**Q1.** Part of a data sheet for a PIN photodiode intended for an optical fibre communication system is shown below.

Reverse leakage dark current	max 5nA
Sensitivity (reverse current caused by light)	0.6 A/W
Capacitance (at zero bias)	10 pF
Response time (to 95% amplitude)	5 ns

(a)   The PIN photodiode is used in the following circuit which converts an optical signal travelling along a fibre into an electrical signal.
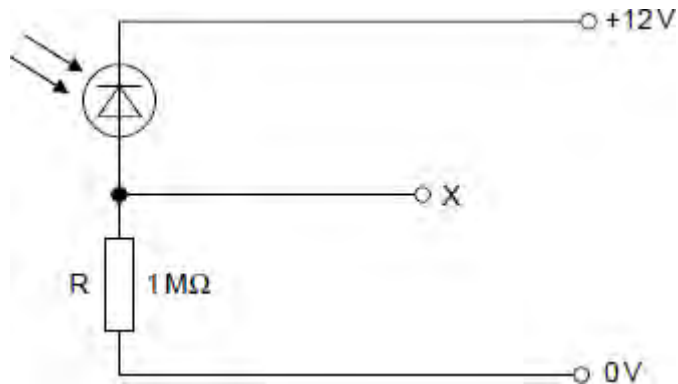
(i)   In what bias direction is the photodiode connected?

....

(1)

(ii)   Calculate the maximum voltage at X that exists when the photodiode is in the dark.

....

....

(2)

(iii)   Sensitivity is the reverse current caused by the light power that hits the active area of the device.

Calculate the current through the photodiode and then the voltage at X when light of power 1μW hits the active area of the photodiode.

Current ....

....

Voltage at X ....

....

(3)

(iv) Calculate the time constant of the circuit assuming the photodiode acts as a simple capacitor.

....

....

(2)

(v) Suggest a reason why the response time of the photodiode given in the datasheet is much less than the value you have calculated in part (iv).

....

....

(1)

(vi) The output voltage at X is low even when an optical signal is present. Suggest **two** ways of increasing the output voltage.

....

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(2)

(b) The power of the optical signal received at the photodiode, after passing through the optical fibre, is found to be less than the transmitted power.

Describe and explain **two** possible causes of this.

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(5)
(Total 16 marks)

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