

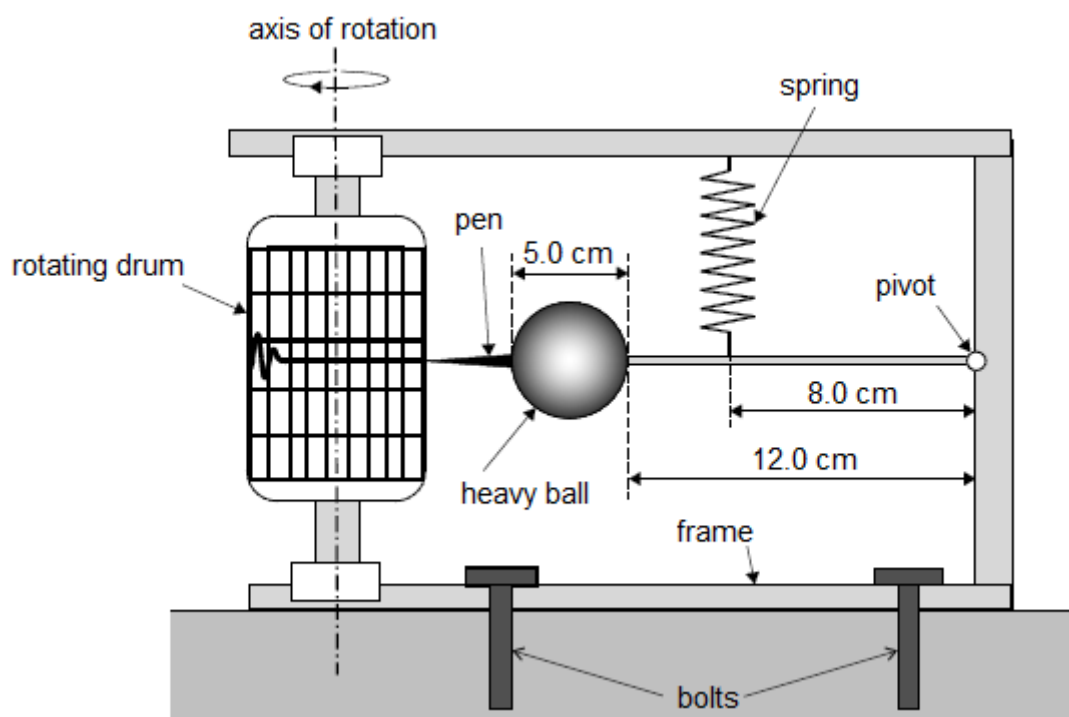
Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Q1.

A seismometer is a device that is used to record the movement of the ground during an earthquake. A simple seismometer is shown in the diagram.



A heavy spherical ball is attached to a pivot by a rod so that the rod and ball can move in a vertical plane. The rod is suspended by a spring so that, in equilibrium, the spring is vertical and the rod is horizontal. A pen is attached to the ball. The pen draws a line on graph paper attached to a drum rotating about a vertical axis. Bolts secure the seismometer to the ground so that the frame of the seismometer moves during the earthquake.

- (a) The ball is made of steel of density 8030 kg m^{-3} and has a diameter of 5.0 cm.

Show that the weight of the ball is approximately 5 N.

(3)

- (b) The distance from the surface of the ball to the pivot is 12.0 cm, as shown in the diagram above.

Calculate the moment of the weight of the ball about the pivot when the rod is horizontal. Give an appropriate unit for your answer.

moment = _____ unit = _____

(3)

- (c) The spring is attached at a distance of 8.0 cm from the pivot and the spring has a stiffness of 100 N m^{-1} .

Calculate the extension of the spring when the rod is horizontal and the spring is vertical. You may assume the mass of the pen and the mass of the rod are negligible.

extension = _____ m

(3)

- (d) Before an earthquake occurs, the line being drawn on the graph paper is horizontal.

Explain what happens to the line on the graph paper when an earthquake is detected and the frame of the seismometer accelerates rapidly downwards.

