OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

Advanced Subsidiary GCE

PHYSICS A

Unit G481: Mechanics

Specimen Paper

G481 QP

Candidates answer on the question paper.

Additional Materials:
Data and formulae sheet
Electronic calculator

Time: 1 hour

Candidate Name	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- ✎ Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**12**	
2	**8**	
3	**8**	
4	**9**	
5	**12**	
6	**6**	
7	**5**	
TOTAL	**60**	

This document consists of **14** printed pages and **2** blank pages.

Answer **all** the questions.

1

(a) **(i)** Define *speed* of an object. Explain how you would determine the constant speed of a conker at the end of length of string being whirled in a horizontal circle.

.....

.....

.....

.....

.....

.....

.....

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

(ii) Define *velocity* of an object.

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

.....

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

(iii) By reference to speed and velocity, explain the difference between a scalar quantity and a vector quantity, using as an example the terms *speed* and *velocity*.

.....

.....

.....

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

(b) Fig.1.1 shows a long rope that is tied at one end to a high support. A girl swings forwards and backwards across a pool using the other end of the rope.

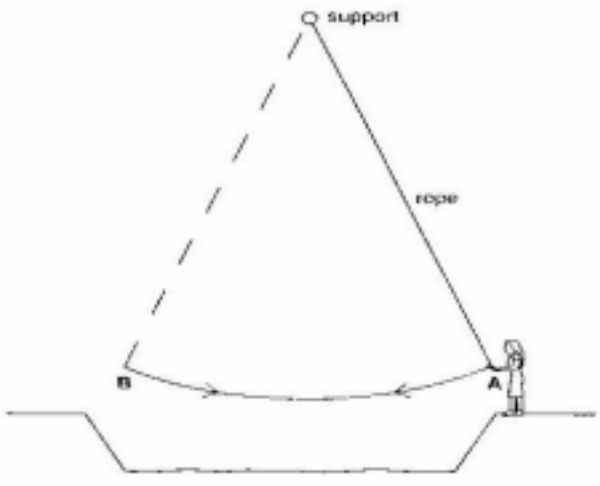

Fig.1.1

Fig.1.2 shows the variation with time *t* of the displacement *x* of the girl from **A** to **B** and back to **A**.

