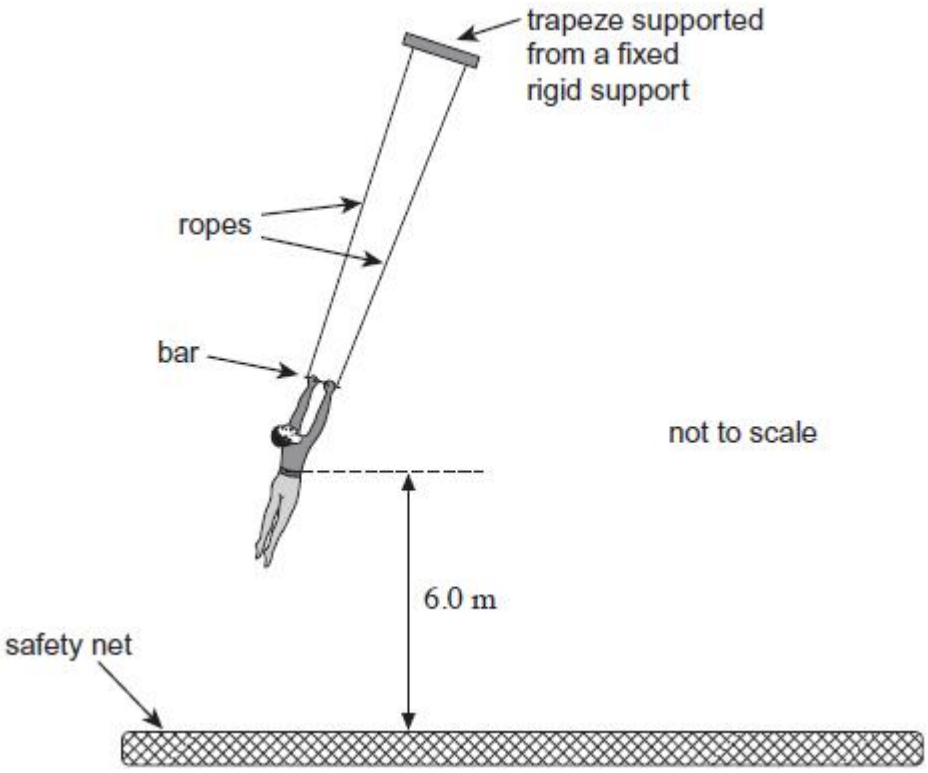
Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Q1.

Figure 1 shows an acrobat swinging on a trapeze.

Figure 1



(a) (i) State and explain how the tension in the ropes of the trapeze varies as the acrobat swings on the trapeze.

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(3)

(ii) The period of the oscillation of the acrobat on the trapeze is 3.8 s.

Calculate the distance between the point of suspension of the trapeze and the centre of mass of the acrobat.

Assume that the acrobat is a point mass and that the system behaves as a simple pendulum.

distance _____ m

(2)

(b) At one instant the amplitude of the swing is 1.8 m. The acrobat lets go of the bar of the trapeze at the lowest point of the swing. He lands in a safety net when his centre of mass has fallen 6.0 m.

(i) Calculate the speed of the acrobat when he lets go of the bar.

speed _____ m s^{-1}

(3)

(ii) Calculate the horizontal distance between the point of suspension of the trapeze and the point at which the acrobat lands on the safety net.

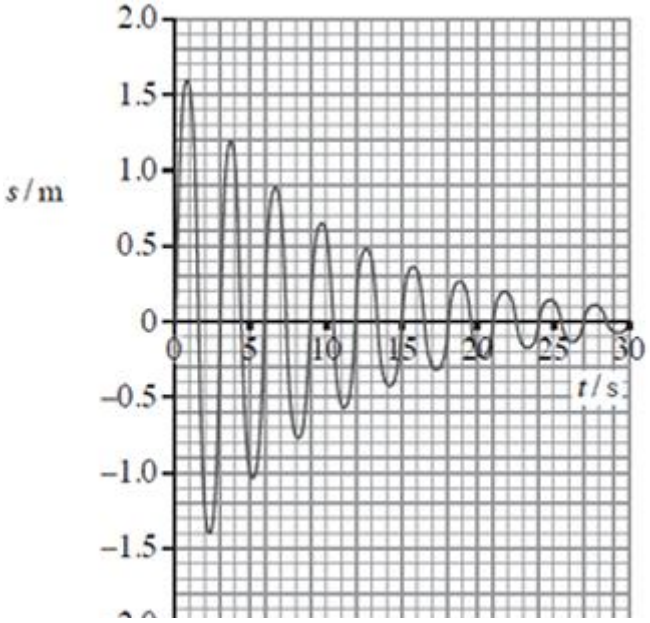
horizontal distance _____ m

(3)

(c) **Figure 2** shows the displacement−time (s–t) graph for the bar of the trapeze after the acrobat has let go of the bar.

