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

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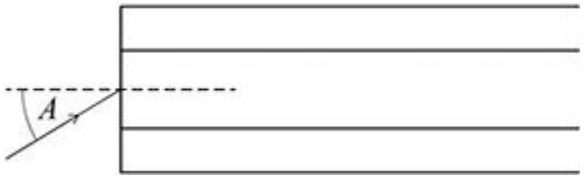
Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Q1.

Figure 1 shows a ray of monochromatic light incident at angle A from air onto the end of a straight optical fibre.

This ray undergoes total internal reflection at the core−cladding boundary. A ray that enters the optical fibre at an angle greater than A will only be partially reflected at the core−cladding boundary.

Figure 1



The table below shows some properties of the optical fibre.

	Refractive index
cladding	1.41
core	1.47

(a) Calculate the speed of the light ray in the optical fibre.

speed = _____ m s^{-1}

(1)

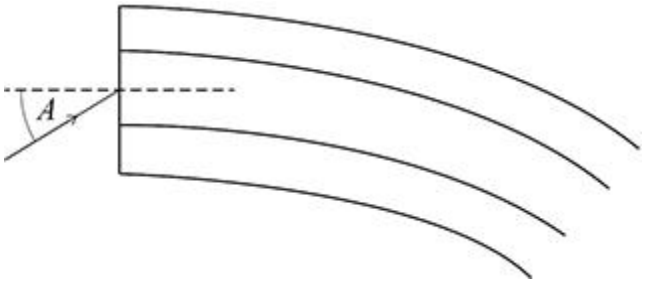
(b) Calculate A, in degrees, for the optical fibre shown in **Figure 1**.

A = _____ degrees

(3)

(c) A ray is incident on the optical fibre at angle A. The optical fibre is now bent, as shown in **Figure 2**.

Figure 2



Draw, on **Figure 2**, what happens to the ray within the optical fibre. Explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

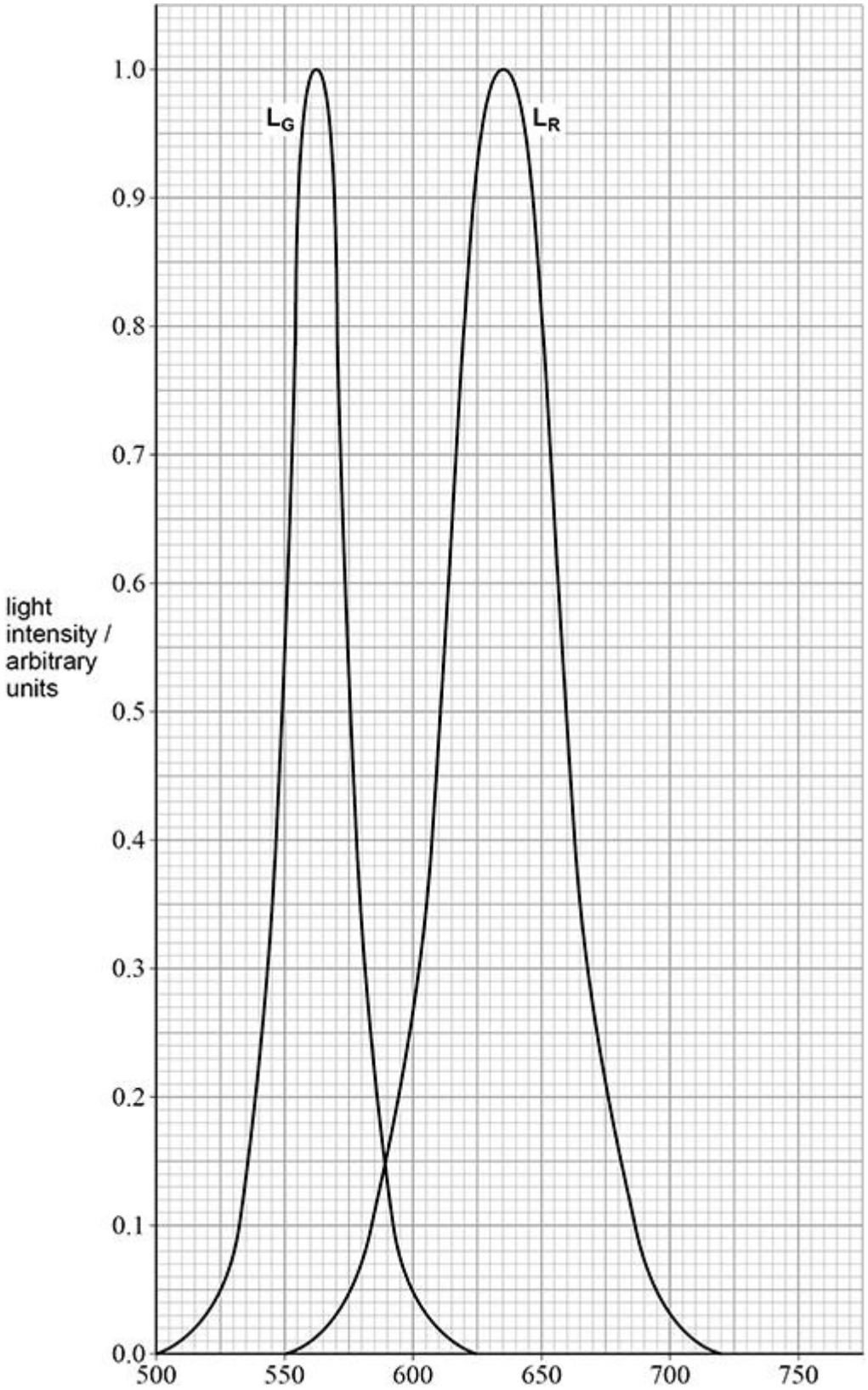
Q2.