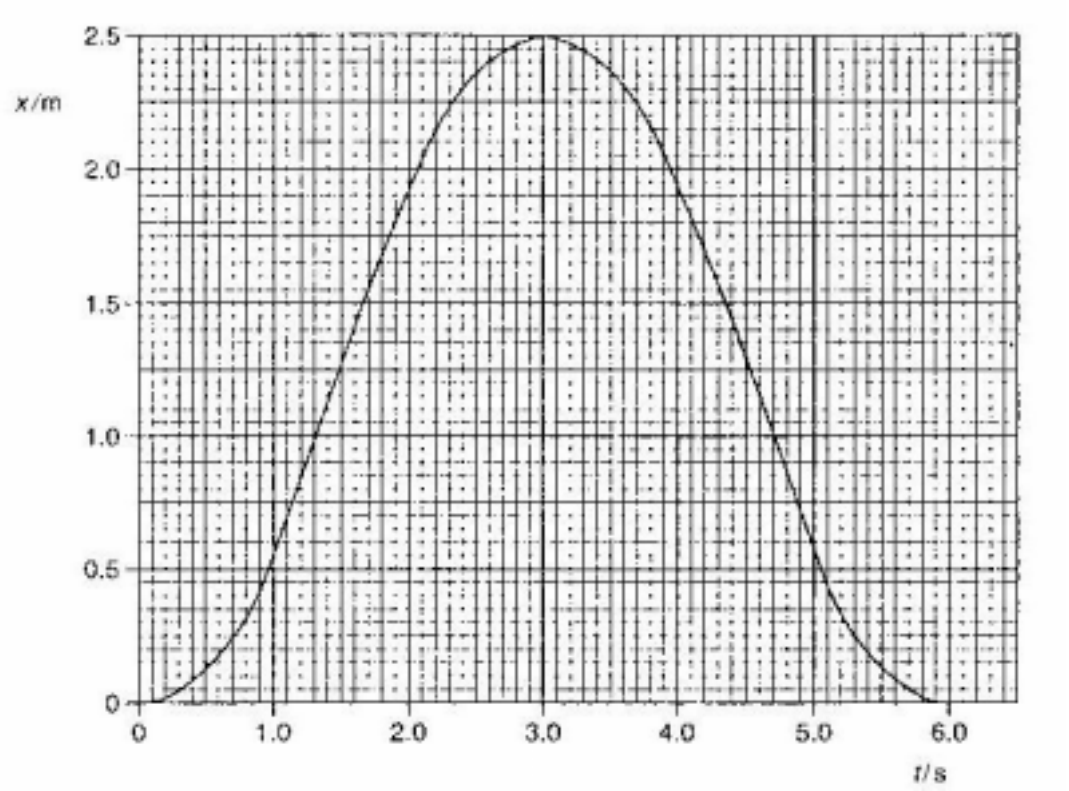

Fig.1.2

(i) State what the gradient of the graph represents and explain why the graph shows both positive and negative gradients.

.....

.....

.....

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

(ii) Mark on Fig.1.2 with a cross a position where the speed of the girl is zero (label this **Z**). **[1]**

(iii) 1. Explain how you can determine using Figure 1.2 that the maximum speed of the girl is about 1.4ms^{-1}.

.....

.....

.....

2. Estimate the uncertainty in the value of the maximum speed obtained in this way.

.....

.....

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

[Turn over

[Total: 13]

2

(a) Define *acceleration*.

.....

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

(b) An aircraft of total mass 1.5×10^5 kg accelerates, at maximum thrust from the engines, from rest along a runway for 25 s reaching the required take-off speed of 65 m s^{-1}.

Assume that the acceleration of the aircraft is constant. Calculate

(i) the net force acting on the aircraft to produce this acceleration

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

(ii) the distance travelled by the aircraft in this time.

distance = ... m **[2]**

(c) At a particular airport, the length of the runway for the same take-off speed is less than your answer in **(b)(iii)**. State and explain what change could be made to the aircraft to enable it to reach the required take-off speed on this shorter runway.

.....

.....

.....

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

[Total: 8]

[Turn over

3

(a) Define

(i) *power*

.....

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

(ii) a *joule.*

.....

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

(b) A force F acts on an object. The object moves at an angle θ to this force. Explain why the work done W by the force in the direction of motion of the object is not just

$$W = Fx$$

but is equal to

$$W = Fx\cos\theta$$

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

.....

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

(c) Fig.3.1 shows a part of a fairground ride with a carriage on rails.

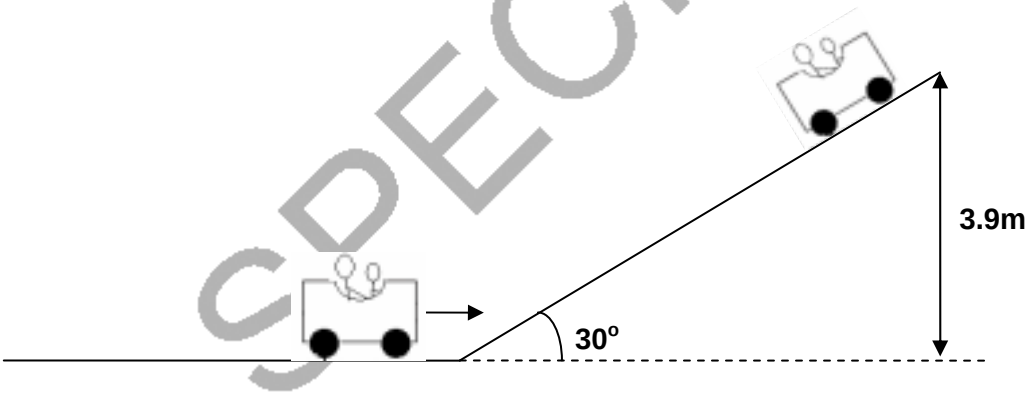

Fig. 3.1

The carriage of mass 500 kg is travelling towards a slope inclined at 30° to the horizontal. The carriage has a kinetic energy of 25 kJ at the bottom of the slope. The carriage comes to rest after travelling up the slope to a vertical height of 3.9 m.

(i) Show that the gravitational potential energy gained by the carriage is 19 kJ. **[2]**

(ii) Calculate the total work done against the resistive forces as the carriage moves up the slope.

work done = ... kJ **[1]**

(iii) Calculate the magnitude of the resistive force acting against the carriage as it moves up the slope.

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

[Total: 8]

4

(a) State Hooke's law.

.....

