

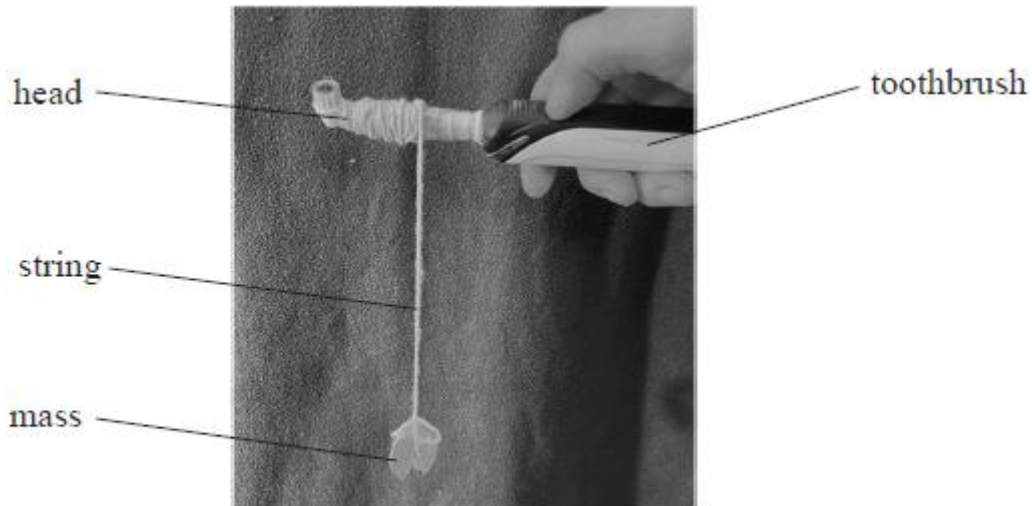
Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

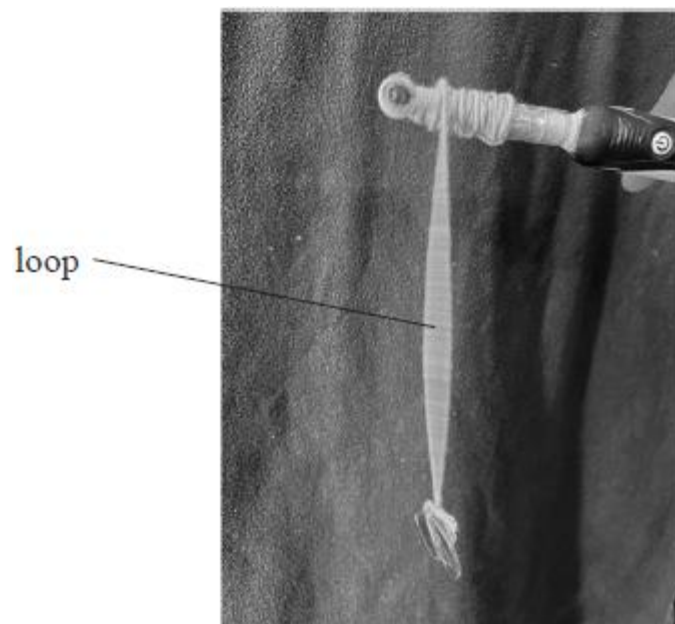
Q1.

A student wound a piece of string around the head of an electric toothbrush. The student attached a small mass to the other end of the string, as shown in Photograph 1.



Photograph 1

The toothbrush was switched on and the head started to vibrate. The student rotated the toothbrush slowly to unwind the string. At a particular length, large vibrations were observed on the string. The string formed a loop, as shown in Photograph 2.



Photograph 2

Explain how the vibrations of the toothbrush head caused the loop to form.

