20 °C to 60 °C}}.$$

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

(ii) State and explain a situation in which the very high value of specific heat capacity for water is useful.

....

....

....

....

.... **[2]**

(b) Describe an electrical experiment to determine the specific heat capacity c of a liquid.

Include in your answer:

- a labelled diagram of the arrangement
- a list of the measurements to be taken
- an explanation of how the value of c would be determined from your results
- possible sources of uncertainty in your measurements and how these could be reduced.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... **[8]**

[Total: 12]

6 **(a)** The ideal gas equation may be written as

$$pV = nRT.$$

State the meaning of the terms n and T.

n ....

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

(b) Fig. 6.1 shows a cylinder that contains a fixed amount of an ideal gas. The cylinder is fitted with a piston that moves freely. The gas is at a temperature of 20 °C and the initial volume is $1.2 \times 10^{-4}\,m^3$. Fig. 6.2 shows the cylinder after the gas has been heated to a temperature of 90 °C under constant pressure.

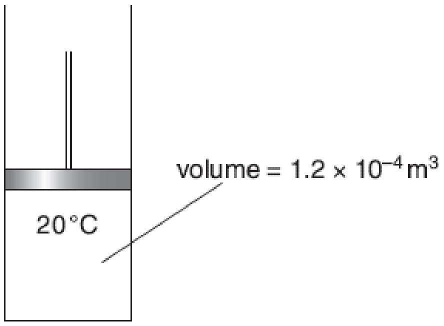

Fig. 6.1

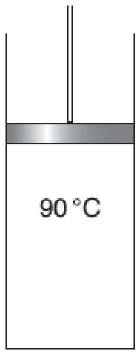

Fig. 6.2

(i) Explain in terms of the motion of the molecules of the gas why the volume of the gas must increase if the pressure is to remain constant as the gas is heated.

....

....

....

....

....

....

....

....

....

.... **[4]**

(ii) Calculate the volume of the gas at 90 °C.

volume = ... m^3 **[2]**

(c) The mass of each gas molecule is 4.7×10^{-26} kg. Estimate the average speed of the gas molecules at 90 °C.

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

[Total: 11]

END OF QUESTION PAPER