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

(b) Fig. 4.1 shows the variation of the applied force *F* with the extension *x* for a particular spring.

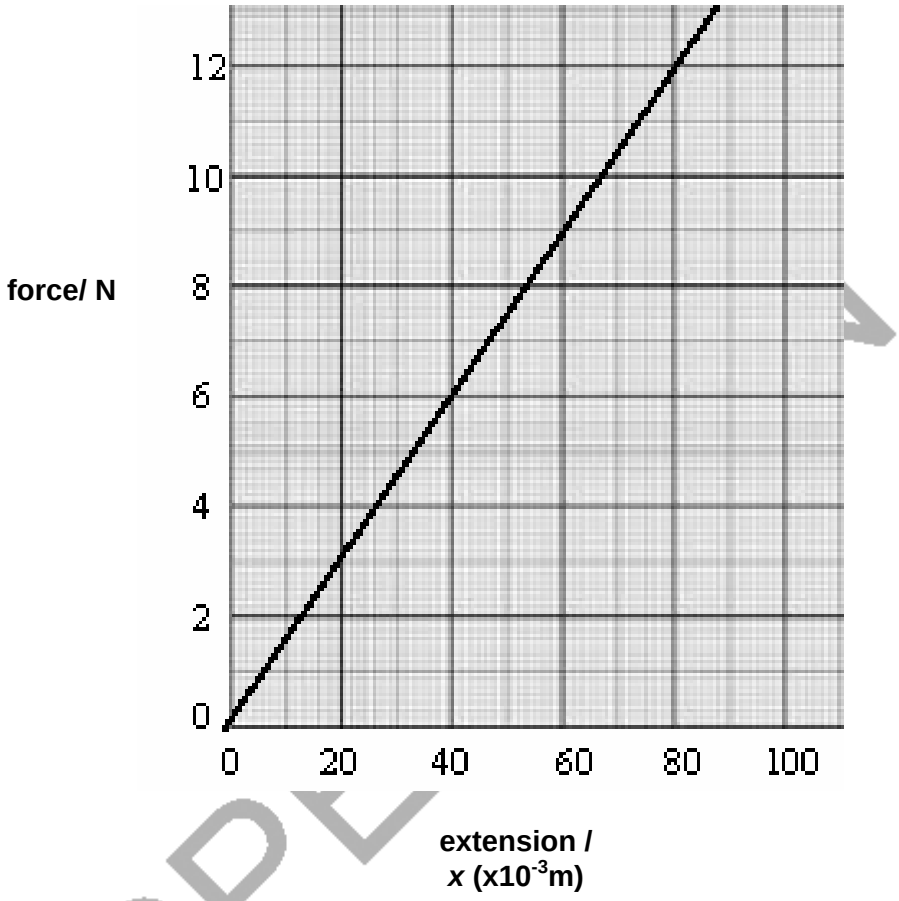

Fig. 4.1

(i) Use Fig. 4.1 to determine the force constant of the spring.

force constant = ...N m^{-1} **[2]**

(ii) Determine the elastic potential energy stored in the spring when a force of 20 N is applied.

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

(iii) State one assumption made in your calculation of the energy in **(ii)**.

.....

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

(iv) The energy stored in the spring is used to propel a metal ball of mass *m* horizontally. There is 100% transfer of energy from the spring to the ball. Show how the speed *v* of the metal ball is proportional to the extension *x* of the spring. Find the constant of proportionality.

.....

.....

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

[Total: 9]

5

(a) Explain the following terms in relation to motion of a road vehicle.

(i) *braking distance*

.....

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

(ii) *thinking distance*

.....

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

(b) A car of mass 800 kg is travelling at a speed of 20 m s^{-1}. Calculate

(i) the kinetic energy of the car

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

(ii) the deceleration of the car when the braking distance is 24 m.

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

(c) Describe in terms of the forces acting on the driver how wearing a seat belt and having an airbag in a car can help to protect the driver from injury in a head on collision.

.....

.....

.....

.....

.....

.....

.....

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

(d) The wearing of seat belts became law in the UK in January 1983. Fig. 5.1 shows the annual deaths due to road accidents in Scotland since 1950.

