



## PHYSICS

### BOOKS - PRADEEP PHYSICS (HINGLISH)

#### COMMUNICATION SYSTEMS

##### Solved Examples

1. Show that the minimum length of antenna required to transmit a radio signal of frequency 10 MHz is 7.5m.

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2. An audio signal of amplitude 0.1 V is used in amplitude modulation of a carrier wave of amplitude 0.2 V. Calculate the modulation index.



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3. An audio signal of 2.8 kHz modulates a carrier of frequency deviation of 56 kHz. Calculate.

(i) frequency modulation index (ii) frequency range of FM wave.



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4. In a diode AM detector, the output circuit consists of  $R = 1k\Omega$  and  $C = 10pF$ . A carrier signal of 100 kHz is to be detected. Is it good? If yes, then explain why? If not, what value of C would you suggest ?



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5. What should be the height of transmitting antenna if the T.V. telecast is to cover a radius of 128 km?  $R_e = 6.4 \times 10^6 m$ . If the average population density around the tower is  $1000 / km^2$ , how much population is covered?



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6. Can you think of any challenges before the telecommunications today?



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7. Have you ever heard of mobile malware?



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8. Calculate the length of half wave dipole antenna at (a)  $30\text{MHz}$  (b)  $300\text{MHz}$  (c)  $3000\text{MHz}$ . What interference do you draw from these results?



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9. What is the length of Marconi antenna for a transmission frequency of 15 MHz?



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10. The length of Marconi antenna at a place is  $1.5m$ . What is the optimum transmission frequency?



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11. What should be the length of the dipole antenna for a carrier wave of frequency  $3 \times 10^8 Hz$ ?



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12. The maximum peak to peak voltage of an AM wave is 16 m V and the minimum peak to peak voltage is 8 m V. What is the modulation index ?



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13. A modulated carrier wave has maximum and minimum amplitudes of 800 m v and 200 m V. What is the percentage modulation?

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14. A sinusoidal carrier voltage of frequency 1200 kHz is amplitude modulated by a sinusoidal voltage of frequency 20 kHz. The maximum and minimum modulated carrier amplitudes of 100 V and 90 V are produced. Calculate the frequency of lower and upper side bands, unmodulated carrier amplitude, modulation index and amplitude of each side band.

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15. An audio signal of 15000 Hz modulate a carrier generated by a tank circuit containing 1 nF capacitor and 10 microhenry inductor. Calculate the frequencies of first pair of side bands.



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**16.** A broadcast AM transmitted radiates 50 KW of carries power. What will be the radiated power at 85 % modulation



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**17.** A message signal of frequency 10 kHz and peak voltage 10 volt is used to modulate a carrier of frequency 1 MHz and peak voltage 20 volt. Determine (a) modulation index (b) the side bands produced.



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**18.** Calculate modulation index of an FM signal in which modulating frequency is 2 k Hz and maximum deviation is 10 k Hz.



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**19.** In a detector, output circuit consists of  $R = 10k\Omega$  and  $C = 100pF$ .

Calculate the frequency of carrier signal it can detect.



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**20.** A message signal of frequency 10 kHz and peak voltage 10 volt is used to modulate a carrier of frequency 0.5 MHz and peak voltage 100 volt.

Determine (i) modulation index (ii) the side bands produced.



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**21.** An audio signal of 12 kHz modulates a carrier generated by a tank circuit containing 100 microhenry inductor and 100 pF capacitor.

Calculate the frequency of first pair of side bands.



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**22.** Frequencies higher than 10 Mhz are found not to be reflected by the ionosphere on a particular day at a place. Calculate the maximum electron density of the ionosphere.



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**23.** On a particular day, the maximum frequency reflected from the ionosphere is 10 MHz. On another day, it was found to increase to 11 MHz. Calculate the ratio of the maximum electron densities of the ionosphere on the two days. Point out a plausible explanation for this.



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**24.** A ground receiver station is receiving a signal at (a) 6.0 MHz and (b) 110 MHz, transmitted from ground transmitter at a height of 300 m located at a distance of 100 km. Identify whether it is coming via space wave or sky wave propagation or satellite transponder. Radius of earth

$= 6.4 \times 10^6 m$ , maximum number density of electrons in ionosphere =  $10^{12} m^{-3}$ .



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**25.** Calculate the values of relative permittivity of E and F regions of the ionosphere in the case of an electromagnetic wave of frequency 50 MHz. Given electron density for E and F regions is  $10^{11} m^{-3}$  and  $8 \times 10^{11} m^{-3}$  respectively.



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**26.** What is the value of frequency at which an e.m. wave must be propagated for the D - region to have a refractive index of 0.49 ? Electron density for D-layer is  $10^9 m^{-3}$ .



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**27.** A TV transmitting antenna is 125 m tall. How much service area this transmitting antenna cover, if the receiving antenna is at the ground level? Radius of earth =  $6400\text{km}$ .



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**28.** A T. V. tower has a height of 100 m. How much population is covered by the T.V. broadcast if the average population density around the tower is  $1500\text{ km}^{-2}$  ? (Radius of earth =  $6.37 \times 10^6\text{m}$ .)



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**29.** A TV tower has a height of 500 m at a given place. Calculate the coverage range, if the radius of the earth is 6400 km.



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**30.** By what percentage will the transmission range of a T.V. tower be affected when the height of the tower is increased by 21% ?



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**31.** A transmitting antenna at the top of a tower has a height 32 m and that of the receiving antenna is 50 m. What is the maximum distance between them for satisfactory communication in line of sight mode ? Given radius of earth is  $6.4 \times 10^6 m$ .



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**32.** What is the carrier wave? Why high frequency carrier waves are employed for transmission?



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**33.** How do you express amplitude, frequency and phase modulation?



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**34.** What are the band widths of an A.M. radio station and an FM radio station?



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**35.** What is meant by sensitivity of a radio receiver?



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**36.** What is meant by selectivity of a radio receiver?



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37. Why do we need a higher bandwidth for transmission of music compared to that for commercial telephone communication?



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38. An audio signal of frequency  $\nu_a$  is to be transmitted as an electromagnetic wave (i) directly as such (ii) through its use as modulating signal on a carrier wave of frequency  $\nu_c$ . State the ratio of the size of antenna that can properly sense the time variation of the signal.



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39. What is the modulation index for an AM wave for which maximum amplitude is  $a$  and the minimum amplitude is  $b$ .



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**40.** What is the function of repeater in a communication system?



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**41.** Why is modulation necessary at all ?



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**42.** What is meant by channel and channel noise?



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**43.** What are the band widths of an A.M. radio station?



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**44.** What is full form of AGC ? Where is it used?



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**45.** Where do we use amplitude limiters ?



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**46.** What is the basic difference between an analog communication system and a digital communication system?



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**47.** What is the significance of modulation index?



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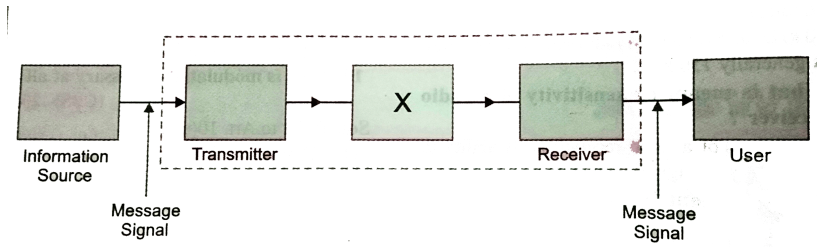
**48.** The carrier wave is represented by

$$C(t) = 5 \sin(10\pi t) \text{ volt}$$

A modulating signal is a square wave as shown in figure. Determine modulation index.

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49. Figure shows the block diagram of a generalized communication system. Identify the element labelled X and write its function.



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50. What is audio frequency range?

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51. What is a modulating signal ?



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52. What is the changed in amplitude modulation?



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53. What is the range of values of modulation index of an AM wave?



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54. What is total modulation index when a carrier wave is modulated by a number of sine waves having modulation index  $\mu_1, \mu_2, \mu_3, \dots \mu_n$ ?



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55. What is varied in a FM wave?



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56. What is the meant by deviation in frequency of FM wave?



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57. What is modulation index of an FM wave ?



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58. Distinguish between amplitude modulation and frequency modulation.



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59. Which is more advantageous: amplitude modulation or frequency modulation ?



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**60.** Which factor decides the quality of reproduced document sent by a FAX?



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**61.** What is an analog communicating system?



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**62.** Name of the type of communication in which the signal is a discrete and binary coded version of the message.



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**63.** What is meant by attenuation?



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**64.** A device X can convert one form to energy into another. Another device Y can be regarded as a combination of transmitter and receiver.

Name of the devices X and Y.



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**65.** What are the band widths of an A.M. radio station and an FM radio station?



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**66.** The band width required for transmitting video signal is



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**67.** What band width is required for transmission of T.V. signals?



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**68.** How does the effective power radiated by an antenna vary with wavelength?



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**69.** What type of modulation is required for television broadcasts?



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**70.** A carrier wave of peak voltage 20 V is used to transmit a message signal. What should be the peak voltage of modulating signal, in order to have 80% modulating index?



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**71.** What is represented by PAM, PTM and PCM?



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72. What is the basic function of a demodulator?



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73. Is the type of receiver much the same for various forms of modulation?



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74. What is meant by data retrieval?



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75. What does a modem represent?



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**76.** What is fax?



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**77.** What does a 'modem' do?



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**78.** Name three different compression techniques used in fax.



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**79.** What is meant by 'band width' of transmission?



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**80.** Give an expression for band-width in AM transmission.



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**81.** Which of the two - AM or FM is preferred for high fidelity reception?



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**82.** What is meant by noise?



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**83.** Name the device which can represent digital data by analog signals and vice versa.



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**84.** Name the process by which exact reproduction of a document at a distant place can be perceived.



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**85.** Give any one difference between FAX and e-mail systems of communication.



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**86.** What is the expressions for band width in FM transmission?



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**87.** What is meant by attenuation and distortion?



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**88.** Name the two basic modes of communication. Which one is used for telephonic communication?



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**89.** Why are broadcast frequencies of carrier waves sufficiently spaced in amplitude modulated waves ?



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**90.** Why is the amplitude of modulating signal kept less than the amplitude of carrier wave ?



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**91.** For an amplitude modulated wave, the maximum amplitude is found to be 10 V, while the minimum amplitude is 2 V. What is the modulation

index ?



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**92.** What are the three frequencies in an amplitude modulated wave?

What are LSB and USB?



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**93.** What are the limitations of amplitude modulation?



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**94.** What is a transducer? Give two examples.



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**95.** AM and FM transmission are said to be 'real time systems'. Why?



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**96.** Why should transmitters broadcasting programmes use different carrier frequencies?



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**97.** Why is an FM signal less susceptible to noise than an AM signal ?



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**98.** What is a transmission medium? What are the various transmission media used to communication system?



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**99.** Write two factors justifying the need of modulating a signal.

A carrier wave of peak voltage  $12V$  is used to transmit a message signal.

What should be the peak voltage of the modulating signal in order to have a modulation index of 75% ?



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**100.** WHY MODULATION REQUIRED ?



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**101.** Draw a block diagram for data transmission .