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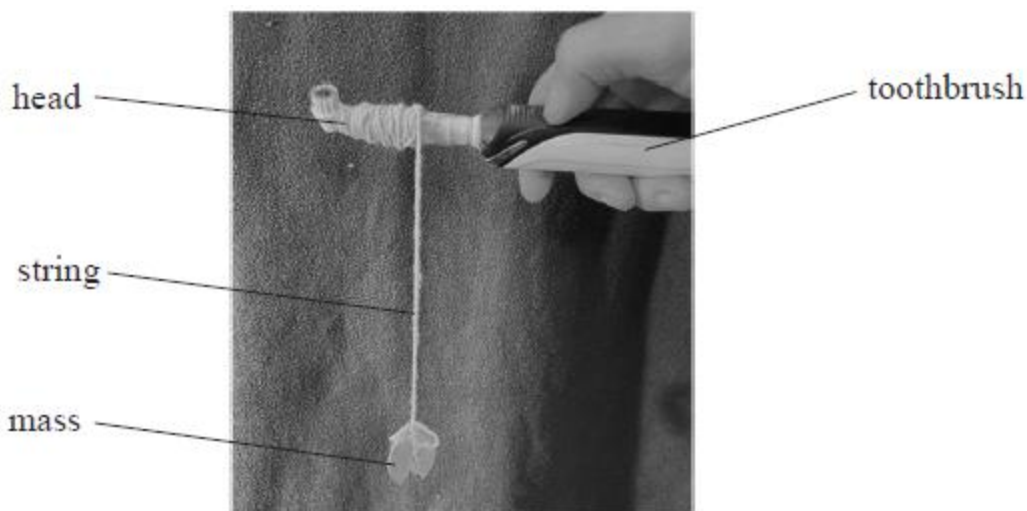
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(Total for question = 5 marks)

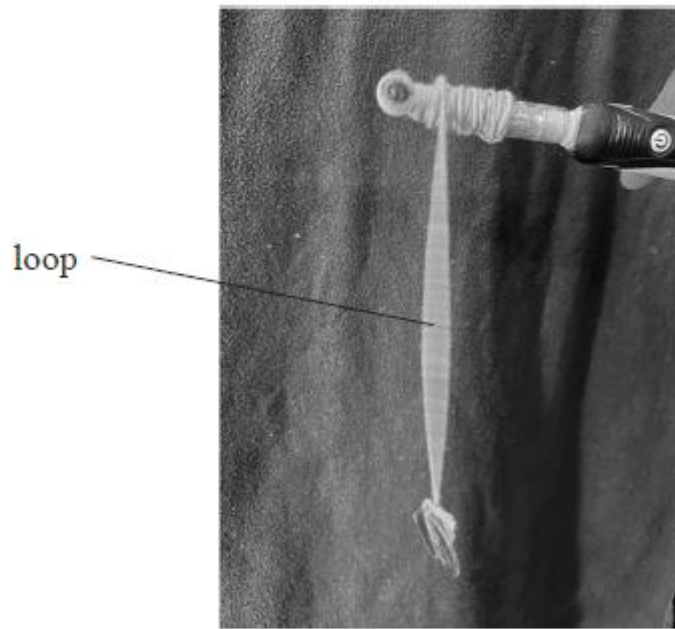
Q2.

A student wound a piece of string around the head of an electric toothbrush. The student attached a small mass to the other end of the string, as shown in Photograph 1.



Photograph 1

The toothbrush was switched on and the head started to vibrate. The student rotated the toothbrush slowly to unwind the string. At a particular length, large vibrations were observed on the string. The string formed a loop, as shown in Photograph 2.



Photograph 2

The student continued to unwind the string and the loop disappeared. When the length of the unwound string was twice that shown in Photograph 2 two loops were seen. Three loops were seen when the unwound length was three times that shown in Photograph 2 and so on.

Determine the frequency of vibration of the toothbrush head.

