Practice Question Set For A-Level
**Subject : Physics**
**Paper-1 Topic: Waves**

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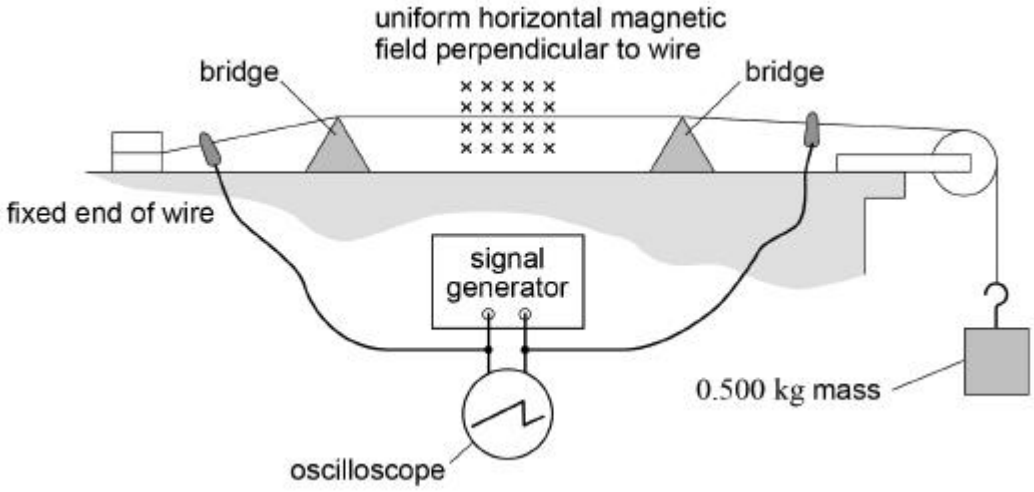
**Name of the Student**:_____
**Max. Marks : 21 Marks** **Time : 21 Minutes**

## Q1.

A stationary wave is formed on a stretched wire.

**Figure 1** shows the wire, fixed at one end, supported by two bridges and passing over a pulley.

**Figure 1**

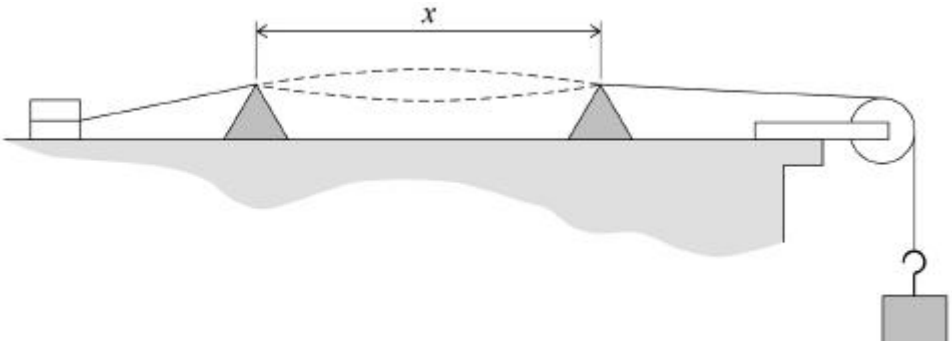



A 0.500 kg mass is attached to the free end of the wire.
A uniform horizontal magnetic field is applied perpendicular to the wire between the bridges.
A signal generator is connected to each end of the wire.

The oscilloscope shown is used to determine the frequency of the output of the signal generator. The wire oscillates because the alternating current in the wire interacts with the magnetic field.