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**102.** Outline the essential features of a communication system.



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**103.** Why is modulation necessary at all ?



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**104.** Obtain an equation for amplitude modulated wave. Discuss frequency spectrum of such a wave.



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**105.** Explain what is meant by demodulation. Give a simple circuit for radio detection.



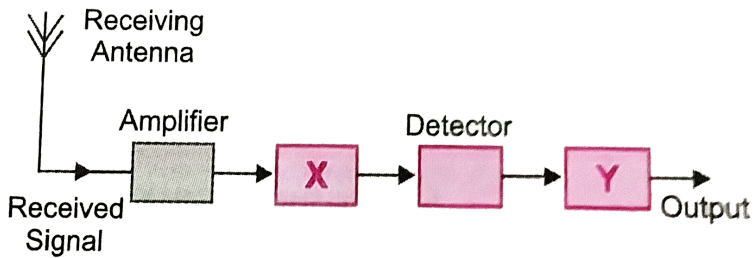
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**106.** Discuss briefly how amplitude modulated wave is produced. Give a block diagram of transmitter.



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**107.** In the given block diagram of a receiver, Figure, identify the boxes labelled as X and Y and write their functions.

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**108.** What is modulation? Explain its necessity.

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**109.** Define modulation and demodulation. Explain the need for modulation.

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**110.** Define modulation. Write any two types of modulation of carrier wave.



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**111.** Draw block diagrams of an amplitude modulated (i) transmitter (ii) receiver.



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**112.** Draw a block diagram of a generalized communication system. Write the functions of each of the following:

(a) Transmitter

(b) Channel

(c) Receiver .



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**113.** Distinguish between a transducer and a repeater.



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**114.** Why does the electrical conductivity of earth's atmosphere increase with altitude?



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**115.** The D-layer and E-layer disappear at night in earth's atmosphere? Why?



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**116.** The F-layer persists in earth's atmosphere at night. What are the reasons for it ?



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**117.** Why do we have better high radio frequency reception at night?



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**118.** Why is the thin ozone layer on top of the stratosphere crucial for human survival? Identify to which a part of electromagnetic spectrum does this radiation belong and write one important application of the radiation?



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**119.** Why is ground wave transmission of signals restricted to a frequency of 1500 kHz ?



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**120.** Long distance radio broadcasts use short wave bands. Explain why?



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**121.** Why is the communication using line of sight mode limited to frequencies above 40 MHz?



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**122.** What mode of communication is employed for transmission of Tv signals?



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**123.** Why do we require a satellite for long distance T.V. transmission?



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**124.** Explain why T.V. transmissin towers are usually made high.



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**125.** If the sum of the heights of transmitting and receiving antennas in line of sight of communication is fixed at  $h$ , show that the range is maximum when the two antennas have a height  $h/2$  each.



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**126.** optical and radio telecopies are build on ground but X-ray astronomy is possible only from satellites or biting the earth. Explain why?



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**127.** What is an active satellite? How is it different from a passive satellite?



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**128.** Why can moon be not used as a communication satellite?



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**129.** From which layer of the atmosphere,radio waves are reflected back?



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**130.** What are radiowaves?



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**131.** What is the maximum distance, the radiowaves can cover in a single reflection from ionosphere?



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**132.** Name the two basic modes of communication system.



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**133.** On what factors, does the maximum range of ground wave propagation depend?



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**134.** What is line of sight distance in communication system?



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**135.** Long distance radio broadcasts use short wave bands. Explain why?



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**136.** What is the limit of frequency upto which signals using sky waves can be transmitted?



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**137.** Give one example each of a system that uses the (i) sky wave (ii) Space wave mode of propagation.



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**138.** Name the two regions of AM band.



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**139.** Name the band to which electromagnetic wave of frequency 120 MHz belongs.



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**140.** Why is the transmission of signals using sky waves restricted to frequencies upto 30 mega hertz?



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**141.** Give the reason why transmission of T.V. signals via sky waves is not possible.



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**142.** Assertion: Only microwaves are used in radar.

Reason: Because microwaves have very small wavelength.



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**143.** What are T.V. signals? How can they be received?



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**144.** What is the essential requirements for transmitting a microwave from one point to another on the earth?



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**145.** Why is a slight shaking of pictures of a television screen noticed when a low lying air craft passes over head?



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**146.** How many number of satellites are needed for global communications?



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**147.** Name the satellites which has revolutionised communication system in India.



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**148.** Mention the two important functions of INSAT 1B.



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**149.** When is a satellite said to be in sun-synchronous orbit?



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**150.** Name the two types of orbits (other than the geostationary orbit) used in satellite communication.



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**151.** What is the factor which limits the covering range of T.V. transmission ?



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**152.** Define the term critical frequency in relation to sky wave propagation of electromagnetic waves.



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**153.** What is meant by skip distance?



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**154.** What is meant by the term remote sensing?



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**155.** Name the remote sensing satellites of India.



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**156.** Mention any two uses of IRS-1A.



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**157.** Name the type of communication that uses carrier signals having frequencies in the range  $10^{12}$  Hz to  $10^{16}$  Hz



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**158.** Name the type of radiowave propagation involved with T.V. signals broadcast by a tall antenna.



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**159.** A fax message is to be sent from Delhi to Washington via a geostationary satellite. Calculate the minimum time delay between the dispatch and its getting received. Take height of the geostationary satellite = 36000 km.



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**160.** What is internet ?



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**161.** Internet is a network of networks. Comment on it.



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**162.** What is the basic idea of mobile telephony? What is the frequency range used in the operation of mobile phones?



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**163.** What is global positioning system? (GPS)



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**164.** Name the three major segments of global positioning system.



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**165.** How many GPS satellites are required to locate the position of a person at some height above the earth's surface?



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**166.** For what SIM stands for in mobile phone?



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**167.** Write the full forms of the terms:

(i) LAN

(ii) WWW.



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**168.** What do you understand by AM range of radio communication? Can these waves pass through atmosphere?



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**169.** Explain the "green house effect" of earth's atmosphere.



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**170.** Explain the term (i) ground wave and (ii) sky wave.



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**171.** Mention three different modes of propagation used in communications system. Explain with the help of a diagram how long distance communication can be achieved by ionospheric reflection of radio waves?



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**172.** What do you understand by (a) medium wave band (b) short wave band?



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**173.** Distinguish between Sky wave and Space wave modes of propagation in a communication system.



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**174.** On what factors, does the maximum range of ground wave propagation depend? How can the maximum range of ground wave propagation be increased?



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**175.** Why cannot the (i) ground waves (ii) space waves and (iii) sky waves be sustained for long distance communication system beyond 10 MHz to 20 MHz.



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**176.** What is meant by critical frequency for sky wave propagation? Write an expression for the critical frequency in terms of the maximum electron density of the ionosphere. What is the range of variation of frequency for this critical frequency?



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**177.** Is it necessary to use satellite for long distance T.V. transmission?

Give reasons.



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**178.** Why sky waves are not used the transmission of television signals?



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**179.** What is the line of sight communication? (ii) Why is it not possible to use sky waves for transmission of T.V. signals? Upto what distance can a signal be transmitted using an antenna of height  $h$ ?



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**180.** What is a geostationary statellite? What are the basic requirements for such a satellite?

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**181.** What is a communicate satellite? Name the communication satellites of India.

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**182.** What is the range of frequencies used for TV transmission? What is common between these waves and light waves?

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**183.** Explain using a proper diagram, the mode of propagation used in the frequency range above 40 MHz.

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**184.** What is the range of frequencies used in satellite communication?

What is common between these waves and light waves?



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**185.** State two factors by which the range of transmission of TV signal can be increased.



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**186.** Why is the communication using line of sight mode limited to frequencies above 40 MHz?



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**187.** Distinguish between "Point to Point" and "Broadcast" modes of communication.





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**188.** What do you understand by space wave propagation? Why is it known as line of sight propagation? Explain selective fading?



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**189.** Explain using a proper diagram, the mode of propagation used in the frequency range above 40 MHz.



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**190.** What is a satellite communication ? Give a simple block diagram for satellite communication. Explain the functions of various parts.



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## 191. MERITS AND DEMERITS OF SATELITE COMMUNICATION



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192. Deduce an expression for the distance from which the T.V. signals can directly be received from a T.V. tower of height  $h$ .



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193. Give (brief) reasons for the following :

- (a) We use 'sky wave' mode of propagation of electromagnetic waves, only for frequencies upto 30 to 40 MHz.
- (b) The LOS communication, via space waves, has a (fairly) limited range.
- (c) A mobile phone user gets uninterrupted link to talk while walking.



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**194.** Differentiate between sky wave and space wave propagation. Also explain line of sight (LOS) communication.



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**195.** What are microwaves? Give their uses.



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**196.** Mention three different modes of propagation used in communications system. Explain with the help of a diagram how long distance communication can be achieved by ionospheric reflection of radio waves?



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**197.** Explain the following terms in relation to the use of internet?

(i) Internet surfing (ii) social networking

(iii) E-mail.



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**198.** IMPORTANT TERMS FOR SKY WAVE PROPAGATION



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**199.** What are T.V. signals? Explain their propagation. Find the relation between coverage distance and height of transmitting antenna.



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**200.** What is remote sensing? Explain briefly how it is carried out. Mention some of its applications?



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**201.** Give some basic ideas about Internet. Why central governance is not necessary for internet?



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**202.** What is mobile telephony? Discuss briefly its usage. Mention some points of concern in the usage of cell phones.



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**203.** Explain the basic features of global positionig system. Give some of its important applications?



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**204.** Optical communication system having an operating wavelength  $\lambda$  metre can use only  $x\%$  of its source frequency as its channel band width. The system is to be used for transmitting T.V signals requiring a band width of  $F$  hertz. How many channels can this system transmit simultaneously? Show graphically how this number of channels varies with operating wavelength of the system.



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**205.** An audio signal of 3.2 kHz modulates a carrier of frequency 84 kHz and produces a deviation of 96 kHz. Find (i) frequency modulation index and (ii) frequency range of the FM wave.



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**206.** On a particular day, the maximum frequency reflected from the ionosphere is 12 MHz, On another day, it was found to decrease to 9 MHz.

By what percentage the maximum electron density of the ionosphere has been decreased.



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**207.** A transmitting antenna of height 25 m is fitted at the top of a tower of height 20m. What is the height of the receiving antenna from ground level if the maximum distance between transmitting antenna and receiving antenna on ground is 56 km. Radius of earth = 6400 km.



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**208.** The value of frequency at which electromagnetic wave has been propagated through the D-region of atmosphere is  $3.27 \times 10^5 \text{ Hz}$ . The electron density for D-region is 400 electrons/cc. What is the refractive index of D-region of atmosphere?



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**209.** Which of the following frequencies will be suitable for beyond the horizon communication using sky waves?



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**210.** Frequencies in the UHF range normally propagate by means of



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**211.** A carrier wave of peak voltage 12 V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75%?



