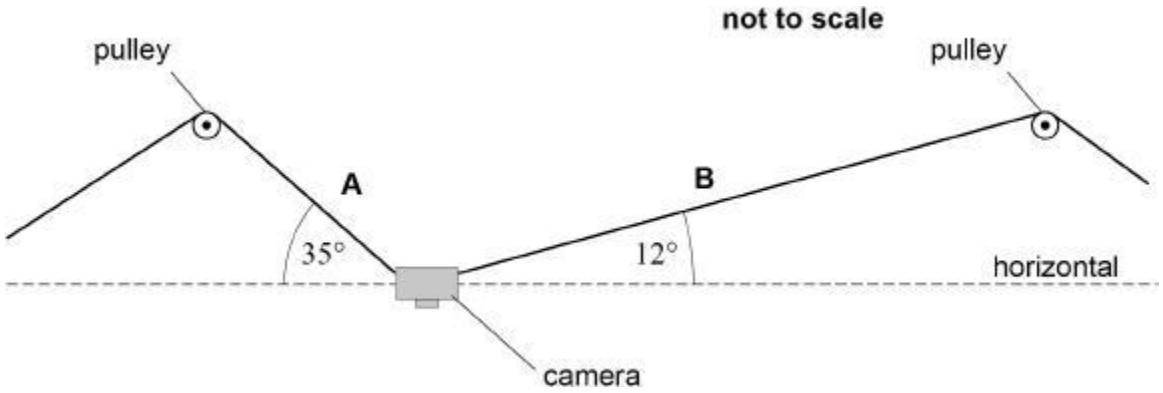
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

The diagram shows a camera filming a sports event from above. The position of the camera is controlled by two steel cables, **A** and **B**, that pass over fixed, smooth pulleys.



(a) In the diagram above the camera is stationary. The tension in **A** is 430 N and **A** makes an angle of 35° to the horizontal. **B** makes an angle of 12° to the horizontal.

Calculate the tension in **B**.

tension in **B** = _____ N

(2)

(b) The cross-sectional area of **A** is 7.0×10^{-6} m^2. The unstretched length of **A** is 150 m.

Calculate the extension of **A** when the tension in it is 430 N.

Young modulus of steel = 210 GPa

extension = _____ m

(2)

(c) The camera is moved horizontally to the right to a new stationary position. The tension in **A** is now different from that in the diagram above.

Deduce whether the tension in **A** has increased or decreased.

(3)

(d) The camera's signal is transmitted as a series of pulses through an optical fibre. The table shows data for two optical fibres **X** and **Y**. Both optical fibres are identical except for their core diameter.

Optical fibre	Core diameter / μm
X	8
Y	50

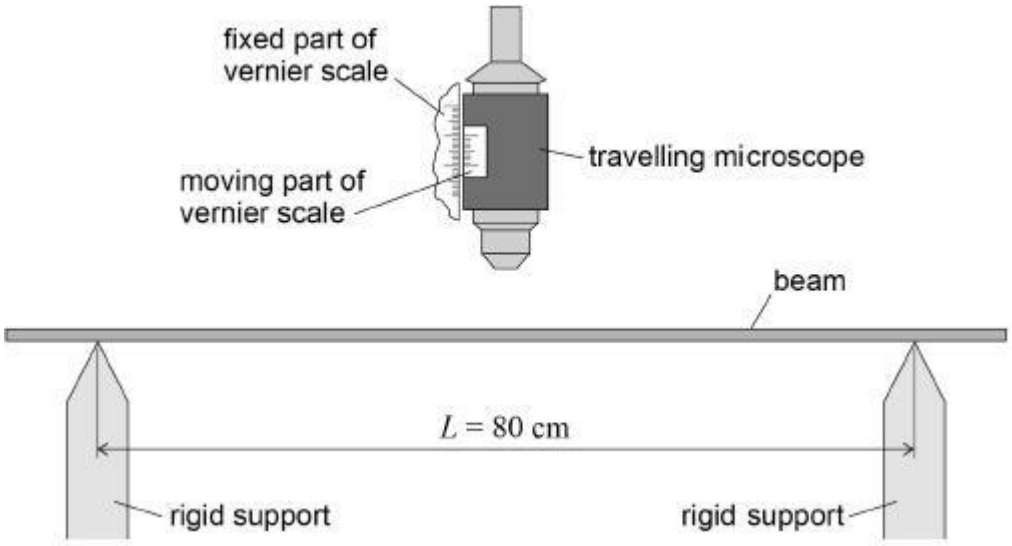
Deduce which fibre allows a greater pulse transmission rate.

