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

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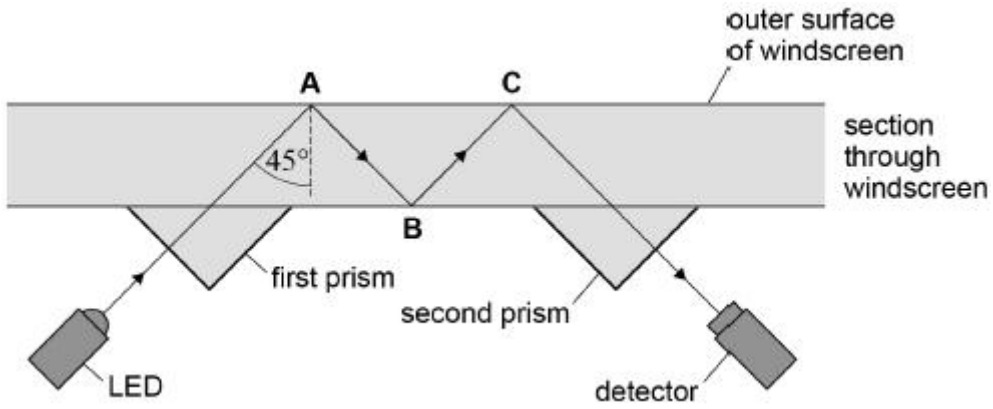
Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Q1.

Some cars are fitted with a water sensor designed to switch on windscreen wipers automatically when it rains. **Figure 1** shows a simplified diagram of the sensor.

Figure 1



A light ray travels from the light-emitting diode (LED) through the first prism and into the windscreen. The ray reflects off the surfaces of the windscreen at **A**, **B** and **C** and then passes through the second prism into the detector.

(a) Suggest how the design ensures that there is no deviation of the ray as it enters the first prism.

_____

_____

(1)

(b) Suggest **two** features of the design that ensure that there is no deviation of the ray as it leaves the first prism and enters the windscreen glass.

1 _____

_____

2 _____

_____

(2)

(c) The refractive index of the windscreen glass is 1.52

Explain why the ray follows the path shown inside the windscreen glass in **Figure 1**.

Support your answer with a suitable calculation.

_____

_____

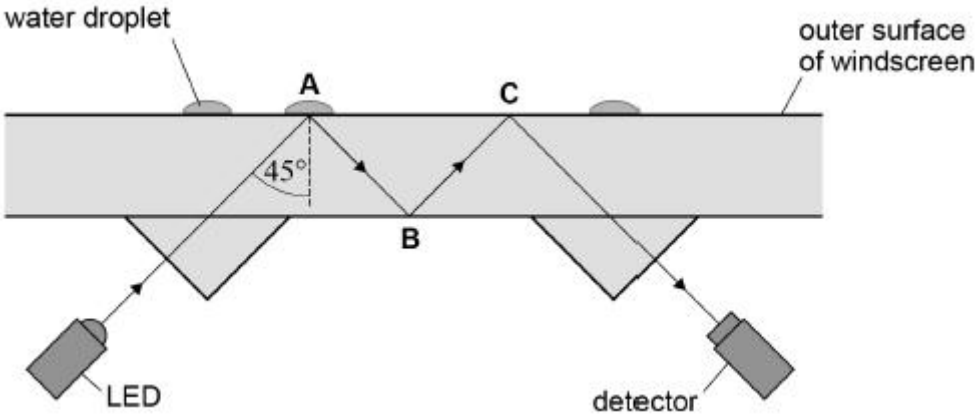
_____

_____

(2)

(d) When it starts to rain, water droplets form on the outside of the windscreen as shown in **Figure 2**.

Figure 2



The refractive index of water is 1.33

Explain why the presence of water at **A** causes the intensity of the light at the detector to decrease.

Support your answer with a suitable calculation.

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(2)

(e) The refractive index of the windscreen glass can vary by a few per cent across the thickness of

the glass.

Discuss how this variation may affect the path of the ray through the windscreen glass.

