Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

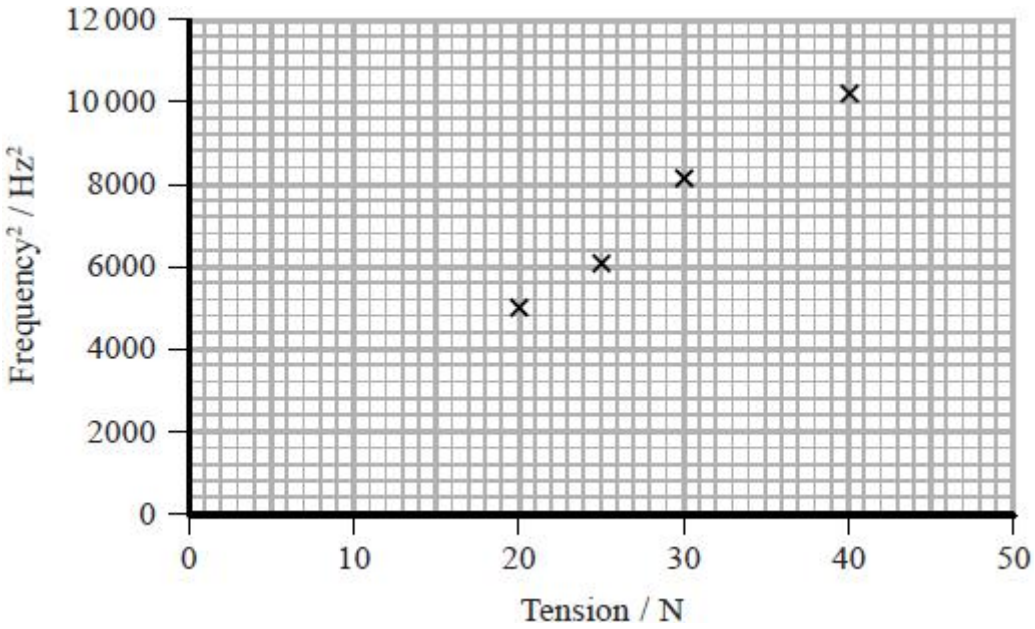
A student carries out an experiment using a guitar string. She investigates the effect of varying the tension in the guitar string on the frequency of sound produced when the string is plucked.

(a) The student records the following data and plots a graph.

Tension / N	20	25	30	35	40
Frequency / Hz	70	78	90	95	101
Frequency² / Hz²	4900	6084	8100		10 201

Complete the table and graph.

(3)



(b) The student reads that guitar strings have a mass per unit length of between 0.4×10^{-3} kg m^{-1} and 7×10^{-3} kg m^{-1}.

Determine whether the guitar string used in this experiment lies within this range.
length of string vibrating = 0.40 m

(5)

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(Total for question = 8 marks)

Q2.

Read the extract and answer the question that follows.

In the 17th century there were two proposed theories to explain the refraction of light. Using a wave model, Huygens stated that light slows down when it passes from air to water. Using a particle model, Newton stated that light speeds up when it passes from air to water. Newton's theory was more readily accepted until the speed of light in water was measured in the 19th century.

In the early 20th century, Einstein used observations from the photoelectric effect to provide evidence for the particle model of light.

Nowadays, both the wave model of light and the particle model of light are accepted, as each can be used to explain different aspects of the behaviour of light.

In the 1920s, experiments demonstrating diffraction of electrons confirmed de Broglie's work on the wave nature of particles.

In one such experiment an electron had a momentum of 4.8×10^{-24} kg m s^{-1}.
Measurements confirmed that the de Broglie wavelength of the electron was 1.40×10^{-10} m.

Deduce that these observations are consistent with the value of *h* given on the data sheet provided.

(3)

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(Total for question = 3 marks)

Q3.

(a) State what is meant by the de Broglie wavelength.

(2)

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(b) An electron is accelerated from rest, in a vacuum, through a potential difference of 500 V.

(i) Show that the final momentum of the electron is about 1×10^{-23} N s.

(3)

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(ii) Calculate the de Broglie wavelength for this electron.

(2)

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de Broglie wavelength = ...

(Total for question = 7 marks)