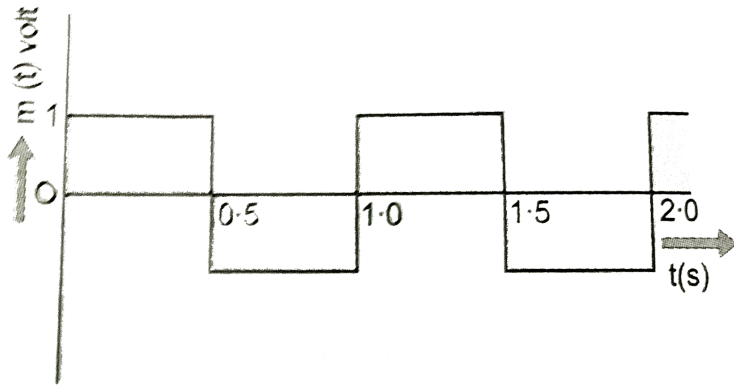
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**212.** A modulating signal is a square wave is shown in figure. The carrier wave is given by  $C(t) = 2 \sin(8\pi t)$  volt.

(i) Sketch the amplitude modulated wave form.



(ii) What is the modulating index?



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**213.** For an amplitude modulated wave, the maximum amplitude is found to be 10 V while the minimum amplitude is found to be 2 V. Determine the modulation index  $\mu$ . What would be the value of  $\mu$  if the minimum amplitude is zero volt?

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**214.** Which of the following would produce analog signals and which would produce digital signals?



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**215.** Would sky waves be suitable for transmission of TV signals of 60 MHz frequency?



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**216.** Two waves A and B of frequencies 2MHz and 3 MHz, respectively are beamed in the same direction for communication via sky wave. Which one of these is likely to travel longer distance in the ionosphere before suffering total internal reflection?



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**217.** The maximum amplitude of an AM wave is found to be 15 V while its minimum amplitude is found to be 3 V. What is the modulation index?



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218. Compute  $LC$  product of a tuned amplifier circuit required to generate a carrier *wave* of  $1\text{MHz}$  for amplitude modulation



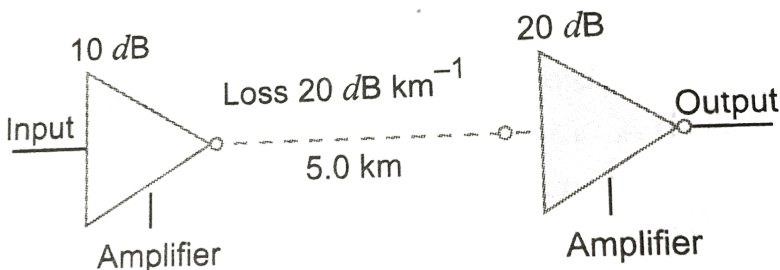
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219. Why is an AM signal likely to be more noisy than a FM signal upon transmission through a channel?



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220. Figure (EP) shows a communication system. What is the output power when input signals is of  $1.01\text{ mW}$ ? [ gain in  $\text{dB} = 10 \log_{10}(P_o / P_t)$ ].



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**221.** A TV transmission tower of antenna is at a height of 20 m. How much service area can it cover if the receiving antenna is (i) at ground level (ii) at a height of 25 m ? Calculate the percentage increase in area covered in case (ii) relative to case (i).

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**222.** If the whole earth is to be connected by LOS communication using space waves ( no restriction of antenna size or tower height), what is the minimum no of antennaas required ? Calculate the tower height of these antennas in terms of earth's radius?

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**223.** The maximum fequency for reflection of sky waves from a certain layer bof the ionosphere is found to be  $f_{\max} = 9(N_{\max})^{1/2}$ , Where N

$N_{\text{max}}$  is the maximum electron density at that layer of the ionosphere. On a certain day it is observed that signals of frequencies higher than 5 MHz are not received by reflection from the  $F_1$  layer of the ionosphere while signals of frequencies higher than 8 MHz are not received by reflection from the  $F_2$  layer of the ionosphere. Estimate the maximum electron densities of the  $F_1$  and  $F_2$  layers on that day.



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**224.** On radiation (sending out) an AM modulated signal, the total radiated power is due to energy carried by  $\omega_c$ ,  $\omega_c - \omega_m$  and  $\omega_c + \omega_m$ . Suggest ways to minimise cost of radiation without compromising on information.



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**225.** (i) The intensity of a light pulse travelling along a communication channel decreases exponentially with distance  $x$  according to the relation  $I = I_0 e^{-\alpha x}$ , where  $I_0$  is the intensity at  $x = 0$  and  $\alpha$  is the attenuation

constant.

Show that the intensity reduces by 75 percent after a distance of  $\frac{\ln 4}{\alpha}$

(ii) Attenuation of a signal can be expressed in decibel (dB) according to the relation

$\text{dB} = 10 \log_{10}(I/I_0)$ . What is the attenuation in  $\text{dB}/\text{km}$  for an optical fibre in which the intensity falls by 50 percent over a distance of 50 km?



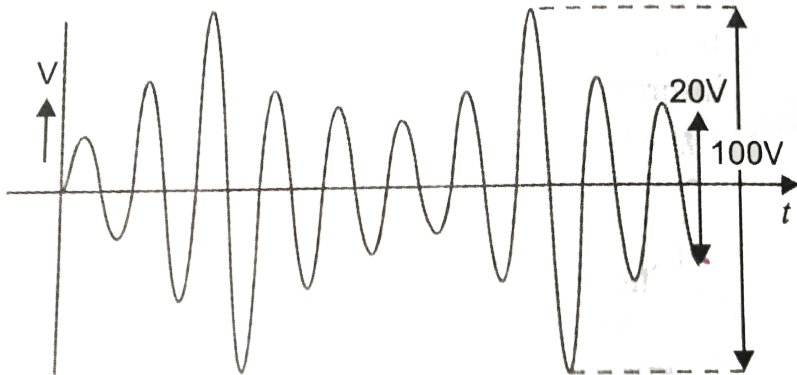
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**226.** A 50 MHz sky wave takes 4.04 ms to reach a receiver via re-transmission from a satellite 600 km above earth's surface. Assuming re-transmission time by satellite negligible, find the distance between source and receiver. If communication between the two was to be done by Line of sight (LOS) method, what should be the size of transmitting antenna ?



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**227.** An amplitude modulated wave is as shown in figure. Calculate (i) the percentage modulation, (ii) peak carrier voltage and , (iii) peak value of information voltage.



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**228.** An audio signal is modulated by a carrier wave of 20 MHz such that the bandwidth required for modulation is 3 kHz. Could this wave be demodulated by a diode detector which has the values of R and C as (i)  $R = 1k\Omega, C = 0.01\mu F$  (ii)  $R = 10k\Omega, C = 0.01\mu F$  (iii)  $R = 10k\Omega, C = 1\mu F$ .



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**229.** A ground receiver station is receiving a signal at 8 MHz , transmitted from ground transmitter at a hight of 289 m located at a distance of 100 km. Identify whether it is coming via space wave or sky wave propagation or satellite transponder. Radius of earth  $= 6.4 \times 10^6 m$ . Maximum number density of electrons in ionosphere  $= 10^{12} m^{-3}$ .



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**230.** If sky wave with a frequency of 60 MHz is incident on D- region at an angle of  $30^\circ$  , then find the angle of refractive.



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**231.** What is meant by selectivity and sensitivity of radio receiver?



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**232.** The carrier frequency of a station is 40 MHz. A resistor of  $10k\Omega$  and a capacity of  $12\mu F$  are available in the detector circuit, Is it good enough for detection? Explain.



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**233.** In a satellite communication, what is the minimum angular spacing of two satellites using the same frequency band.



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**234.** What is a ground wave? Why short wave communication over long distance is not possible via ground waves?



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**235.** Explain that microwaves are better carriers of signals than radio waves?



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**236.** Estimate the fastest bit rate capable of being carried by light of wavelength  $1.3\mu m$ . How many phone calls could be carried at this bit rate ? Band width of optical fibre = 2 GHz.



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**237.** Modulation is the phenomenon of superimposing the low audio frequency base band message or information signals ( called the modulation signals) on a high frequency wave (called, the carrier wave). The resultant wave is called the modulated wave, which is transmitted.

Read the above passage and answer the following questions:

- (i) What are the Audio Frequency and Radio Frequency ranges?
- (ii) Why audio frequency signals, as such cannot be transmitted over long distance?
- (iii) What does the phenomemom imply in day to day life ?



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**238.** Demodulation is the reverse process of modulation, which is performed in a receiver to recover the original modulating signals. At the receiving end, the signals are generally weak due to attenuation in the channel. The receiver selects only the desired signal, rejecting the unwanted (noise) signals and amplifies the same.

Read the above passage and answer the following questions:

- (i) What are the main functions of a demodulator?
- (ii) Give any two examples of demodulators.
- (iii) What does the phenomenon of demodulation imply in day to day life?



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**239.** Rakesh and Rajesh are 8th class students. They are fond of watching cricket match, particularly when it is played between Australia and India. They observed that most of the players, when they are in the field, apply a cream on their face. They

did not know its reason. One day they asked this question to their teacher. The teacher thought it to be a good question and explained the reason for applying this cream to the whole class.

Based on this paragraph, answer the following questions:

- (i) In your opinion, what explanation did the teacher offer to the students in the class?
- (ii) Why is small ozone layer on top of the stratosphere considered crucial for human survival?
- (iii) Write any two values displayed by Rakesh and Rajesh and their class teacher?



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### Short A Q 3 Marks

1. What does a modern communication system involve? Draw a block diagram of a basic communication system.



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2. Obtain an expression for modulation index of an AM wave. What are power and current relations in such a wave? Why is amplitude of modulating signal kept less than the amplitude of carrier wave?



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3. Define the term modulation. Name three different types of modulation used for a message signal using a sinusoidal continuous carrier wave. Explain the meaning of any one of these.



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4. What do you understand by Radiowaves? Mention the various frequency band, their wavelength range and main use of each, used in the field of communication.



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5. What do you understand by space communication? Mention the various modes of space communication.



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6. Which basic mode of communication is used in satellite communication? What type of wave propagation is used in this mode? Write giving reason, the frequency range used in this mode of propagation.



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7. What does the term LOS communication mean ? Name the types of waves that are used for this communication. Give typical examples, with the help of suitable figure, of communication system that use space wave propagation.



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8. Which mode of propagation is used by short wave broadcast services having frequency range from a few MHz upto 30 MHz ? Explain diagrammatically how long distance communication can be achieved by this mode . Why is there an upper limit to frequency of waves used in this mode ?



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### Long Answer Questions

1. Derive an equation for frequency modulated wave. What is modulation index of an FM wave?



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2. Compare and contrast amplitude modulation and frequency modulation.



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3. What is earth's atmosphere ? How has it been classified into different layers? Discuss their importance.



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### Conceptual Problems

1. What is remote control? How has it been used in T.V. working? Name the main types of remote control receivers.



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### Short Answer 2 Marks

1. What does the term LOS communication mean ? Name the types of waves that are used for this communication. Which of the two heights of



transmitting antenna and height of receiving antenna can affect the range over which this mode of communication remains effective?



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### Ncert Exercises

1. Due to economic reasons, only the upper side band of an AM wave is transmitted, but at the receiving station, there is a facility for generating the carrier. Show that if device is available which can multiply two signals, then it is possible to recover the modulating signal at the receiver station.