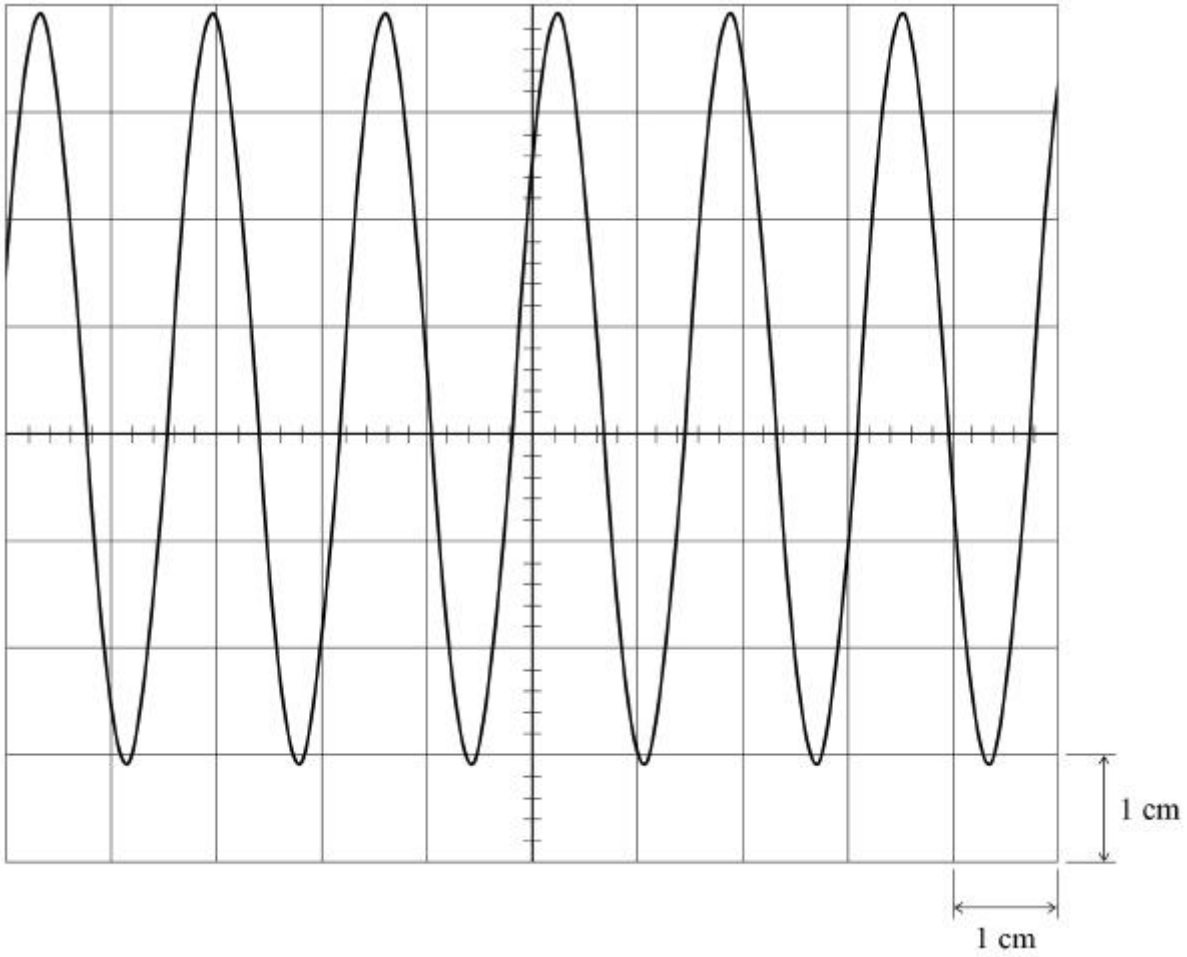
**Figure 2** shows the first harmonic stationary wave produced when the distance $x$ between the bridges is adjusted.

**Figure 2**




(a) The output potential difference (pd) of the signal generator is displayed on the oscilloscope, as shown in **Figure 3**.

**Figure 3**




The time-base setting of the oscilloscope is 10 ms $cm^{-1}$.

