**Name of the Student**:_____
**Max. Marks : 20 Marks** **Time : 20 Minutes**

## Q1.

Two methods involved in the detection of exoplanets are the radial velocity method and the transit method.

(a) Explain what is meant by the transit method of detection.

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**(3)**

(b) Explain why it is important that there is more than one method of detection.

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**(2)**
**(Total 5 marks)**

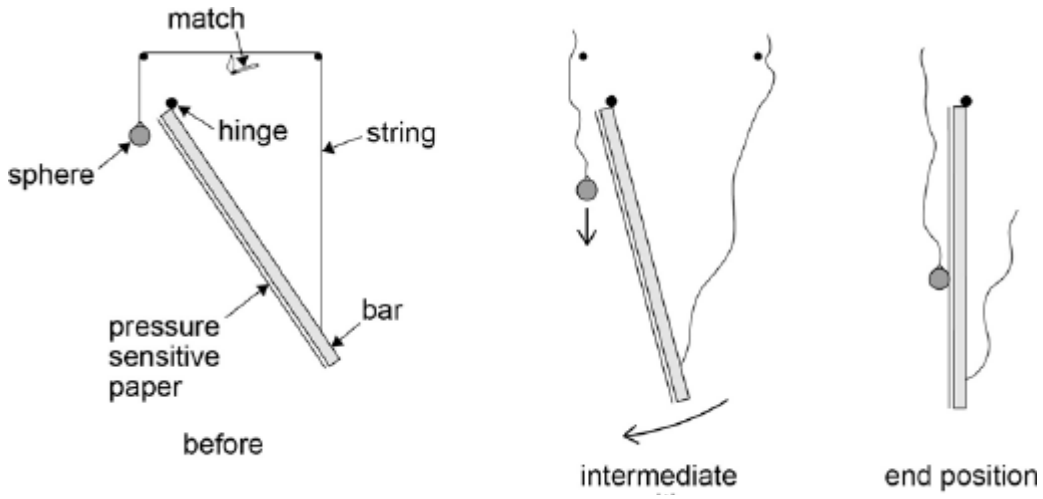
## Q2.

This question is about measuring the acceleration of free fall $g$.

A student undertakes an experiment to measure the acceleration of free fall.

**Figure 1** shows a steel sphere attached by a string to a steel bar. The bar is hinged at the top and acts as a pendulum. When the string is burnt through with a match, the sphere falls vertically from rest and the bar swings clockwise. As the bar reaches the vertical position, the sphere hits it and makes a mark on a sheet of pressure-sensitive paper that is attached to the bar.

**Figure 1**




The student needs to measure the distance $d$ fallen by the sphere in the time $t$ taken for the bar to reach the vertical position.

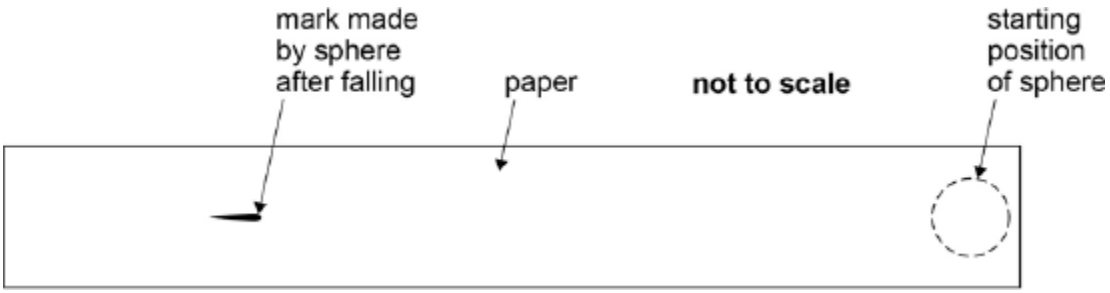
To measure $d$ the student marks the initial position of the sphere on the paper. The student then measures the distance between the initial mark and the mark made by the sphere after falling.

To measure $t$ the student sets the bar swinging without the string attached and determines the time for the bar to swing through 10 small-angle oscillations.

(a) **Figure 2** shows the strip of paper after it has been removed from the bar. The initial position of the sphere and the final mark are shown.

Mark on **Figure 2** the distance that the student should measure in order to determine $d$.

**Figure 2**




**(1)**

(b) The student repeats the procedure several times.

Data for the experiment is shown in the table below.

| $d$ / m |
|---|
| 0.752 |
| 0.758 |
| 0.746 |
| 0.701 |

| |
|---|
| 0.772 |
| 0.769 |

Time for bar to swing through 10 oscillations as measured by a stop clock = 15.7 s

Calculate the time for one oscillation and hence the time $t$ for the bar to reach the vertical position.

time_____s

**(1)**

(c) Determine the percentage uncertainty in the time $t$ suggested by the precision of the recorded data.

uncertainty =_____ %

**(2)**

(d) Use the data from the table to calculate a value for $d$.

$d$ = _____m

**(2)**

(e) Calculate the absolute uncertainty in your value of $d$.

uncertainty =_____ m

**(1)**

(f) Determine a value for $g$ and the absolute uncertainty in $g$.

$g$ =_____ $ms^{-2}$

uncertainty =_____ $ms^{-2}$

**(3)**

(g) Discuss **one** change that could be made to reduce the uncertainty in the experiment.

_____

_____

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_____

**(2)**

(h) The student modifies the experiment by progressively shortening the bar so that the time for an oscillation becomes shorter. The student collects data of distance fallen $s$ and corresponding times $t$ over a range of times.

Suggest, giving a clear explanation, how these data should be analysed to obtain a value for $g$.

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**(3)**

**(Total 15 marks)**