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### Long Ques Ans

1. (i) Draw the plot of amplitude versus  $\omega$  for an amplitude modulated wave whose carrier wave ( $\omega_c$ ) is carrying two modulating signals,  $\omega_1$  and  $\omega_2$  ( $\omega_2 > \omega_1$ ).

(ii) Is the plot symmetrical about  $\omega_c$ ? Comment especially about plot in region  $\omega < \omega_c$ .

(iii) Extrapolate and predict the problems one can expect if more waves are to be modulated.

(iv) Suggest solutions to the above problem. In the process can one understand another advantage of modulation in terms of bandwidth?



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### Higher Order Thinking Skills

1. For an optical communication system, operating at  $\lambda = 800nm$ , only 1 % the optical source frequency is the available channel band width. How many channels can be accomodated for transmitting video T.V. signal requiring an approximate band width of 4.5 MHz?



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2. On a particular day, the maximum frequency reflected from the ionosphere is 8 MHz. On another day, it was found to increase to 9 MHz. Calculate the ratio of maximum electron densities of the ionosphere on the two days. Point out a plausible explanations for this.



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### Value Based Questions

1. Television (T.V.) is a receiver that can be tuned to any transmitter. We can therefore, watch and enjoy the T.V. programmes of our choice on different channels at prescribed times.

Read the above passage and answer the following questions:

- (i) Why do children feel that T.V. is a boon ?
- (ii) What are the reservations of elderly people with regard to television?
- (iii) What are your personal views on the subject?

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2. Ground/ surface wave propagation is a mode of propagation in which the signal wave glides over the surface of earth, while going from transmitter to receiver. In this mode, there is a loss of power (i.e., attenuation) of signal wave due to diffraction and absorption of signal wave energy by ground. The attenuation of ground / surface wave signal increases very rapidly with the increase in its frequency. Therefore, the ground/ surface wave propagation is not suitable for the propagation of high frequency signal wave and for very long range communication.

Read the above passage and answer the following questions:

- (i) What is the frequency range of a signal wave employed for the ground wave propagation?
- (ii) For what purpose the ground wave propagation is used?
- (iii) What does the study of ground wave propagation imply in day to day life?

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3. Satellite communication is a mode of communication of signal between transmitter and receiver through satellite. The satellite communication is like the line of sight microwave communication.

A communication satellite is a space craft placed in an orbit around the earth provided with microwave

transmitting and receiving equipment called Radio transponder. The range of microwave frequencies used in satellite communication for uplink is  $5.925\text{GHz}$  to  $6.425\text{GHz}$  and for downlink is  $3.7\text{GHz}$  to  $4.2\text{GHz}$ .

(i) How is the line of sight microwave communication possible through satellite?

(ii) Why can't a single satellite cover the whole earth for microwave communication?

(iii) What is the practical utility of satellite communication?



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4. When Sunita, a class XII student came to know that her parents are planning to rent out the top floor of their house to a mobile company,

she protested. She tried hard to convince her parents that this move would be a health hazard. Ultimately, her parents agreed.

(i) In what way can the setting up of transmission tower by a mobile company in a residential colony prove to be injurious to health?

(ii) By objecting to this move of her parents, what value did Sunita display?

(iii) Estimate the range of em waves which can be transmitted by the antenna of height 20 m (Given radius of earth = 6400 km).



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## Exercise

1. The length of Marconi antenna at a place is 0.75 m. What is the optimum transmission frequency?



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2. Calculate the length of quarter wave antenna for transmission frequency of 20 MHz.



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3. The length of a half wave dipole antenna is 0.5 m, Calculate the optimum transmission frequency.



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4. What should be the length of the dipole antenna for a carrier wave of frequency  $3 \times 10^8$  Hz?



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5. For a carrier wave of frequency 6 MHz, what should be the length of Marconi antenna?



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6. A message signal of 12 kHz and peak voltage 20 V is used to modulate a carrier wave of frequency 12 MHz and peak voltage 30 V. Calculate the (i) modulation index (ii) side- band frequencies.



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7. In a simple AM transmitter, the tuned circuit uses a coil of  $40\mu H$  and a shunt capacitor of 1 n F. If the oscillator output is modulated by audio frequencies upto 5kHz, what is the frequency range occupied by side bands?



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8. A sinusoidal carrier voltage is amplitude modulated by a sinusoidal voltage of 10 kHz to a depth of 40%. If the carrier frequency is 10 MHz and carrier amplitude is 40V, what are the frequencies and amplitude of two side bands?





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9. A sinusoidal voltage amplitude modulates another sinusoidal voltage of amplitude 2 kV resulting in two side bands of amplitude 200 V. Find the modulation index.



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10. A band width of 5 MHz is available for AM transmission. If the maximum audio signal frequency used for modulating the carrier is not to exceed 5 kHz, how many stations can be broad cast within this band simultaneously without interfering with each other?



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11. A 100 kHz band width is to accommodate 10 AM broadcasting stations simultaneously. What is the maximum modulating frequency permissible for each station?



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**12.** A broadcast radio transmitter radiates 10 kW when the modulation percentage is 60. How much of this is carrier power?



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**13.** When the modulation percentage is 75, an AM transmitter produces to 10kW. How much of this is carrier power?



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**14.** When a broadcast AM transmitter is 50% modulated, its antenna current is 12 A. What would be the carrier current?



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15. In the above question, what will be the antenna current if depth of modulation is increased to 0.9?



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16. A 1000 kHz carrier is modulated with 800 Hz audio signals. What are the frequencies of first pair of side bands:



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17. A broadcast *AM* transmitter radiates  $50kW$  of carrier power . What will be the radiated power at 50 % modulation ?



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18. A message signal of frequency  $12kHz$  and peak voltage 12 volt is used to modulate a carrier of frequency  $1MHz$  and peak voltage 24 volt. What

is the modulation index and the side bands produced ?



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19. In a diode detector , output circuit consists of  $R = 1M\omega$  and  $C = 1pF$ . Calculate the carrier frequency it can detect.



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20. The carrier frequency of a station is  $50MHz$ . A resistor of  $10k\omega$  and a capacitor of  $10pF$  are available in the circuit . Is it good enough for detection ?



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21. An  $AM$  transmitter records an antenna current of  $10.5A$ . The antenna current drops to  $10A$  when only carrier is transmitted . What is the percentage modulation ?



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22. A broadcast  $AM$  transmitter radiates  $20kW$  of carrier power . What will be radiated power at 25 % modulation ?



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23. In a diode detector , output circuit consists of a resistance of  $5M\Omega$  and a capacitor of  $100pF$ . Calculate the carrier frequency it can detect.



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24. A radio set can be tuned to any station in the frequency range  $6MHz$  band. What is the corresponding wavelength band of radio set ?



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25. A ground receiver station is receiving a signal at (a)  $5MHz$  and  $100MHz$ , transmitted from a ground transmitter at a height of  $400m$  located at a distance of  $125km$ . Identify whether it is coming via space wave or sky wave propagation or satellite transponder.

Radius of earth

$$= 6.4 \times 10^6 m, \text{ maximum number density of electrons in ionosphere} \\ = 10^{12} m^{-3}.$$



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26. On a particular day, the maximum frequency reflected from the ionosphere is  $10MHz$ . On another day, it was found to decrease to  $8MHz$ . Calculate the ratio of the maximum electron densities of the ionosphere on the two days.



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27. On a particular day , the maximum frequency reflected from the ionosphere is  $9MHz$ . On another day , it was found to increase by  $1MHz$  . Calculate , the ratio of the maximum electron densities of the ionosphere on the two days .



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28. What is the value of frequency at which electromagnetic wave must be propagated for the D - region of atmosphere to have a refractive index of 0.5. Electron density for D - region is 400 electrons/c.c.



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29. Find ratio of critical frequency for reflection of radiowaves from  $E$ ,  $F_1$  and  $F_2$  layers in ionosphere of earth's atmosphere having electron density  $2 \times 10^{11}$ ,  $3 \times 10^{11}$  and  $8 \times 10^{11} m^{-3}$  respectively.



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**30.** For sky wave propagation of a  $15MHz$  signal what should be the minimum electron density in ionosphere ?



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**31.** A T.V. tower has a height  $100m$ . What is the population density around the T.V. tower if the population density around the T.V. tower if the total population covered is  $50lakh$  ? Radius of earth  $= 6.4 \times 10^6m$ .



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**32.** What will be the required height of a T.V. tower which can cover the population of  $60.3laks$  if average population density around the tower is  $1000km^{-2}$ . Radius of earth  $= 6.4 \times 10^6m$ .



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**33.** What should be the height of transmitting antenna if the T.V. telecast is to cover of a radius of  $128\text{km}$ ?

Radius of earth  $= 6.4 \times 10^6\text{m}$ .



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**34.** A TV tower has a height of  $100\text{m}$  . How much population is covered by TV broadcast? Given radius of the earth  $= 6.4 \times 10^6\text{m}$  and average density of population  $= 10^3\text{km}^{-2}$ .



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**35.** A transmitting antenna at the top of a tower has a height of  $45\text{m}$  and height of the receiving antenna is  $80\text{m}$ . What is the maximum distance between them , for satisfactory communication of LOS mode ? Radius of earth  $= 6400\text{km}$ .



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**36.** A T.V. transmission tower at a particular station has a height of  $160m$  .

(a) What is its coverage range ?

(b) How much population is covered by transmission , if the average population density around the tower is  $1200km^{-2}$ ?

( c ) By how much the height of tower be increased to double its coverage range ?

Given radius of earth =  $6400km$ .



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**37.** If  $v_r$  is velocity of red light and  $v_b$  is velocity of blue light in vaccum then

A.  $v_r > v_b$

B.  $v_r < v_b$

C.  $v_r = v_b$

D. none of these

**Answer: C**



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**38.** Which of the following is not an electromagnetic wave?

A. X - rays

B. UV rays

C. Sound waves

D. radio waves

**Answer: C**



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**39.** The height from the surface of earth and electron density of  $D$  layer of earth's atmosphere are

A.  $65\text{km}, 10^9\text{m}^{-3}$

B.  $100\text{km}, 10^9\text{m}^{-3}$

C.  $180\text{km}, 10^{11}\text{m}^{-3}$

D. none of these

**Answer: A**



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**40.** The wavelength range of *SHF* ( super high frequency) waves is

A.  $1\text{m}$  to  $10\text{m}$

B.  $1\text{cm}$  to  $10\text{cm}$

C.  $1\text{m}$  to  $1\text{km}$

D.  $10\text{m}$  to  $100\text{m}$

**Answer: B**



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**41.** Ground wave propagation is not suited for

- A. high frequency signals
- B. low frequency signals
- C. medium frequency signals
- D. none of these

**Answer: A**



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**42.** Sky wave propagation is also called

- A. tropospheric wave propagation
- B. satellite communication
- C. ionospheric wave propagation

D. none of these

**Answer: C**



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**43.** The correct relation between plasma frequency  $\nu$  of a radio wave and electron density  $N$  of the ionosphere layer is

A.  $\nu = 10^9 N$

B.  $\nu = 9N$

C.  $\nu = 9\sqrt{N}$

D.  $N = 9\sqrt{\nu}$

**Answer: C**



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44. Refractive index  $\mu$  of a layer in sky wave propagation is given by

A.  $\mu = \sqrt{1 - \frac{81.45N}{v^2}}$

B.  $\mu = \sqrt{1 + \frac{81.45N}{v^2}}$

C.  $\mu = \sqrt{1 + \frac{81.45N^2}{v}}$

D.  $\mu = \sqrt{1 - \frac{81.45N^2}{v}}$

**Answer: A**



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45. Line of sight propagation is

A. ground wave propagation

B. sky wave propagation

C. microwave propagation

D. none of these

**Answer: C**



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**46.** Minimum number of geostationary satellites needed for stallite communication is

A. 1

B. 2

C. 3

D. 4

**Answer: C**



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**47.** Through which mode of propagation, the radio waves can be sent from one place to another



A. Ground wave propagation

B. Sky wave propagation

C. Space wave propagation

D. All the above

**Answer: D**



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**48.** From which layer of the atmosphere,radio waves are reflected back?