(3)

Q2.

Figure 1 shows apparatus used to investigate the bending of a beam.

Figure 1

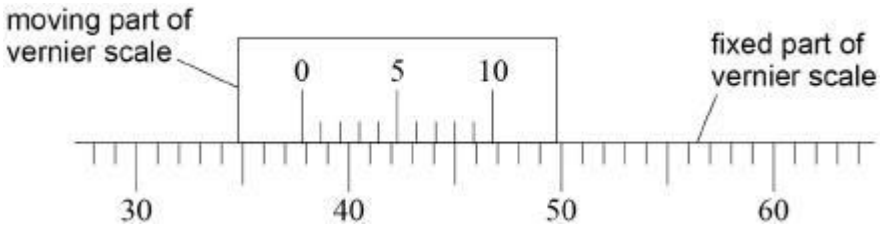


The beam is placed horizontally on rigid supports.
The distance L between the supports is 80 cm.

A travelling microscope is positioned above the midpoint of the beam and focused on the upper surface.

(a) **Figure 2** shows an enlarged view of both parts of the vernier scale.

Figure 2



The smallest division on the fixed part of the scale is 1 mm.

What is the value of the vernier reading R_0 in mm?
Tick (✓) **one** box.

34.8 ☐

37.8 ☐

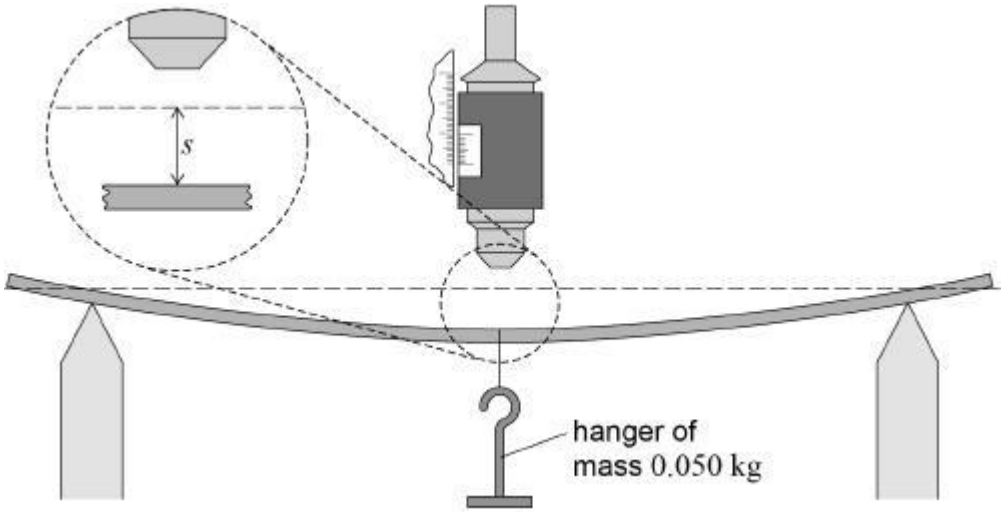
45.8 ☐

49.8 ☐

(1)

(b) **Figure 3** shows the beam bending when a hanger of mass 0.050 kg is suspended from the midpoint.

Figure 3



The microscope is refocused on the upper surface and the new vernier reading R is recorded.
The vertical deflection s of the beam is equal to $(R - R_0)$.

The total mass m suspended from the beam is increased in steps of 0.050 kg.
A value of s is recorded for each m up to a value of m = 0.450 kg.
Further values of s are then recorded as m is decreased in 0.050 kg steps until m is zero.