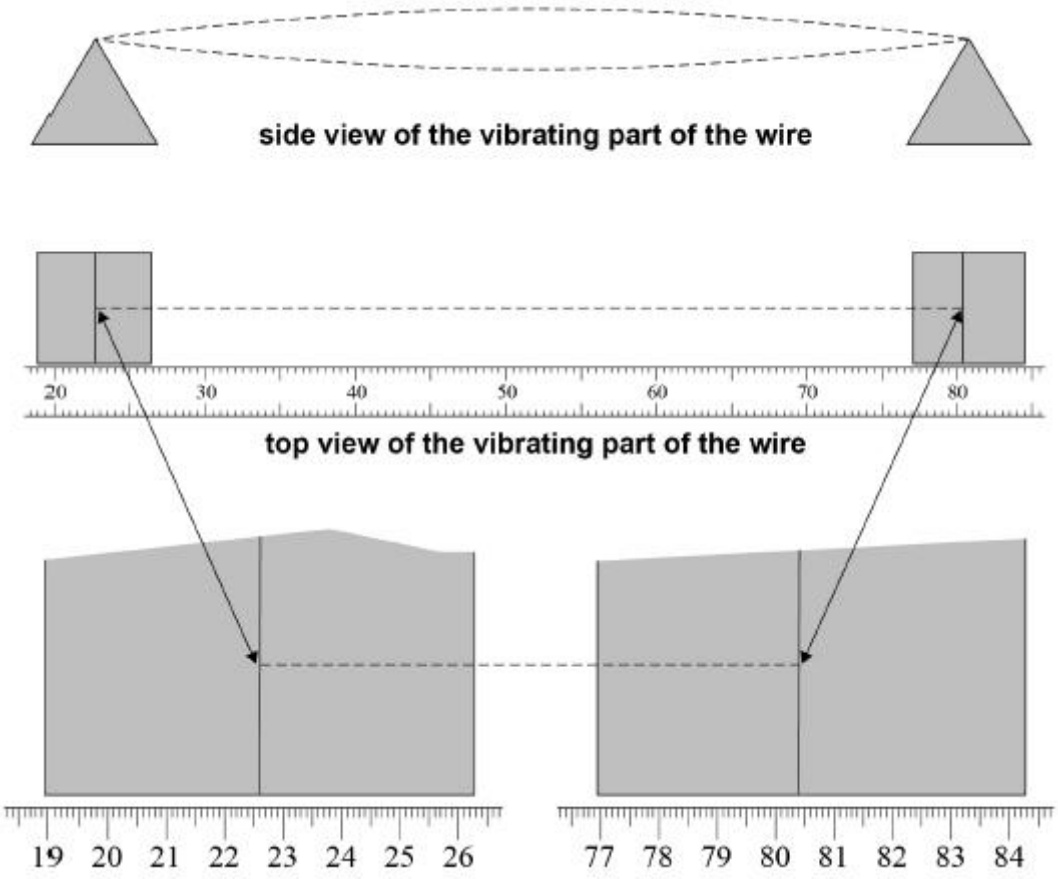
Determine $f$, the frequency of the alternating pd.

$f$ = _____ Hz

**(2)**

(b) A metre ruler is placed next to the bridges supporting the wire, as shown in **Figure 4**.

**Figure 4**




Determine the wavelength of the stationary wave shown in **Figure 4**.

$\lambda$ = _____ m

**(2)**

(c) The stationary wave is formed by two waves of frequency $f$ and wavelength travelling $\lambda$ with speed $c$ in opposite directions.

Determine $c$.

$c$ = _____ m s$^{-1}$

**(1)**

(d) Determine, in kg m$^{-1}$, the mass per unit length of the wire.

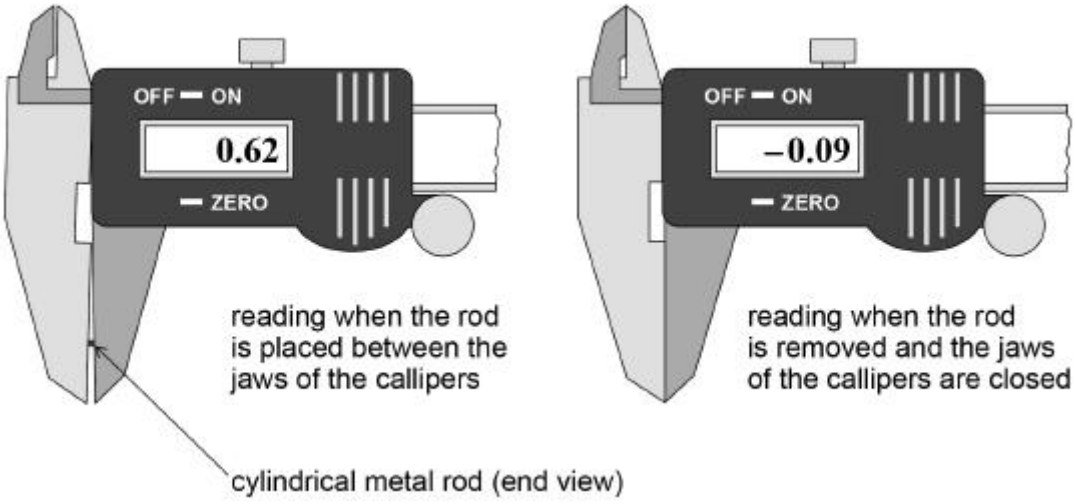
mass per unit length = _____ kg $m^{-1}$

**(2)**

(e) A student uses digital vernier callipers to measure the diameter of a cylindrical metal rod. The student places the rod between the jaws of the callipers and records the reading indicated. Without pressing the zero button, the student removes the rod and closes the jaws.