A. Ionosphere

B. Chromosphere

C. Mesosphere

D. None

**Answer: A**



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49. The height of a TV tower is  $180m$ . To what distance the transmission can be made from this tower , if the radius of earth is  $6.4 \times 10^6 m$ ?

A.  $18km$

B.  $48km$

C.  $90km$

D.  $64km$

**Answer: B**



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50. When the antenna is held parallel to horizontal surface of earth , the electromagnetic wave would be ..... Polarised.



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51. The gaseous envelope surrounding the earth is called .....



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52.  $F_2$ - layer of earth's atmosphere is at a vertical height of about ..... km in night time and about ..... in day time .



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53. The electromagnetic wave is of frequency range from  $5 \times 10^5 Hz$  to  $10^9 Hz$  are called.....



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54. The phenomenon of loss of power of a ground wave is called .....



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55. A mode of wave propagation is also known as .....



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56. Sky wave propagation is also called



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57. The highest frequency of radio waves which the when sent at some angle towards the ionosphere , gets reflected from ionosphere and returns to earth is called ..... .



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58. The distance between transmitting antenna and receiving antenna at which they can see each other is called .....



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59. The first Indian experimental satellite named ..... was launched on .....

.



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60. GPS stands for ..... .



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61. Three waves A, B and C of frequencies 1600 kHz, 5 MHz and 60 MHz, respectively are to be transmitted from one place to another. Which of the following is the appropriate mode of communication?

A.  $A$  is transmitted via space wave while  $B$  and  $C$  are transmitted via sky wave

B.  $A$  is transmitted via ground wave ,  $B$  via sky wave and  $C$  via space wave

C.  $B$  and  $C$  are transmitted via ground wave while  $A$  is transmitted via sky wave

D.  $B$  is transmitted via ground wave while  $A$  and  $C$  are transmitted via space wave

**Answer: B**



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62. A  $100m$  long antenna is mounted on a  $500m$  tall building. The complex can become a transmission tower for waves with  $\lambda$ .

A.  $\sim 400m$

B.  $\sim 25m$

C.  $\sim 150m$

D.  $\sim 2400m$

**Answer: A**



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**63.** A  $1KW$  signal is transmitted using a communication channel which provides attenuation at the rate of  $-2dBperkm$  . If the communication channel has a total length of  $5km$  , the power of the signal received is

$$[ \text{gain in } dB = 10 \log \left( \frac{P_0}{P_i} \right) ]$$

A.  $900W$

B.  $100W$

C.  $990W$

D.  $1010W$

**Answer: B**



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64. A speech signal of  $3kHz$  is used to modulate a carrier signal of frequency  $1MHz$ , using amplitude modulation. The frequencies of the side bands will be

A.  $1.003MHz$  and  $0.997MHz$

B.  $3001kHz$  and  $2997kHz$

C.  $1003kHz$  and  $1000kHz$

D.  $1MHz$  and  $0.997MHz$

**Answer: A**



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65. A message signal frequency  $\omega_m$  is superposed on a carrier wave of frequency  $\omega_c$  to get an amplitude modulated wave ( $AM$ ). The frequency of the  $AM$  wave will be

A.  $\omega_m$



B.  $\omega_c$

C.  $\frac{\omega_c + \omega_m}{2}$

D.  $\frac{\omega_c - \omega_m}{2}$

**Answer: B**



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**66.** A male voice after modulation-transmission sounds like that of a female to the receiver. The problem is due to

A. poor selection of modulation index ( selected  $0 < m < 1$ )

B. Poor bandwidth selection of amplifiers

C. poor selection of carrier frequency

D. loss of energy in transmission

**Answer: B**



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67. A basic communication system consists of (A) transmitter (B) information source (C) user of information (D) channel (E) receiver`

Choose the correct sequence in which these are arranged in a basic communication system.

A.  $ABCDE$

B.  $BADEC$

C.  $BDACE$

D.  $BEADC$

**Answer: B**



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68. Identify the mathematical expression for amplitude modulated wave:

A.  $A_c \sin[\{\omega_c + k_1 v_m(t)\}t + \phi]$

B.  $A_c \sin\{\omega_c t + \phi + k_2 v_m(t)\}$

C.  $\{A_c + k_2 v_m(t)\} \sin(\omega_c t + \phi)$

D.  $A_c v_m(t) \sin[\omega_c t + \phi]$

**Answer: C**



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**69.** An audio signal of 15 kHz frequency cannot be transmitted over long distance without modulation because.

A. the size of the required antenna would be at least  $5km$  which is not convenient

B. the audio signal can not be transmitted through sky waves

C. the size of the required antenna would be at least  $20km$  , which is not convenient

D. effective power transmitted would be very low , if the size of the antenna is less than  $5\lambda$

**Answer: A::B::D**



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**70.** Audio sine waves of 3 kHz frequency are used to amplitude modulate a carrier signal of 1.5 MHz. Which of the following statements are true?

- A. The side band frequencies are  $1506\text{kHz}$  and  $1494\text{kHz}$
- B. The bandwidth required for amplitude modulation is  $6\text{kHz}$
- C. The bandwidth required for amplitude modulation is  $3\text{kHz}$
- D. The side band frequencies are  $1503\text{kHz}$  and  $1497\text{kHz}$

**Answer: B::D**



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71. A TV transmission tower has a height of 240 m. Signals broadcast from this tower will be received by LOS communication at a distance of (assume the radius of earth to be  $6.4 \times 10^6 m$ )

A.  $100km$

B.  $24km$

C.  $55km$

D.  $50km$

**Answer: B::C::D**



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72. In amplitude modulation, the modulation index  $\mu$ , is kept less than or equal to 1 because.

A.  $m > 1$  , will result in interference between carrier frequency and message frequency , resulting into distortion

B.  $m > 1$  will result in overlapping of both side bands resulting into loss of information

C.  $m > 1$  will result in change in phase between carrier signal and message signal

D.  $m > 1$  indicates amplitude of message signal greater than amplitude of carrier signal resulting into distortion

**Answer: B::D**



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**73.** Modulation is the process of superposing

A. low frequency audio signal of high frequency waves

B. low frequency radio signal on low frequency audio waves

C. high frequency ratio signal on low frequency audio signal

D. low frequency radio signal on high frequency audio waves.

**Answer:**



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**74.** A carrier wave is modulated by n number of sine waves with modulation indices  $\mu_1, \mu_2, \mu_3 + \dots$ . The total modulation index ( $\mu$ ) of the wave is

A.  $\mu_1 + \mu_2 + \mu_3 + \dots$

B.  $\sqrt{\mu_1^2 + \mu_2^2 + \mu_3^2 + \dots}$

C.  $\left[ \frac{\mu_1^2 + \mu_2^2 + \mu_3^2 + \dots}{n} \right]^{1/2}$

D.  $\left[ \frac{n}{\mu_1^2 + \mu_2^2 + \mu_3^2 + \dots} \right]^{1/2}$

**Answer:**



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**75.** Which of the following is not transducer?

A. Loudspeaker

B. Amplifier

C. Microphone

D. All of these

**Answer:**



**Watch Video Solution**

**76.** For what value of  $m_a$  will the total power per cycle be maximum in the modulated wave?

A. zero

B. T

C.  $1/2$

D.  $> 1$

**Answer:**



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77. In amplitude modulation, sinusoidal carrier frequency used is denoted by  $\omega_c$  and the signal frequency is denoted by  $\omega_m$ . The bandwidth ( $\Delta\omega_m$ ) of the signal is such that  $\Delta\omega_m < \omega_c$ . Which of the following frequency is not contained in the modulated wave.

A.  $\omega_m + \omega_c$

B.  $\omega_c - \omega_m$

C.  $\omega_m$

D. All of these

**Answer:**

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78. A diode AM detector with the output circuit consisting of  $R = 1k\Omega$  and  $C = 1\mu f$  would be more suitable for detecting a carrier signal of:

- A. 0.1 kHz
- B. 1kHz
- C. 0.75kHz
- D. 10kHz

**Answer:**



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**79.** In an amplitude modulation with modulation index 0.5 the ratio of the carrier wave to that of side band in the modulated wave is

- A. 4:1
- B. 1:2
- C. 1:1
- D. 2:1

**Answer:**

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**80.** A signal wave of frequency 12 kHz is modulated with a carrier wave of frequency 2.51 MHz. The upper and lower side band frequencies are respectively.

A. 2512 kHz and 2508 kHz

B. 2522 kHz and 2498 kHz

C. 2502 kHz and 2498 kHz

D. 2512 kHz and 2488 kHz

**Answer:**

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**81.** Which of the following device is full duplex?