(2)

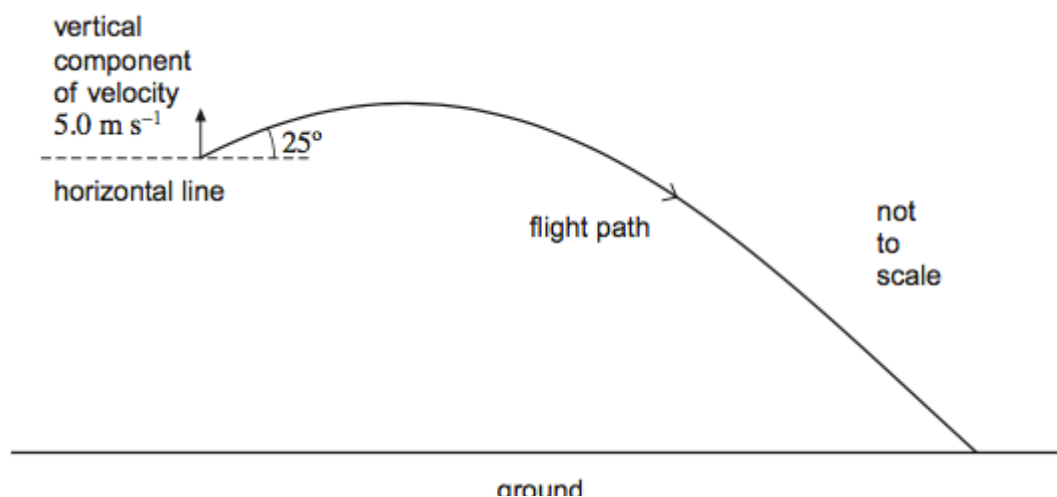
(Total 11 marks)

Q2.

A projectile is launched some distance above the ground at an angle of 25° above the horizontal with a vertical component of velocity of 5.0 m s^{-1} . **Figure 1** shows the flight path of the projectile. The flight takes 1.3 s.

Ignore the effects of air resistance throughout this question.

Figure 1



- (a) (i) Show that the initial speed of the projectile is about 12 m s^{-1} .

(2)

- (ii) Calculate the horizontal component of velocity as the projectile hits the ground.

horizontal component of velocity = _____ m s^{-1}

(2)

- (b) (i) Calculate the maximum height above the starting point reached by the projectile. Give your answer to an appropriate number of significant figures.

maximum height reached = _____ m

(2)

- (ii) Calculate the total horizontal distance travelled by the projectile from its starting point.

horizontal distance = _____ m

(1)

- (c) (i) Mark with an **A** on the flight path in **Figure 1** the position where the speed of the projectile is greatest.

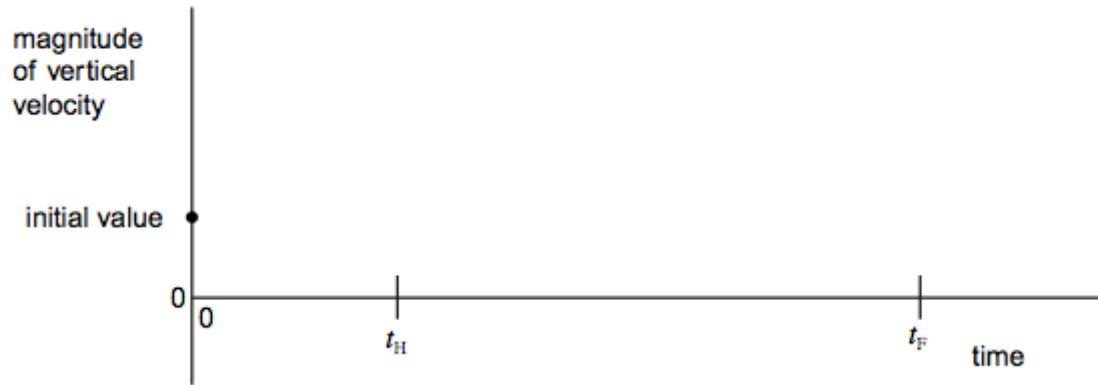
(1)

- (ii) Mark with a **B** on the flight path in **Figure 1** the position where the speed of the projectile is least.

(1)

- (iii) The projectile reaches its maximum height at time t_H and finishes its flight at time t_F . Draw on **Figure 2** a graph to show how the **magnitude** of the vertical component of velocity of the projectile varies with time. Numerical values are **not** required.

Figure 2



(2)

(Total 11 marks)