A light-emitting diode (LED) emits light over a narrow range of wavelengths.
These wavelengths are distributed about a peak wavelength λ_p.

Two LEDs $\mathbf{L_G}$ and $\mathbf{L_R}$ are adjusted to give the same maximum light intensity.
$\mathbf{L_G}$ emits green light and $\mathbf{L_R}$ emits red light.

Figure 1 shows how the light output of the LEDs varies with the wavelength λ.

Figure 1



(a) Light from **L_R** is incident normally on a plane diffraction grating.
The fifth-order maximum for light of wavelength λ_p occurs at a diffraction angle of 76.3°.

Determine N, the number of lines per metre on the grating.

N = _____ m^{-1}

(3)

(b) Suggest **one** possible disadvantage of using the fifth-order maximum to determine N.

_____

_____

_____

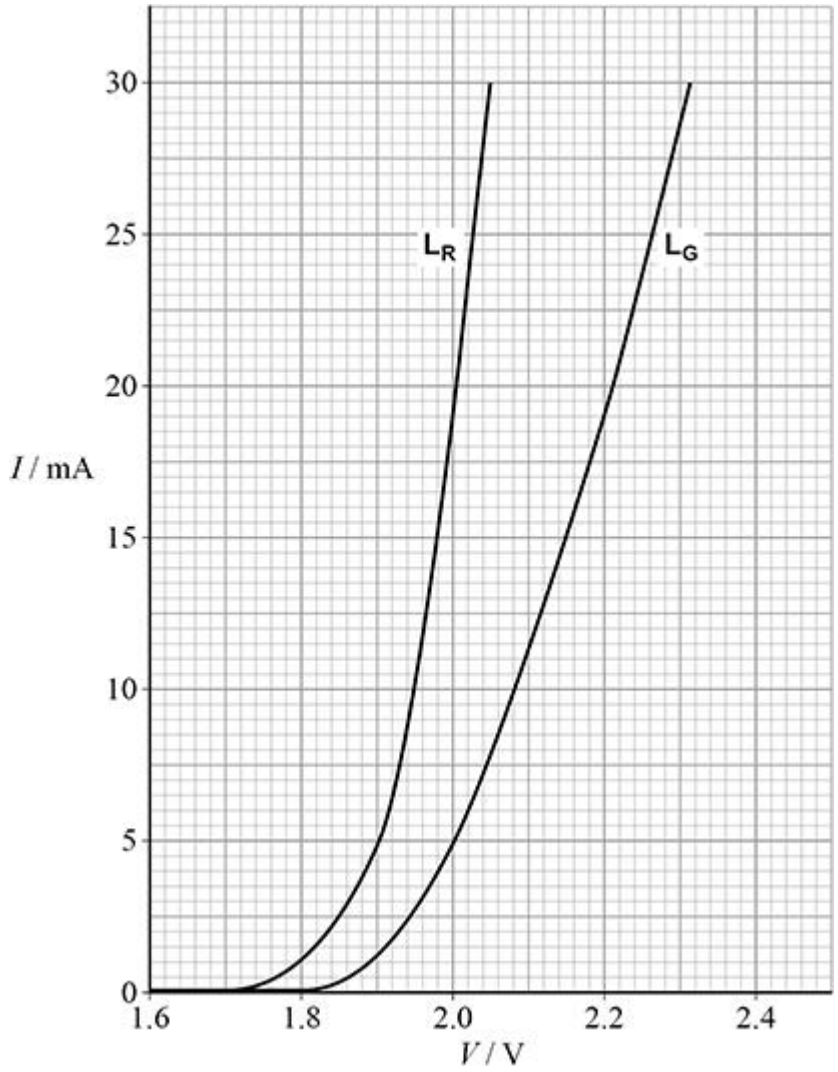
_____

_____

(1)

(c) **Figure 2** shows part of the current−voltage characteristics for $\mathbf{L_R}$ and $\mathbf{L_G}$.