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_____

(2)

(f) A different design has the LED and the detector further apart. The ray undergoes more reflections inside the windscreen glass before reaching the detector.

Discuss **two** ways in which this different design affects the sensitivity of the sensor to the presence of water droplets.

1 _____

_____

_____

_____

2 _____

_____

_____

_____

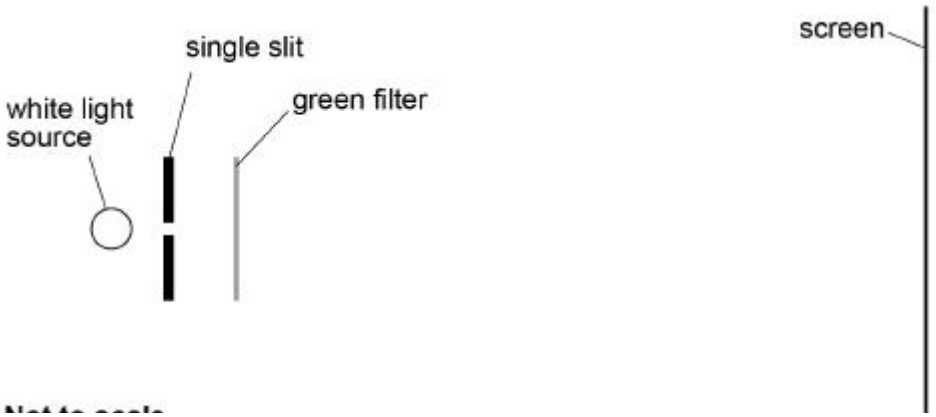
(2)

(Total 11 marks)

Q2.

Figure 1 shows an arrangement to investigate diffraction. White light is incident on a single slit. After leaving the slit, the diffracted light passes through a green filter to reach the screen.

Figure 1



(a) Describe the pattern produced on the screen.

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_____

_____

_____

(2)

(b) The green filter is replaced with a red filter.

Describe the change in the pattern produced on the screen.

_____

_____

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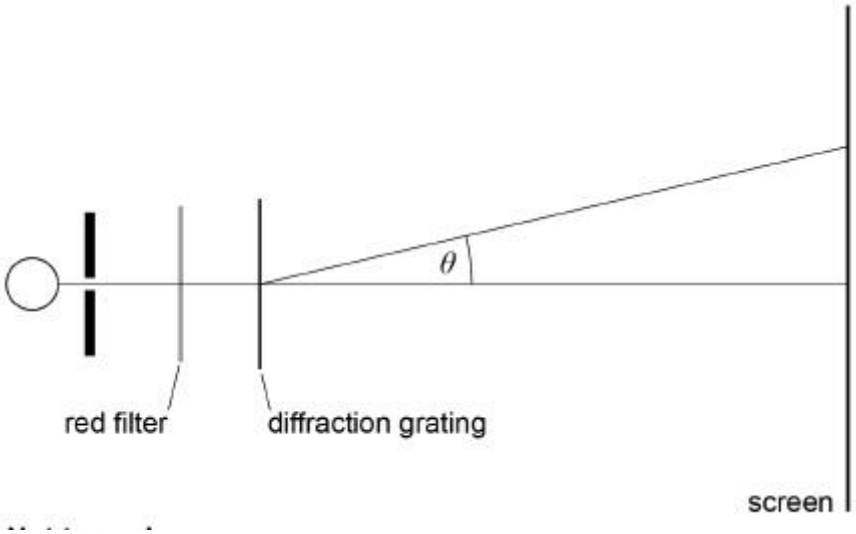
_____

(2)

(c) A diffraction grating is placed between the red filter and the screen. The diffraction grating has 500 lines per millimetre. Light is incident normally on the grating. **Figure 2** shows the arrangement.

Figure 2



The wavelength of the red light is 650 nm.

Calculate the angle θ between a first-order maximum and the central maximum.

θ _____ degrees

(2)

(d) In practice, the filter transmits red light with wavelengths in the range 600 nm to 700 nm.

Suggest how this affects the appearance of the maxima.

_____

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_____

_____

_____

(2)

(Total 8 marks)