**Figure 5** shows the calliper readings in millimetres, before and after the jaws are closed.

**Figure 5**




Calculate the diameter $d$ of the rod.

$d$ = _____ mm

**(1)**

(f) Describe relevant procedures to limit the effect of random error in the result for $d$.

_____

_____

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**(2)**

(g) Determine the density of the rod.
The mass per unit length of the rod is $3.54 \times 10^{-3}$ kg m$^{-1}$.

density = _____ kg m$^{-3}$

**(3)**

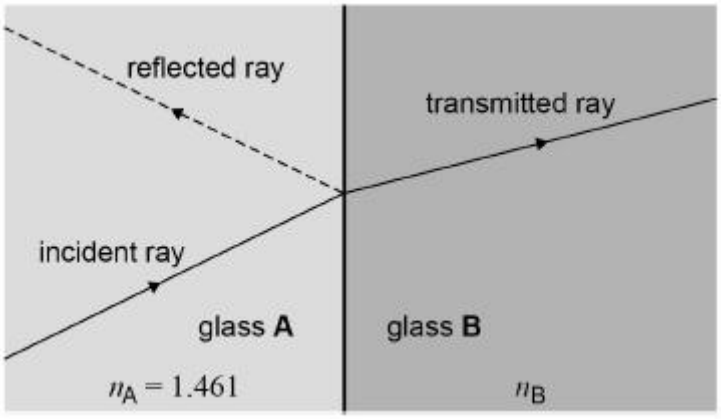
**(Total 13 marks)**

## Q2.

(a) **Figure 1** shows an incident ray of light being partially reflected at the boundary between glass **A** and glass **B**. The refractive index $n_A$ of glass **A** is 1.461

The speed of light in glass **B** is 3.252% less than the speed of light in glass **A**.

**Figure 1**




Calculate the refractive index $n_B$ of glass **B**.

Give your answer to an appropriate number of significant figures.

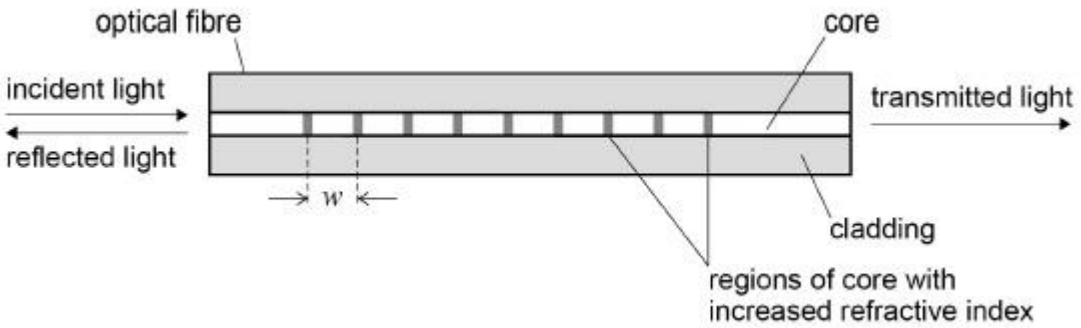
speed of light in a vacuum = $2.998 \times 10^8$ m s$^{-1}$

$n_B$ = _____

**(3)**

(b) **Figure 2** shows a cross-sectional view of an optical fibre strain gauge.