Student **A** performs the experiment and observes that values of s during unloading are **sometimes** different from the corresponding values for loading.

State the type of error that causes the differences student **A** observes.

_____

(1)

(c) Student **B** performs the experiment using a thinner beam but with the same width and made from the same material as before.

Discuss **one** possible advantage and **one** possible disadvantage of using the thinner beam.

Advantage _____

_____

_____

_____

_____

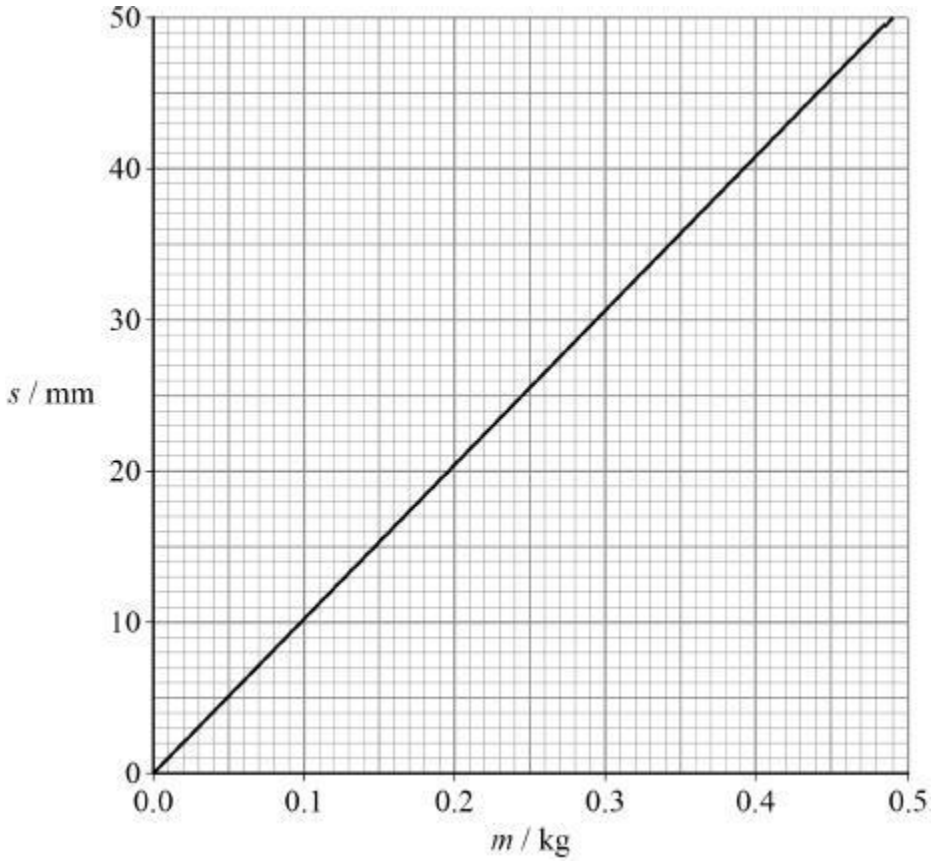
Disadvantage _____

_____

(3)

(d) **Figure 4** shows the best-fit line produced using the data collected by student **A**.

Figure 4



It can be shown that $s = \frac{\eta m}{E}$

where E is the Young modulus of the material of the beam and η is a constant.

Deduce in s^{-2} the order of magnitude of η.

E = 1.14 GPa

order of magnitude of η = _____ s^{-2}

(4)

(e) Student **C** performs a different experiment using the same apparatus shown in **Figure 1**.
A mass M is suspended from the midpoint of the beam.
The vertical deflection s of the beam is measured for different values of L.

Figure 5 shows a graph of the results for this experiment.