Figure 2



When the linear part of the characteristic is extrapolated, the point at which it meets the horizontal axis gives the activation voltage V_A for the LED.
V_A for $\mathbf{L_G}$ is 2.00 V.

Determine, using **Figure 2**, V_A for $\mathbf{L_R}$.

V_A for $\mathbf{L_R}$ = _____ V

(2)

(d) It can be shown that:

$$V_A = \frac{hc}{e\lambda_p}$$

where h = the Planck constant.

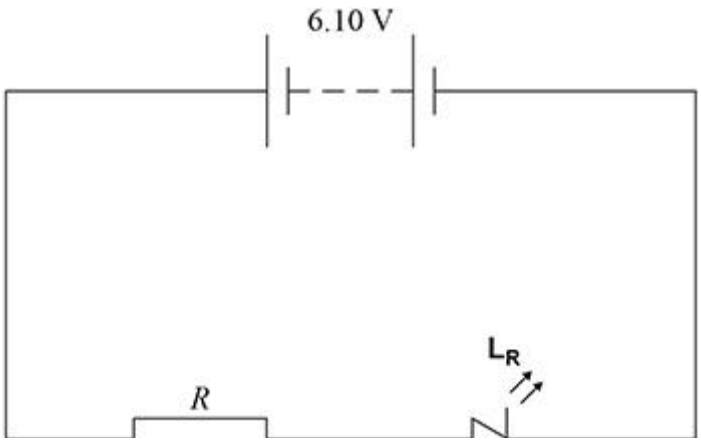
Deduce a value for the Planck constant based on the data given about the LEDs.

h = _____ J s

(2)

(e) **Figure 3** shows a circuit with $\mathbf{L_R}$ connected to a resistor of resistance R.

Figure 3



The power supply has emf 6.10 V and negligible internal resistance.
The current in $\mathbf{L_R}$ must not exceed 21.0 mA.

Deduce the minimum value of R.

minimum value of R = _____ Ω

(2)

(Total 10 marks)