A. Mobile phone

B. Walky=talky

C. Loud speaker

D. radio

**Answer:**



**Watch Video Solution**

**82.** A signal of  $5\text{ kHz}$  frequency is amplitude modulated on a carrier wave of frequency  $2\text{ MHz}$ . The frequency of the resultant signal is /are

A.  $2\text{ MHz}$  only

B.  $2005\text{ kHz}$  and  $1995\text{ kHz}$

C.  $2005\text{ kHz}$ ,  $2000\text{ kHz}$  and  $1995\text{ kHz}$

D.  $2000\text{ kHz}$  and  $1995\text{ kHz}$

**Answer:**



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**83.** A radiostation has two channels. One is AM at 1020 kHz and the other FM at 89.5MHz. For good results you will use

- A. Longer antenna for the AM channel and shorter for the PM
- B. shorter antenna for the AM channel and longer for the FM
- C. same length antenna will work for both
- D. Information gives is not enough to say which one to use for which

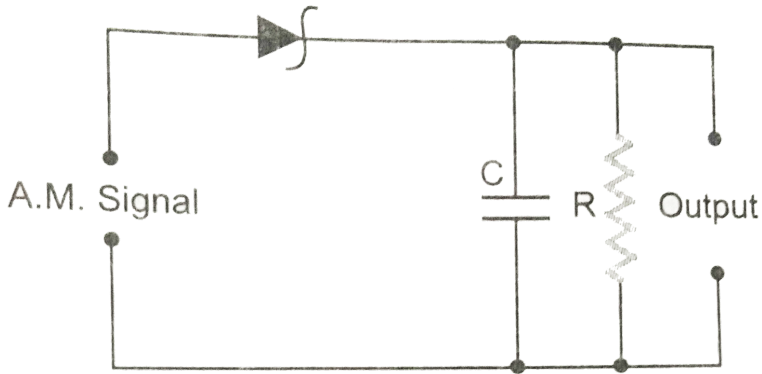
**Answer:**



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**84.** Fig. 10 (CF).1 is the circuit diagram of an AM demodulator. For good demodulation of AM signal of carrier frequency  $f$ , the value of  $RC$  should

be



- A.  $RC=1/f$
- B.  $RC < 1/f$
- C.  $RC \leq 1/f$
- D.  $RC > 1/f$

**Answer:**



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**85.** If both the length of an antenna and the wavelength of the signal to be transmitted are doubled, the power radiated by the antenna

- A. is doubled
- B. is halved
- C. increases 16 times
- D. remains constant

**Answer:**



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**86.** Which of the following four alternatives is not correct, We need modulation :-

- A. To increase the selectivity
- B. To reduce the time lag between transmission and reception of the information signal
- C. To reduce the size of antenna

D. To reduce the fractional bandwidth that is the ratio of the signal bandwidth to the centre frequency.

**Answer:**



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**87.** Refractive index of ionosphere is:

- A. zero
- B. more than one
- C. less than one
- D. one

**Answer:**



**Watch Video Solution**



**88.** Greenhouse 'warming' is caused by an atmosphere which is

- A. transparent to visible light but opaque to infrared light
- B. transparent to both visible and infrared light
- C. opaque to both visible and infrared light
- D. warming due to the hot air from the world's increasing population

**Answer:**



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**89.** Beyond which frequency, the ionosphere bends any incident electromagnetic radiation but does not reflect it back towards the earth?

- A. 20 MHz
- B. 30MHz
- C. 40MHz
- D. 50MHz

**Answer:**



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**90.** The frequencies of electromagnetic waves employed in space communication lie in the range of -

A.  $10^4 Hz$  to  $10^7 Hz$

B.  $10^4 Hz$  to  $10^{11} Hz$

C.  $1 Hz$  to  $10^4 Hz$

D. to  $10^{11} Hz$

**Answer:**



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**91.** In short wave communication waves of which of the following frequencies will be reflected back by the ionospheric layer having

electron density  $10^{11} \text{ perm}^3$ ?

- A. 2 MHz
- B. 10 MHz
- C. 12 MHz
- D. 18 MHz

**Answer:**



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**92.** Electromagnetic waves of frequencies higher than  $9\sqrt{2}$  MHz are found to be not reflected by the ionosphere on a particular day at a place. The maximum electron density in the ionosphere is :

- A.  $\sqrt{5} \times 10^{12} m^{-3}$
- B.  $\sqrt{2} \times 10^{12} m^{-3}$
- C.  $2 \times 10^{12} m^{-3}$

D.  $5 \times 10^{12} m^{-3}$

**Answer:**



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**93.** For sky wave propagation of a  $10MHz$  signal, what should be the minimum electron density in ionosphere?

A.  $1 - 2 \times 10^8 m^{-3}$

B.  $1 - 2 \times 10^{12} m^{-3}$

C.  $1 - 2 \times 10^{14} m^{-3}$

D.  $1 - 2 \times 10^{16} m^{-3}$

**Answer:**



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94. An EM wave of maximum frequency 300 kHz and critical frequency 100 kHz is to be transmitted to a height equal to 150 k. calculate the skip distance.

A. 624km

B. 849km

C. 636km

D. 942km

**Answer:**



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95. What is the refractive index of E-layer when the electromagnetic wave frequency is 50 MHz and the number density of electrons is  $5 \times 10^5$  electrons/cm<sup>3</sup> ?

A. 0.992

B. 1-015

C. 43481

D. 1-000

**Answer:**



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**96.** If sky wave with a frequency of 60 MHz is incident on D- region at an angle of  $30^\circ$ , then find the angle of refractive.

A.  $15^\circ$

B.  $30^\circ$

C.  $60^\circ$

D.  $45^\circ$

**Answer:**



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97. The sky wave with a frequency of 20 MHz is incident on D-region at an angle of  $45^\circ$ , then angle of refraction is

A.  $12.5^\circ$

B.  $15^\circ$

C.  $30^\circ$

D.  $45^\circ$

**Answer:**



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98. The wavelength of electromagnetic waves employed for space communication lie in the range of-

A. 1 mm to 30 m

B. 1 mm to 300m

C. 1 mm to 3 km

D. 1 mm to 30 km

**Answer:**



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**99.** Through which mode of propagation, the radio waves can be sent from one place to another

A. Ground wave propagation

B. Sky wave propagation

C. Space wave propagation

D. All of them

**Answer:**



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**100.** A sky wave with a frequency 55 MHz is incident on D-region of earth's atmosphere at  $45^\circ$ , The angle of refraction is (electron density for D-region is 400 electron/c.c).

A. 400m

B.  $45^\circ$

C.  $30^\circ$

D.  $15^\circ$

**Answer:**



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**101.** What is the maximum distance, the radiowaves can cover in a single reflection from ionosphere?

A. 400m

B. 4000 m

C. 400km

D. 4000km

**Answer:**



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**102.** Maximum usable frequency (MUF) in F-region layer is  $x$ , when the critical frequency is 60 MHz and the angle of incidence is  $70^\circ$ , then  $x$  is

A. 150 MHz

B. 170 MHz

C. 175 MHz

D. 190 MHz

**Answer:**



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**103.** Calculate the phase velocity of electromagnetic wave having electron density and frequency for D layer,  $N=400$  electron/cc,  $\nu=300$  kHz

A.  $3 \times 10^8 \text{ m/s}$

B.  $3 - 75 \times 10^8 \text{ m/s}$

C.  $6.8 \times 10^8 \text{ m/s}$

D.  $1.1 \times 10^9 \text{ m/s}$

**Answer:**



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**104.** Which of the following frequencies will be suitable for beyond the horizon communication using sky waves?

A. 10 kHz

B. 10 MHz

C. 1 GHz

D. 1000 GHz

**Answer:**



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**105.** The maximum distance upto which  $TV$  transmission from a  $TV$  tower of height  $h$  can be received is proportional to

A.  $h^{1/2}$

B.  $h$

C.  $h^{3/2}$

D.  $h^2$

**Answer:**



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**106.** To double the covering range of a TV transmitter tower, its height should be made

- A. 2 tims
- B. 4 times
- C.  $\sqrt{2}$  times
- D. 8 times

**Answer:**



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**107.** A.T.V. tower has a height of 200m. By how much the height of tower be increased to triple its coverage range?

- A. 1600 m
- B. 88 m
- C. 1800 m

D. 600 m

**Answer:**



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**108.** A TV tower has height of 100m. What is the maximum distance upto which TV transmission can be received? ( $R = 6.4 \times 10^6 m$ )

A.  $35.77km$

B.  $32.70km$

C.  $40km$

D.  $40.70km$

**Answer:**



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**109.** A T.V. tower has a height 150m. What is the population density around the T.V. tower if the total population covered is 50 lakh? (Radius of earth =  $6.4 \times 10^6 m$ )

A.  $82.6 km^{-2}$

B.  $800 - 6 km^{-2}$

C.  $828.6 km^{-2}$

D.  $876 - 6 km^{-2}$

**Answer:**



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**110.** ATV tower has a height of 100m. How much population is covered by TV broadcast. If the average population density around the tower is  $1000 km^{-2}$  ? (radius of earth =  $6.4 \times 10^6 m$ )

A.  $10^3$

B.  $10^6$

C.  $4 \times 10^6$

D.  $4 \times 10^9$

**Answer:**



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**111.** The T.V. transmission tower in Delhi has a height of 240 m. The distance up to which the broadcast can be received, (taking the radius of earth to be  $6.4 \times 10^6 m$ ) is

A. 100 km

B. 60 km

C. 55 km

D. 50 km.

**Answer:**





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**112.** The sky wave propagation is suitable for radiowaves of frequency

- A. upto 2 MHz
- B. from 2 MHz to 20 MHz
- C. from 2 MHz to 30 MHz
- D. from 2 MHz to 50 MHz

**Answer:**



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**113.** Which of the following statement is wrong?

- A. Ground wave propagation can be sustained at frequencies 500 kHz to 1500 kHz
- B. Satellite communication is useful for the frequencies above 30 MHz

C. Sky wave propagation is useful in the range of 30 to 40 MHz

D. space wave propagation takes place through tropospheric space

**Answer:**



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**114.** LANDSAT series of satellite move in near polar orbits at an altitude of  
`36000km

A. 36000km

B. 3600 km

C. 918 km

D. 512km

**Answer:**



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**115.** In satellite communication

1. The frequency used lies between 5 MHz and 10 MHz.
2. The uplink and downlink frequencies are different.
3. The orbit of geostationary satellite lies in the equatorial plane at an inclination of  $0^\circ$ .

In the above statements

- A. only 2 and 3 true
- B. all are true
- C. only 2 true
- D. only 1 and 2 true

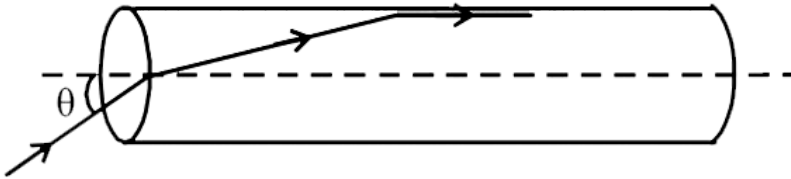
**Answer:**



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**116.** A transparent solid cylindrical rod has a refractive index of  $\frac{2}{\sqrt{3}}$ . It is surrounded by air. A light ray is incident at the mid-point of one end of

the rod as shown in the figure. The incident angle  $\theta$  for which the light ray grazes along the wall of the rod is:



A.  $\sin^{-1}(\sqrt{3}/2)$

B.  $\sin^{-1}(2\sqrt{3})$

C.  $\sin^{-1}(1/\sqrt{3})$

D.  $\sin^{-1}(1/2)$

**Answer:**



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117. A radar has a power of  $1kW$  and is operating at a frequency of  $10GHz$ . It is located on a mountain top of height  $500m$ . The maximum distance upto which it can detect object located on the surface of the earth (Radius of earth  $6.4 \times 10^6m$ ) is

A. 80 km

B. 16 km

C. 40 km

D. 64 km

**Answer:**



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118. An 'antenna' is:

A. is resistive above its resonant frequency

B. is resistive at resonant frequency

C. allows signals to pass  $x_L = x_C$

D. allows signals to pass when  $x_L \neq x_C$

**Answer:**



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**119.** Audio signal cannot be transmitted because

A. the signal has more noise

B. the signal can be amplified for long distance communication

C. energy of audio signal gets lost due to attenuation

D. the transmitting antenna length is very large and impracticable

**Answer:**



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**120.** For sky wave propagation of a 10 MHz signal, which of the following statements are true:

- A. The minimum electron density in the ionosphere is  $1.2 \times 10^{12} m^{-3}$
- B. The minimum electron density in the ionosphere is  $10^6 m^{-3}$
- C. The reflection of the given sky wave signal takes place from E layer of ionosphere
- D. The reflection of the layer of ionosphere