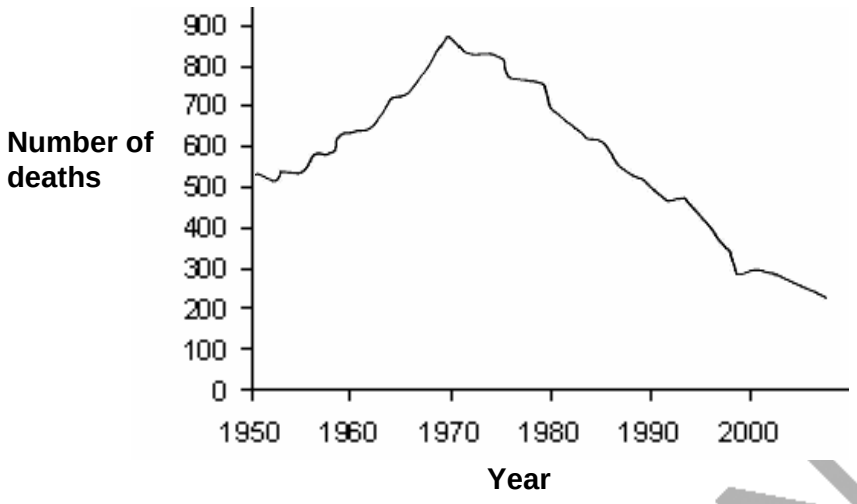

Fig. 5.1

The percentage of car drivers wearing seat belts in 1983 and at present has remained static at 93 %. On average, cars are travelling faster now than in 1983. Suggest another factor which may have been responsible for the decrease in deaths.

.....

.....

.....

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

[Total: 11]

6

(a) State two conditions that are necessary for an object to be in equilibrium.

.....

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

(b) Fig. 6.1 shows a computer resting on a tabletop that is hinged at point **A**.

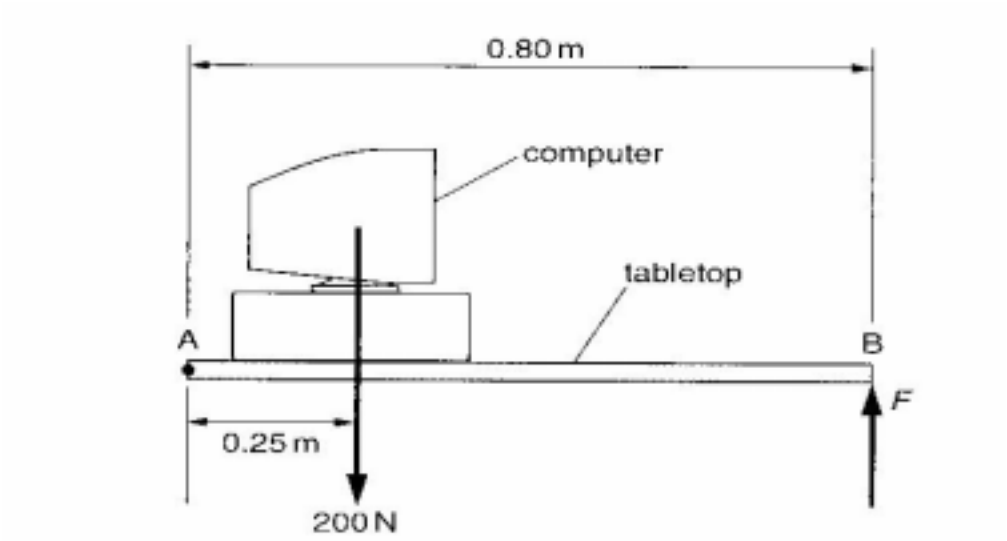

Fig. 6.1

The tabletop has a mass of 5.0 kg and its centre of gravity is 0.40 m from the axis of the hinge **A**. The computer has a weight of 200 N acting through a point 0.25 m from the hinge **A**. The tabletop is supported to maintain it in a horizontal position by a force *F* acting vertically at **B**. The distance AB is 0.80 m.

Calculate the force *F* applied at **B** that is required to maintain the tabletop in equilibrium.

force *F* = ... N **[3]**

(c) Explain why the force *F* and the 200 N force shown in Fig. 6.1 cannot be a couple.

.....

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

[Total: 6]

7 **(a)** Define *the Young modulus* of a material.

.....

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

(b) Explain why the quantity strain has no units.

.....

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

(c) Explain what is meant by a brittle material.

.....

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

(d) Define the ultimate tensile strength of a material. Suggest why an engineer designing a suspension bridge should know the value of this quantity for all his materials.

.....

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

[Total: 5]

Paper Total [60]