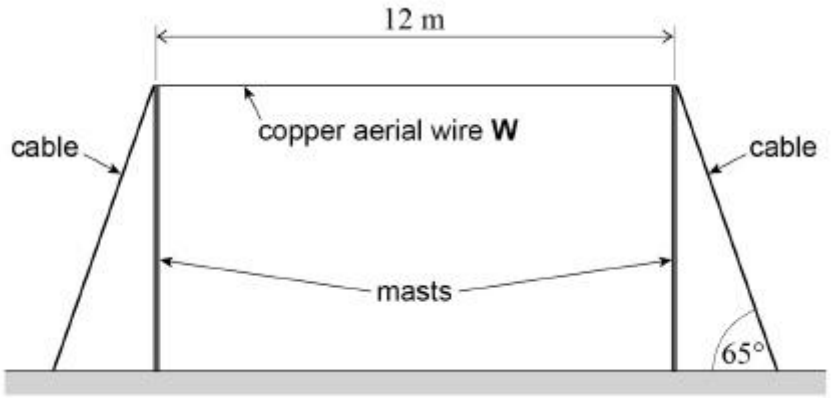
Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

Figure 1 shows a structure that supports a horizontal copper aerial wire **W** used for transmitting radio signals.

Figure 1



The copper aerial wire is 12 m long and its area of cross-section is 1.6×10^{-5} m^2.
The tension in the copper aerial wire is 5.0×10^2 N.

Young modulus of copper = 1.2×10^{11} Pa

(a) Show that the extension produced in a 12 m length of the aerial wire when the tension is 5.0×10^2 N is less than 4 mm.

(2)

(b) The cables that support each mast are at an angle of 65° to the horizontal.

Calculate the tension in each supporting cable so that there is no resultant horizontal force on either mast.

tension = _____ N

(1)

(c) When wind blows, stationary waves can be formed on the aerial wire.

Explain how stationary waves are produced and why only waves of specific frequencies can form on the aerial wire.

_____

_____

_____

_____

_____

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_____

(4)

(d) Calculate the mass of a 1.0 m length of the aerial wire.

Density of copper = 8900 kg m^{-3}

mass = _____ kg

(1)

(e) Calculate the frequency of the wave when the third harmonic is formed on the aerial wire.

frequency = _____ Hz

(2)

(f) Sketch, on **Figure 2**, the standing wave on the wire when the third harmonic is formed.

Figure 2

(1)

(g) High winds produce large amplitudes of vibration of the aerial wire.

Explain why the wire may sag when the high wind stops.

_____

_____

_____

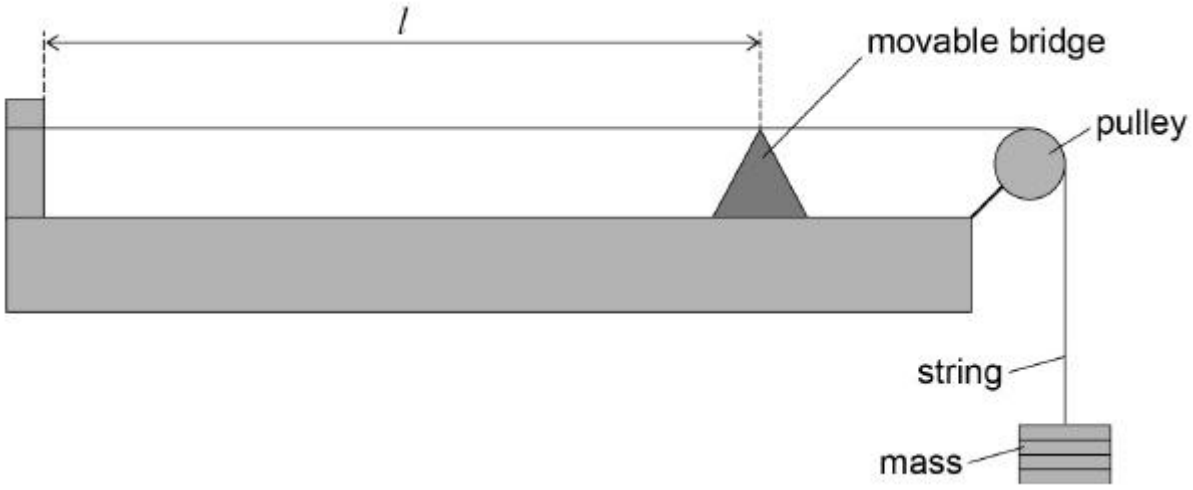
_____

(2)

(Total 13 marks)

Q2.

The diagram shows an arrangement used by a student to investigate vibrations in a stretched nylon string of fixed length l. He measures how the frequency f of first-harmonic vibrations for the string varies with the mass m suspended from it.



The table shows the results of the experiment.

***m* / kg**	***f* / Hz**
0.50	110
0.80	140
1.20	170

(a) Show that the data in the table are consistent with the relationship

$$f \propto \sqrt{T}$$

where T is the tension in the nylon string.

(2)

(b) The nylon string used has a density of 1150 kg m^{-3} and a uniform diameter of 5.0×10^{-4} m.

Determine the length l of the string used.

l = _____ m

(3)

(c) The student uses the relationship in question (a) to predict frequencies for tensions that are much larger than those used in the original experiment.

Explain how the actual frequencies produced would be different from those that the student predicts.

_____

_____

_____

_____

(2)

(Total 7 marks)