Figure 2

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(i) Show that the amplitude of the oscillations decreases exponentially.

(3)

(ii) Explain why the period of the trapeze changes when the acrobat lets go of the bar.

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(2)

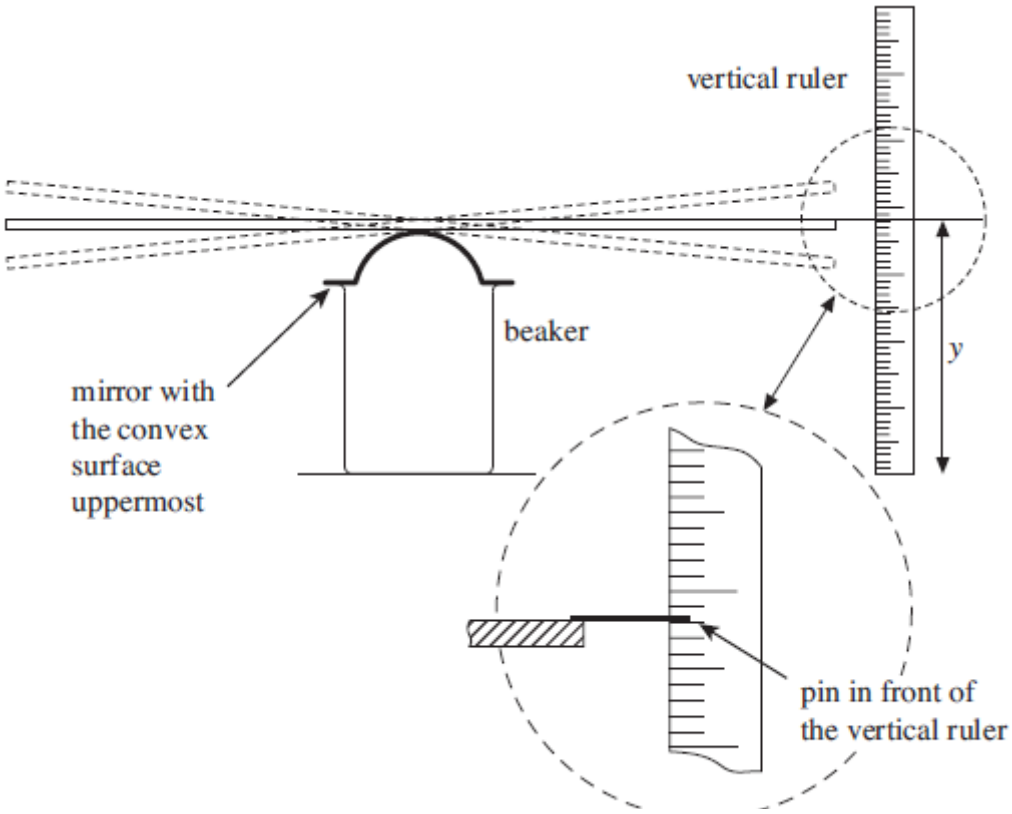
(Total 16 marks)

Q2.

It is suggested to a student who is watching a metre ruler oscillating on the convex surface of a mirror that the amplitude of the oscillations decreases exponentially.
The student is challenged to show whether or not this is true.

The student decides to record the motion of the ruler using a video camera. She attaches a pin to the end of the ruler and positions a vertical scale behind the tip of the pin, as shown in the diagram below.