**Answer:**



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**121.** Which of the following is/are correct with respect to frequency modulation

- A. the amplitude of the modulated wave varies as the frequency of carrier wave

B. the frequency of the modulated wave varies as the amplitude of the modulating wave

C. modulation index of frequency modulation is

$$\mu = \frac{\text{change in frequency}}{\text{original frequency}}$$

D. frequency modulation vary the carrier frequency within some small range about its original value.

**Answer:**



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**122.** Examples of digital signals is/are

A. output of a digital computer

B. FAX

C. letter printed in a book

D. music



**Answer:**



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**123.** Space wave propagation is used in

(a) microwave communication

(b) satellite communication

(c) TV transmission

A. Radio communication

B. Satellite communication

C. TV communication

D. Telephone.

**Answer:**



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**124.** For communication purpose of artificial satellite

- A. micro waves are used
- B. radio transponders are used
- C. uplink and downlink have different frequencies
- D. uplink and downlink have same frequencies

**Answer:**



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**125.** The temperature of earth's atmosphere increases with height in

- A. troposphere
- B. stratosphere
- C. mesosphere
- D. ionosphere

**Answer:**



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**126.** The layer (or play) effective role in space communication at night is (or are) :

A. D-layer

B. E-layer

C.  $F_1$ -layer

D.  $F_2$  – layer

**Answer:**



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**127.** In electromagnetic wave, if  $\vec{E}$ ,  $\vec{B}$  and  $\vec{v}$  are the electric field vector, magnetic field vector and velocity vector of electromagnetic wave, then

A.  $\vec{E}$  is perpendicular to  $\vec{B}$  as well as perpendicular to  $\vec{v}$ .

B.  $\vec{E}$  is parallel to  $\vec{B}$

C.  $\vec{B}$  is perpendicular to  $\vec{v}$

D.  $\vec{B}$  is parallel to  $\vec{v}$

**Answer:**



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**128.** For sky wave propagation of a 18 MHz signal, what should be the minimum electron density in ionosphere ?

A.  $4 \times 10^{12} m^{-3}$

B.  $2 \times 10^{12} m^{-3}$

C.  $4 \times 10^{14} m^{-3}$

D.  $8 \times 10^{14} m^{-3}$

**Answer:**



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**129.** In ground or surface wave propagation, the ions of power in a signal wave is due to

- A. induced charges in earth which travel in ground along with the wave, resulting the alternating currents in the earth's surface
- B. interference of waves
- C. diffraction of waves
- D. high frequency of signal wave.

**Answer:**



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**130.** What mode of communication is employed for transmission of Tv signals?

- A. Ground wave propagation
- B. Sky wave propagation
- C. Sky wave propagation is useful in the range of 30 to 40 MHz
- D. none of the above

**Answer:**



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**131.** Why can moon be not used as a communication satellite?

- A. the distance between earth and moon is not proper
- B. the period of revolution of moon is 27.3 days
- C. the moon is not revolving in the equatorial plane of the earth
- D. none of the above

**Answer:**



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**132.** Height  $h(400\text{m})$  from the ground at place A, from which the radiowaves can be transmitted. There is a receive at station B on earth at a distance  $d(=125\text{km})$ , which can receive the signal from station A. The radiowaves can reach the station B, either through earth's atmosphere or through satellite. There are four main layers in earth's atmosphere named D, E,  $F_1$  and  $F_2$  which play effective role in radio communication. The electron density of these layers is  $4 \times 10^8$ ,  $2 \times 10^{11}$ ,  $5 \times 10^{11}$  and  $8 \times 10^{11} \text{m}^{-3}$ . The radius of the earth is  $6.4 \times 10^6 \text{m}$ .

The ratio of critical frequency for reflection of radiowaves from E,  $F_1$  and  $F_2$  layers in ionosphere of earth's atmosphere is

A.  $2:3:8$

B.  $1/2:1/3:1/8$

C.  $1/4:1/9:1/64$

D.  $\sqrt{2}:\sqrt{3}:\sqrt{8}$

**Answer:**



**133.** Height  $h(400\text{m})$  from the ground at place A, from which the radiowaves can be transmitted. There is a receive at station B on earth at a distance  $d(=125\text{km})$ , which can receive the signal from station A. The radiowaves can reach the station B, either through earth's atmosphere or through satellite. There are four main layers in earth's atmosphere named D, E,  $F_1$  and  $F_2$  which play effective role in radio communication. The electron density of these layers is  $4 \times 10^8$ ,  $2 \times 10^{11}$ ,  $5 \times 10^{11}$  and  $8 \times 10^{11} \text{m}^{-3}$ . The radius of the earth is  $6.4 \times 10^6 \text{m}$ .

On a particular day, the maximum frequency reflected from the ionosphere is 9 MHz. On another day, it was found to increase by 1 MHz. The ratio of maximum electrom density of the ionosphere on the two days is

A.  $9/8$

B.  $3/2\sqrt{2}$

C.  $\frac{100}{81}$



D. none of the above

**Answer:**



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**134.** Height  $h(400\text{m})$  from the ground at place A, from which the radiowaves can be transmitted. There is a receive at station B on earth at a distance  $d(=125\text{km})$ , which can receive the signal from station A. The radiowaves can reach the station B, either through earth's atmosphere or through satellite. There are four main layers in earth's atmosphere named D, E,  $F_1$  and  $F_2$  which play effective role in radio communication. The electron density of these layers is  $4 \times 10^8$ ,  $2 \times 10^{11}$ ,  $5 \times 10^{11}$  and  $8 \times 10^{11} \text{m}^{-3}$ . The radius of the earth is  $6.4 \times 10^6 \text{m}$ .

The value of radio frequency at which the electromagnetic wave must be propagated for the D-layer of atmosphere to have a refractive index of 0.5 is

A. 52 kHz

B. 104kHz

C. 208kHz

D. 78kHz

**Answer:**



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**135.** Height  $h(400\text{m})$  from the ground at place A, from which the radiowaves can be transmitted. There is a receive at station B on earth at a distance  $d(=125\text{km})$ , which can receive the signal from station A. The radiowaves can reach the station B, either through earth's atmosphere or through satellite. There are four main layers in earth's atmosphere named D, E,  $F_1$  and  $F_2$  which play effective role in radio communication. The electron density of these layers is  $4 \times 10^8$ ,  $2 \times 10^{11}$ ,  $5 \times 10^{11}$  and  $8 \times 10^{11} \text{ m}^{-3}$ . The radius of the earth is  $6.4 \times 10^6 \text{ m}$ .

If the frequency of the transmitting station is 5 MHz. and maximum

number density of electrons in the ionosphere is  $10^{-12} m^{-3}$ , state whether it is coming via

- A. Ground waves propagation
- B. Space wave propagation
- C. Sky wave propagation is useful in the range of 30 to 40 MHz
- D. satellite communication.

**Answer:**



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**136.** Height  $h(400\text{m})$  from the ground at place A, from which the radiowaves can be transmitted. There is a receive at station B on earth at a distance  $d(=125\text{km})$ , which can receive the signal from station A. The radiowaves can reach the station B, either through earth's atmosphere or through satellite. There are four main layers in earth's atmosphere named D, E,  $F_1$  and  $F_2$  which play effective role in radio communication. The electron density of these layers is  $4 \times 10^8$ ,  $2 \times 10^{11}$ ,  $5 \times 10^{11}$  and

$8 \times 10^{11} m^{-3}$ . The radius of the earth is  $6.4 \times 10^6 m$ . If the station A sends the T.V. signals, then the maximum area on earth upto which T.V. transmission can be received on earth is (average population density around the tower is  $1000 km^{-2}$ )

A.  $1.6 \times 10^5$

B.  $1.6 \times 10^6$

C.  $1.6 \times 10^7$

D.  $1.6 \times 10^8$

**Answer:**



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**137.** is the set up used in the transimission of information from one place to another. The present day communication systems are electrical, electronic or optical in nature. Three parts of a communication system are:

Transmitter: Communication Channer and Receiver.

A signal is defined as a single valued function of time. This function has a unique value at every instant of time. Most of the speech or information signals cannot be transmitted directly over long distances. They have to be modulated suitably and then transmitted. Communication channel carries the modulated wave from transmitter to receiver. The air, transmission lines and free space are the common communication channels. the receiver consists of a pickup antenna, a with the help of the above passage, choose the most appropriate alternative to each of the following questions:

Communication systems may be

- A. electrical
- B. electronic
- C. optical
- D. any of the above

**Answer:**



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**138.** is the set up used in the transimission of information from one place to another. The present day communication systems are electrical, electronic or optical in nature. Three parts of a communication system are:

Transmitter: Communication Channer and Receiver.

A signal is defined as a single valued function of time. This function has a unique value at every instant of time. Most of the speech or information signals cannot be transmitted directly over long distances. They have to be modulated suitably and then trasmitted. Communication channer carries the modulated wave from transmitter to receiver. The air, transmission lines and free space are the common communication channels. the reciever consisits of a pickup antenna, a with the help of the above passage, choose the most appropriate alternative to each of the following questions:

A signal is a piece of information, which at a particular time has

A. single value

B. maximum value

C. minimum value

D. two values.

**Answer:**



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**139.** Data Transmission is the set up used in the transmission of information from one place to another. The present day communication systems are electrical, electronic or optical in nature. Three parts of a communication system are:

Transmitter: Communication Channel and Receiver.

A signal is defined as a single valued function of time. This function has a unique value at every instant of time. Most of the speech or information signals cannot be transmitted directly over long distances. They have to be modulated suitably and then transmitted. Communication channel carries the modulated wave from transmitter to receiver. The air, transmission lines and free space are the common communication channels. The receiver consists of a pickup antenna, and with the help of the

above passage, choose the most appropriate alternative to each of the following questions:

Out of a pick up antenna, a demodulator, an amplifier and a transducer, the receiver must have

- A. any one
- B. any two
- C. any three
- D. all the four.

**Answer:**



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**140.** If the maximum values of signal and carrier waves are 4 V and 5 V respectively, the percentage of amplitude modulation is  $a \times 10\%$ . What is the value of a ?



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**141.** In a detector, output circuit consists of  $R = 10k\Omega$  and  $C = 100pF$ , the frequency (in MHz) of a carrier signal it can detect must be greater than:



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**142.** What is the maximum usable frequency (in MHz) for E-layer of atomosphere having critical frequency 4 MHz, when the angle of incidence is  $60^\circ$



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**143.** A T.V. Tower has a height 100m. In order to triple its coverage range, the height of tower to be increased is  $a \times 10^2$ m. What is the integer value of a ?



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**144.** A microwave telephone link operating at the central frequency of 10 GHz has been established. If 2% of this is available for microwave communication channel and each telephone is allotted a bandwidth of 8 KHz. the number of telephone channels which can be simultaneously granted is  $2.5 \times 10^a$ . What is the integer value of  $a$ ?



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**145.** Assertion: Microwave communication is preferred to optical communication

Reason: Microwaves provide large number of channels and bandwidths as compared to optical signals.

A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**146.** Assertion: The electromagnetic waves of shorter wavelength can travel longer distances on earth's surface than those of longer wavelengths.