**Figure 2**

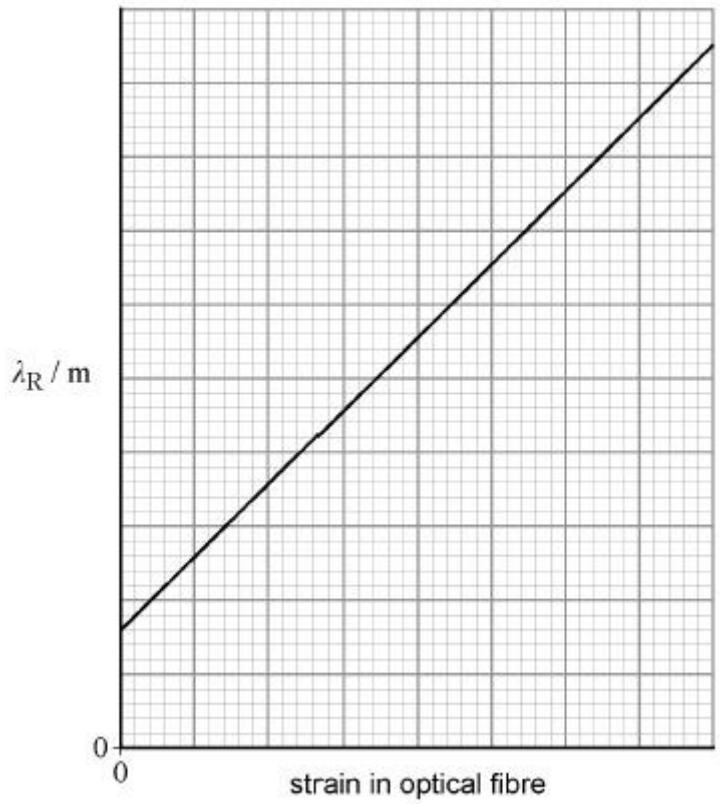



A maximum intensity of the reflected light is produced due to superposition of the light reflected from each of the regions with increased refractive index in the core.

This maximum intensity occurs at a particular wavelength $\lambda_R$.

**Figure 3** shows the relationship between $\lambda_R$ and the strain in the optical fibre.

**Figure 3**




A cable is used to raise and lower a lift. An engineer fixes the optical fibre strain gauge to the cable to monitor changes of the strain in the cable.

The lift is initially at rest and then accelerates downwards for a short time before reaching a constant velocity.

Discuss how the value of $\lambda_R$ changes.

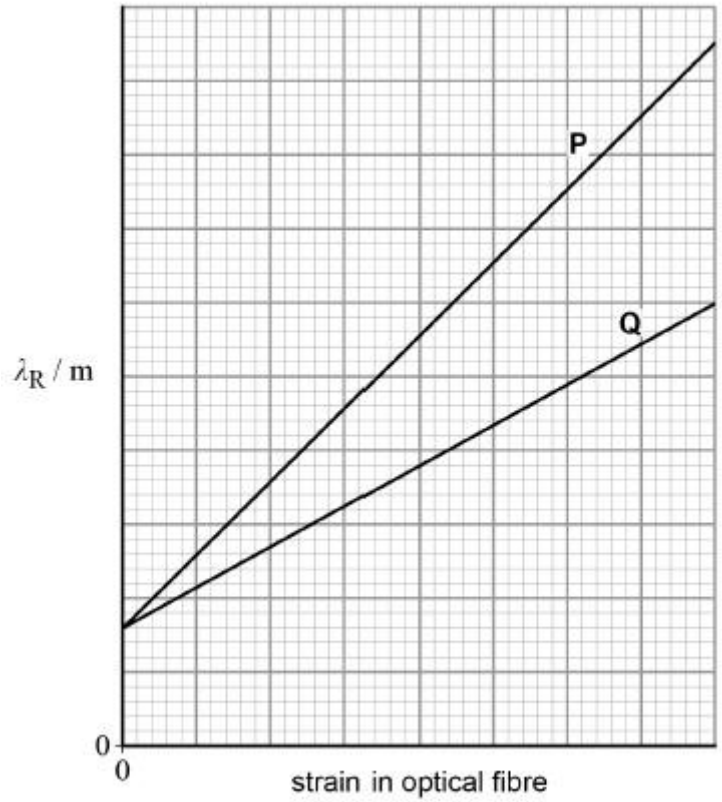
_____

_____

**(3)**

(c) **Figure 4** shows the relationship between $\lambda_R$ and the strain in two optical fibre strain gauges **P** and **Q**. The engineer wishes to measure small accelerations in another lift. She can choose to fix either optical fibre strain gauge **P** or optical fibre strain gauge **Q** to the lift's cable.

**Figure 4**




Explain which gauge the engineer should select.

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**(2)**
**(Total 8 marks)**