Figure 5

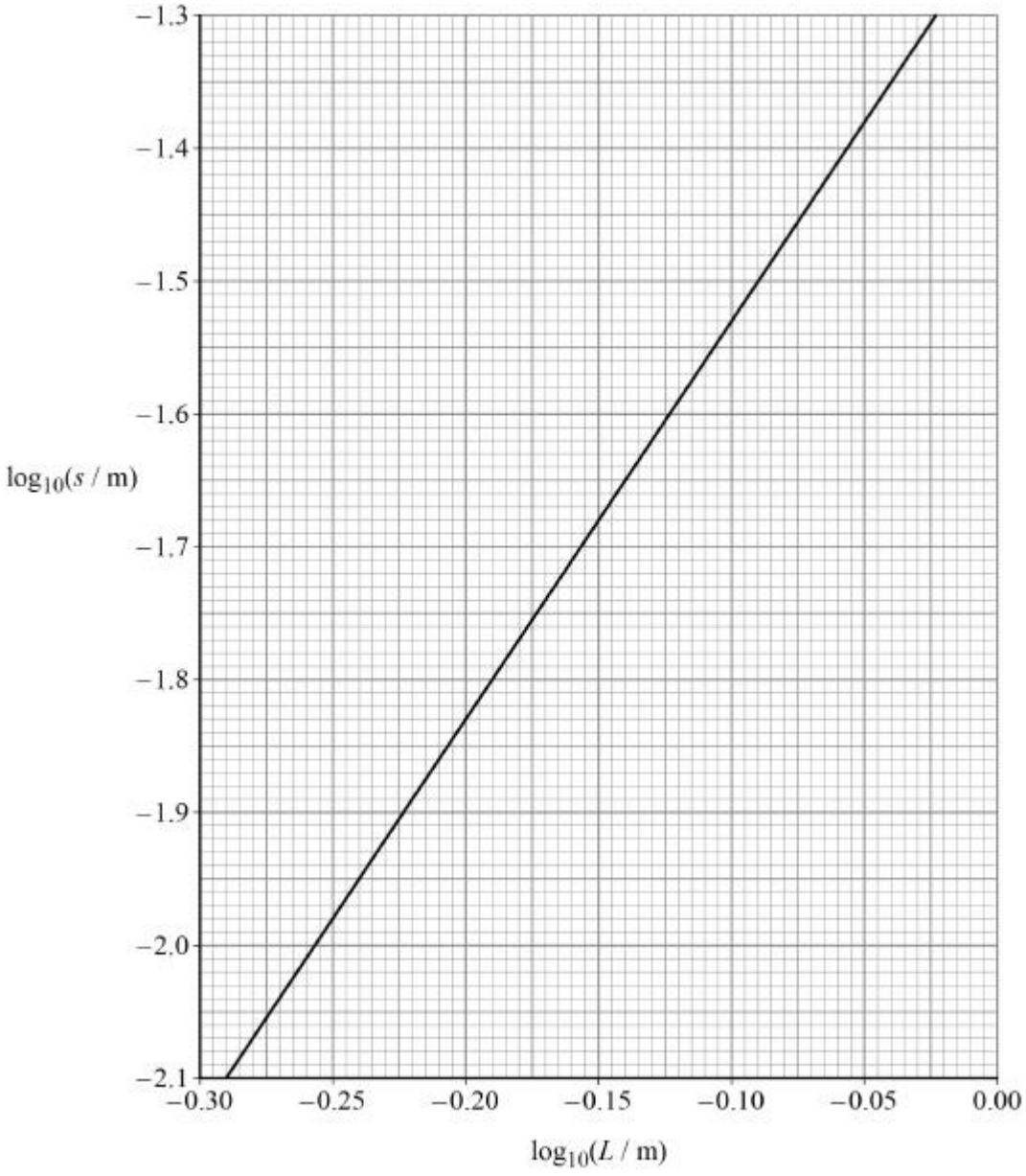


Figure 5 shows that log10(s / m) varies linearly with log10(L / m).

State what this shows about the mathematical relationship between s and L. You do **not** need to do a calculation.

_____

_____

_____

(1)

(f) Deduce, using **Figure 5**, the value of s when L = 80 cm.

s = _____ m

(2)

(g) Determine M using **Figure 4**.

M = _____ kg

(1)

(Total 13 marks)