- unwound length of string with 4 loops = 0.69 m
- mass on string = 0.010 kg
- mass per unit length of string = $9.1 \times 10^{-4} \text{ kg m}^{-1}$

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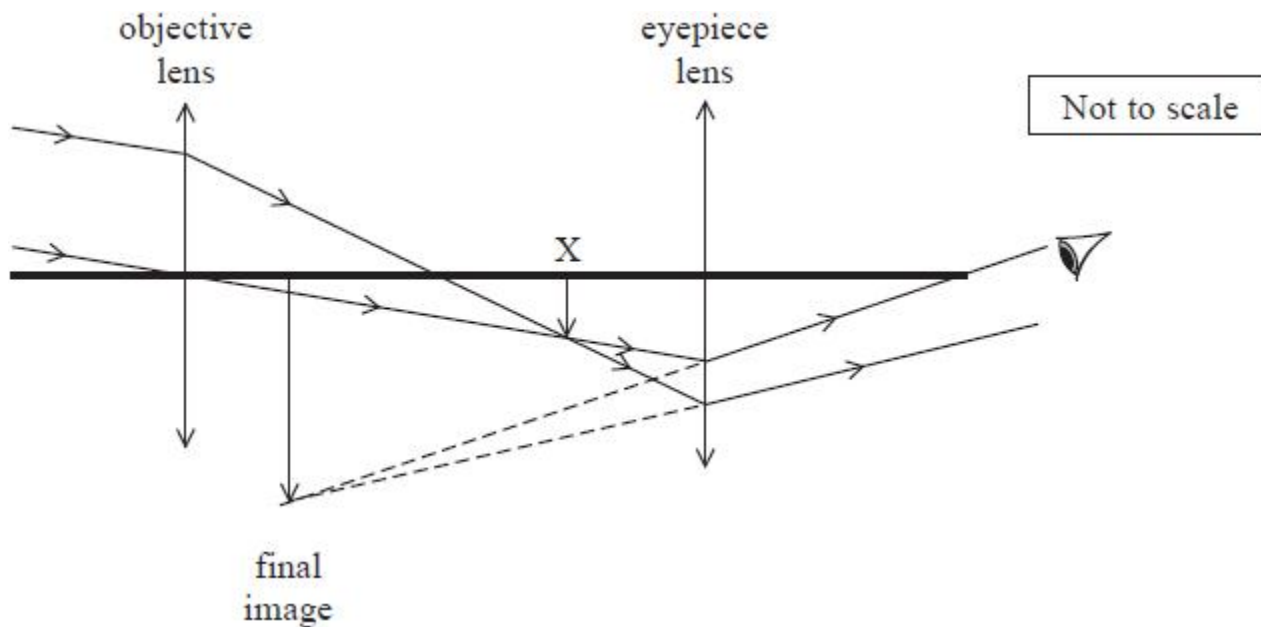
Frequency =

(Total for question = 5 marks)

Q3.

A telescope is used to produce a magnified image of a full Moon. The telescope consists of two converging