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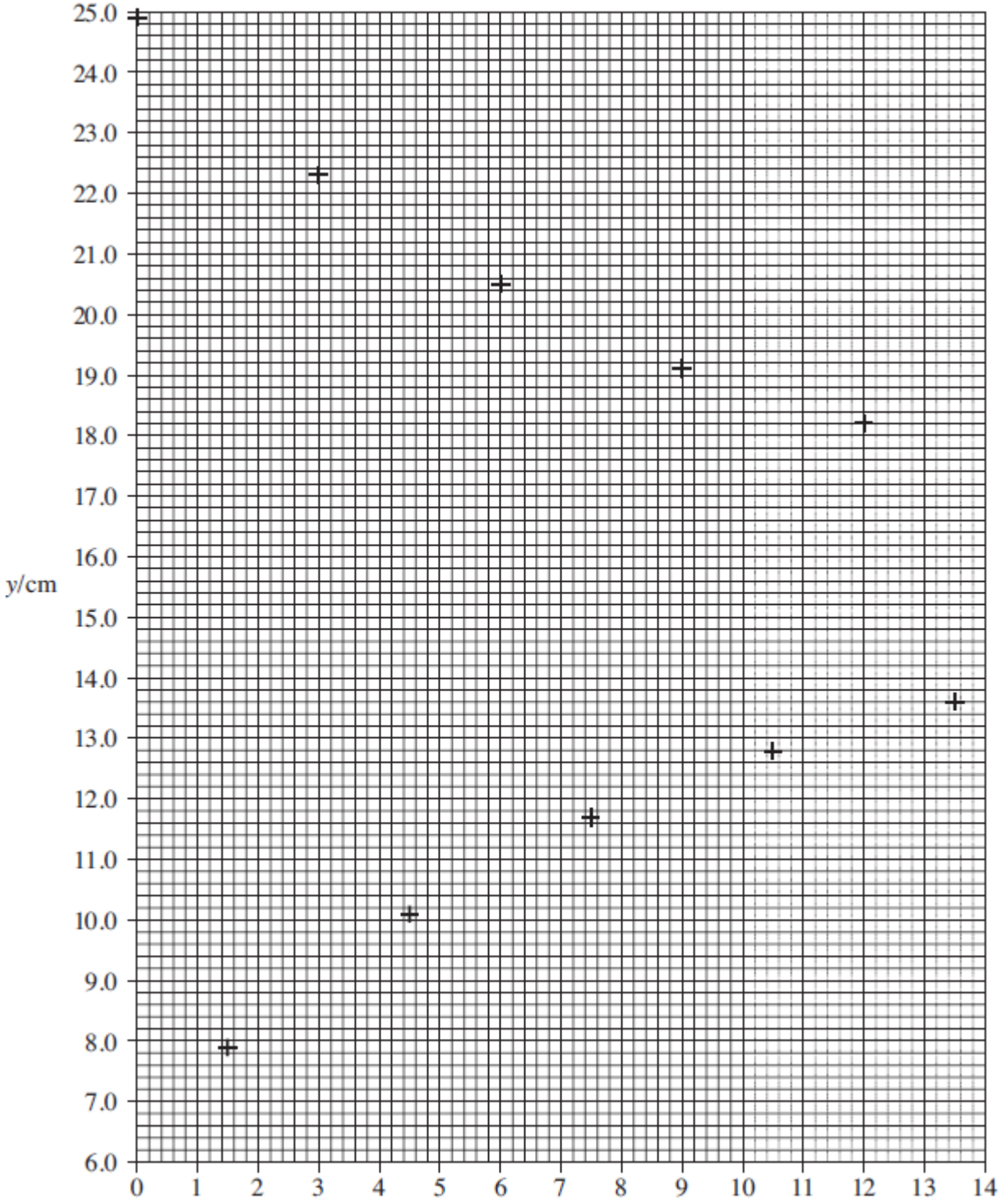
The student records the height above the bench of the tip of the pin at the top, y_t, and at the bottom, y_b, of its motion during several successive swings, n, of the ruler.

Her results are shown below.

n	0	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5
y_t/cm	24.9		22.3		20.5		19.1		18.2	
y_b/cm		7.9		10.1		11.7		12.8		13.6

(a) Her data points are plotted on the graph below.

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On the graph draw

(i) a line to show how y_t varies with n,

(ii) a line to show how y_b varies with n,

(iii) a line parallel to the horizontal axis to mark the position of the tip of the pin against the vertical scale when the ruler is at the equilibrium position.

(2)

(b) Hence or otherwise, explain whether the student's data confirms the suggestion that the amplitude of the oscillations decreases exponentially.

_____

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(3)
(Total 5 marks)

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