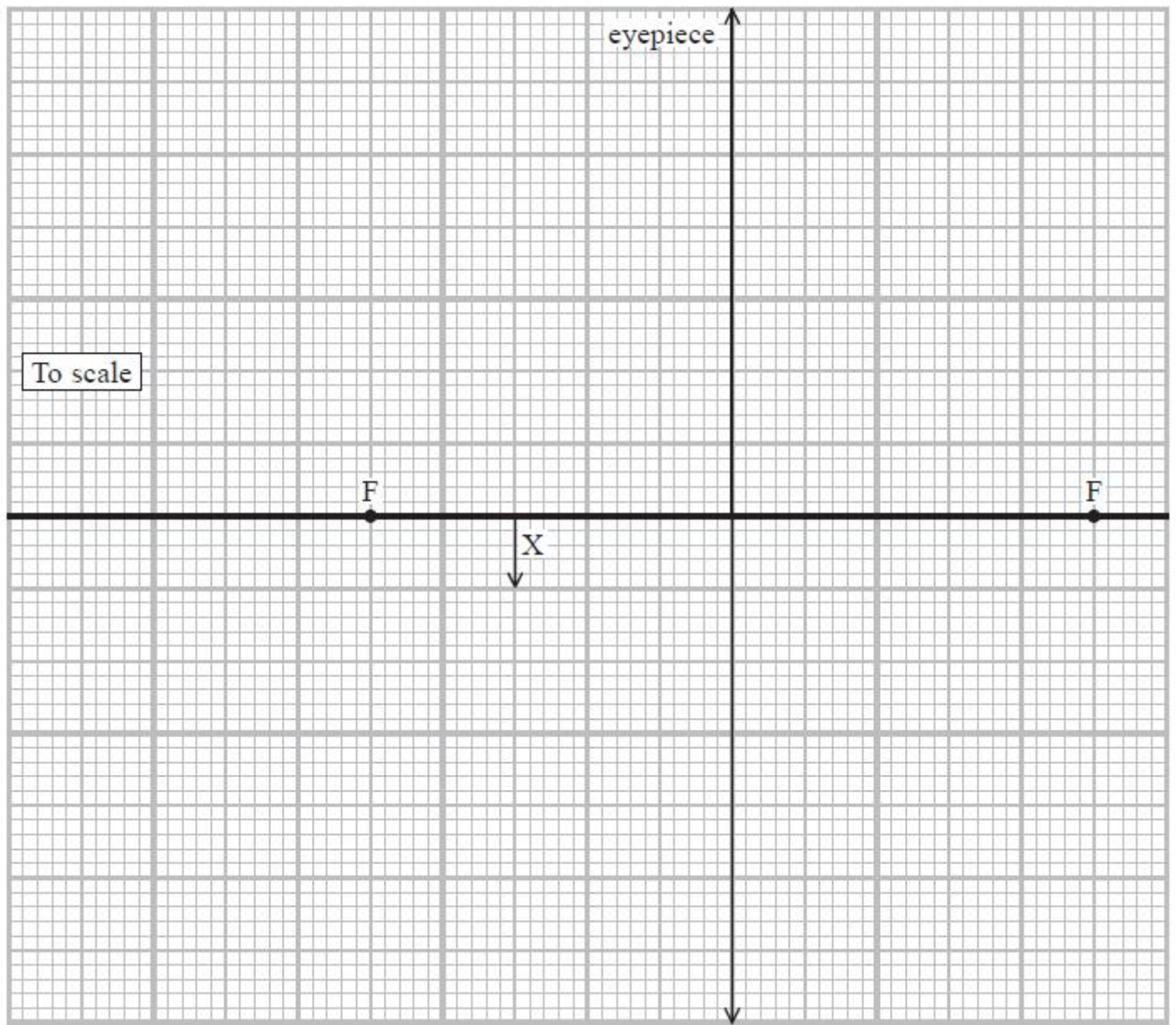
lenses, the objective lens and the eyepiece lens, as shown.



The objective lens produces an inverted image at point X. The image at point X is the object for the eyepiece lens. The eyepiece lens produces a magnified image.

Complete the ray diagram, to scale, to determine the magnification of the image formed by the eyepiece lens.

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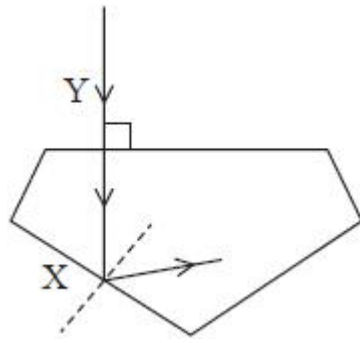
Magnification =

(Total for question = 4 marks)

Q4.

A jeweller inspects the quality of a diamond. She uses a converging lens to produce a magnified image of the diamond.

A ray of light enters the diamond along the normal at point Y as shown.



Not to scale

The ray is incident at the diamond-air interface at X with an angle of incidence equal to 40° .

Deduce whether the ray follows the path at X, as shown.

speed of light in diamond = $1.25 \times 10^8 \text{ m s}^{-1}$

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(Total for question = 4 marks)