Reason: Shorter the wavelength, the larger is the velocity of wave propagation. Also, shorter the wavelength, shorter is the velocity of wave propagation.

A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**147.** Assertion: Environment damage has increased the amount of ozone in the atmosphere.

Reason: Increase of ozone increases the amount of ultraviolet radiation on earth.

A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**148.** Assertion. Audio signal of frequency 10 KHz cannot be transmitted over long distance without modulation.

Reason. Length of the antenna required  $\lambda/4$ . Should have practical value.

- A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
- B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
- C. Assertion is true but the Reason is false.
- D. both, Assertion and Reason are false.

**Answer:**



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**149.** Statement-1: Short wave band are used for transmission of radiowaves to a large distance.

Statement-2: Short waves are reflected from ionosphere.

- A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
- B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
- C. Assertion is true but the Reason is false.
- D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**150.** Assertion:- If earth did not have atmosphere, its average surface temperature would be lower than what it is now.

Reason:- Greenhouse effect of the atmosphere would be absent, if earth did not have atmosphere.

- A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
- B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
- C. Assertion is true but the Reason is false.
- D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**151.** Statement-1: the electrical conductivity of earth's atmosphere increases with altitude.

Statement -2: The high energy particles (i.e.,  $\gamma$ - rays and cosmic rays) coming from outer space while entering our earth's atmosphere cause

ionization of the atoms of the gases present in the atmosphere and their energy decreases as they approach to earth.

- A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
- B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
- C. Assertion is true but the Reason is false.
- D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**152.** Assertion: The surface wave propagation is used for medium frequency and low frequency band.

Reason: The attenuation of surface waves increased with increase in frequency.



- A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
- B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
- C. Assertion is true but the Reason is false.
- D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**153.** Assertion: The television broadcasting becomes weaker with increasing distance.

Reason: The power transmitted from T.V. transmitter varies inversely as the distance of the receiver.

- A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**154.** Assertion: The Microwave propagation is better than the sky wave propagation.

Reason: Microwaves have frequency 100 to 3001 GHz, which have very good directional properties.

A. both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion.

C. Assertion is true but the Reason is false.

D. both, Assertion and Reason are false.

**Answer:**



**Watch Video Solution**

**155.** Assertion: Satellite is an ideal platform for remote sensing.

Reason: Satellite in poplar orbit can provide global coverage or continuous coverage of the fixed area in geostationary configuration.

A. Statement-1 is true: Statement-2 is true, and Statement-2 is correct explanation of Statement-1.

B. Statement-1 is true, Statement-2 is true, but Sttement-2 is not a correct explanation of Statement-1.

C. Statement-1 is true, but Statement-2 is false.

D. Statement-1 is false, but Statement-2 is true.

**Answer:**



**Watch Video Solution**

**156.** Statement-1: Radio waves can be polarised.

Statement-2: Sound waves in air are longitudinal in nature.

- A. Statement-1 is true: Statement-2 is true, and Statement-2 is correct explanation of Statement-1.
- B. Statement-1 is true, Statement-2 is true, but Statement-2 is not a correct explanation of Statement-1.
- C. Statement-1 is true, but Statement-2 is false.
- D. Statement-1 is false, but Statement-2 is true.

**Answer:**



**Watch Video Solution**

**157.** Statement-1: Television signals are propagated through sky waves.

Statement-2 : Television signals have frequency in the 100-200 MHz range.

- A. Statement-1 is true: Statement-2 is true, and Statement-2 is correct explanation of Statement-1.
- B. Statement-1 is true, Statement-2 is true, but Statement-2 is not a correct explanation of Statement-1.
- C. Statement-1 is true, but Statement-2 is false.
- D. Statement-1 is false, but Statement-2 is true.

**Answer:**



**Watch Video Solution**

**158.** Statement-I : Television signals are received through sky-wave propagation

Statement-II : The ionosphere reflects electromagnetic waves of frequencies greater than a certain critical frequency.

- A. Statement-1 is true: Statement-2 is true, and Statement-2 is correct explanation of Statement-1.
- B. Statement-1 is true, Statement-2 is true, but Statement-2 is not a correct explanation of Statement-1.
- C. Statement-1 is true, but Statement-2 is false.
- D. Statement-1 is false, but Statement-2 is true.

**Answer:**



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**159.** Statement-1 : Electromagnetic waves with frequencies smaller than the critical frequency of ionosphere cannot be used for communications using sky wave propagation.

Statement-2: The refractive index of the ionosphere becomes very high for frequency is higher than the critical frequency.

- A. Statement-1 is true: Statement-2 is true, and Statement-2 is correct explanation of Statement-1.
- B. Statement-1 is true, Statement-2 is true, but Statement-2 is not a correct explanation of Statement-1.
- C. Statement-1 is true, but Statement-2 is false.
- D. Statement-1 is false, but Statement-2 is true.

**Answer:**



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**160.** Statement-1: Communication in UHF/VHF regions can be established by space wave or tropospheric wave.

Statement-2 : The refractive index of the ionosphere becomes very high for frequencies higher than the critical frequency.

- A. Statement-1 is true: Statement-2 is true, and Statement-2 is correct explanation of Statement-1.

B. Statement-1 is true, Statement-2 is true, but Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is true, but Statement-2 is false.

D. Statement-1 is false, but Statement-2 is true.

**Answer:**



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**161.** The question has statement - 1 and statement - 2 Of the four choices given after the statements , choose the one that best describes the two statements

statement - 1 : Sky wave signals are used for long distance radio communication . These signals are in general , less stable then ground wave signals

statement - 2 : The state of inosphere varies from to hour day and season to season .



- A. Statement-1 is true: Statement-2 is true, and Statement-2 is correct explanation of Statement-1.
- B. Statement-1 is true, Statement-2 is true, but Statement-2 is not a correct explanation of Statement-1.
- C. Statement-1 is true, but Statement-2 is false.
- D. Statement-1 is false, but Statement-2 is true.

**Answer:**



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**162.** What is meant by quantisation of charge ?



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**163.** Why is the conductivity of n-type semiconductor greater than that of the p-type semiconductor even when both of these have the same level of

doping?



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**164.** How does one explain the emission of electrons from a photosensitive surface with the help of Einstein's equation?



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**165.** A resistor of  $5\Omega$  is connected in series with a parallel combination of a number of resistors each of  $5\Omega$ . If the total resistance of the combination is  $6\Omega$ , how many resistor are in parallel?



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**166.** Draw a circuit diagram of a meter bridge used to determine the unknown resistance  $R$  of a given wire. Hence derive the expression for  $R$  in terms of the known resistance  $S$ .



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**167.** Under what situation a magnet suspended in a uniform magnetic field will be (a) in stable equilibrium and (b) in unstable equilibrium?



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**168.** A man's shortest distance of distinct vision is  $20\text{cm}$ . What will be the type and power of the spectacle lens which he would require to enable him to read a book at a distance of  $60\text{cm}$  ?



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**169.** If the base region of a transistor is made large, as compared to a usual transistor, how does it affect (i) the collector current and (ii) current gain of this transistor.



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**170.** The maximum kinetic energies of photoelectrons emitted from a metal are  $k_1$  and  $k_2$  when it is irradiated with light of wavelength  $\lambda_1$  and  $\lambda_2$  respectively. Find work function of the metal.



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**171.** An electric dipole of length 4 cm, when placed with its axis making an angle of  $60^\circ$  with a uniform electric field, experiences a torque of  $4\sqrt{3}Nm$ . Calculate the

a. magnitude of the electric field, and

b. potential energy of the dipole, if the dipole has charges of  $\pm 8nC$ .



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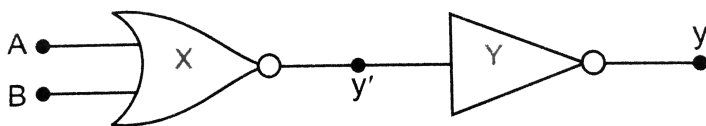
**172.** The potential difference across the collector of a transistor, used in common emitter mode is  $1.5V$ , with the collector resistance of  $3k\Omega$ . Find (i) the emitter current and (ii) the base current, if d.c. gain of the transistor is 50.

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**173.** In the chemical analysis of a rock the mass ratio of two radioactive isotopes is found to be 100:1. The mean lives of the two isotopes are  $4 \times 10^9$  years and  $2 \times 10^9$  years, respectively. If it is assumed that at the time of formation the atoms of both the isotopes were in equal proportion, calculate the age of the rock. Ratio of the atomic weights of the two isotopes is 1.02: 1.

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**174.** Identify the logic gates marked X,Y in Fig. MTP 1.1. write down the output at y, when  $A = 1$ ,  $B = 1$  and  $A = 0$  and  $B=0$ .

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**175.** Write the order of frequency range and one use of each of the following electromagnetic radiations:

(i) Microwaves

(ii) Ultraviolet rays

(iii) Gamma rays.



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**176.** In a YDSE, the separation between slits is  $2\text{mm}$  where as the distance of screen from the plane of slits is  $2.5\text{m}$ . Light of wavelengths in the range  $200 - 800\text{nm}$  is allowed to fall on the slits. Find the wavelengths in the visible region that will be present on the screen at  $1\text{mm}$  from central maximum. Also find the wavelength that will be present at that point of screen in the infrared as well as in the ultraviolet region.



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**177.** Suppose India has a target of producing by 2020 *AD*, 200, 000 *MW* of electric power, ten percent of which was to be obtained from nuclear power plants. Suppose we are given that, on an average, the efficiency of utilization (i.e conversion to electric energy) of thermal energy produced in a reactor was 25 %. How much amount of fissionable uranium would our country need per year by 2020? Take the heat energy per fission of  $^{235}\text{U}$  to be about 200 *MeV*.



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**178.** Large angle scattering of  $\alpha$  – particle led Rutherford to the discovery of atomic nucleus. It is the tiny central core of every atom in which entire positive charge of the atom is concentrated. The distance of closet approach of alpha particle from the nucleus is

$$r_{\theta} = \frac{(Ze)(2e)}{4\pi\epsilon_{\theta}\left(\frac{1}{2}mv^2\right)}$$

This distance  $r_{\theta}$  gave him the order of size of nucleus.

Read the above passage and answer the followign question:

(i) What is the distance of closet approach of an alpha particle of energy

7.7 MeV from gold nucleus ( $z=79$ )?

(ii) What is the implication of this relation in day to day life?



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**179.** What is the cause of refraction of light ?



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**180.** Plot a graph showing the variation of resistance of a conducting wire as function of its radius, keeping the length of a wire and its temperature as constant.



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**181.** Draw a plot showing the variation of de-Broglie wavelength of electron as a function of its K.E.



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**182.** A steady current is flowing in a cylindrical conductor. Is there any electric field within the conductor ? If yes, what is its relation with current density?



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**183.** Write an expression in a vector form for the Lorentz magnetic force  $\vec{F}$  on a charge  $Q$  moving with velocity  $\vec{V}$  in a magnetic field  $\vec{B}$ . What is the direction of the magnetic force?



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**184.** A laser beam has intensity  $3.0 \times 10^{14} \text{ W m}^{-2}$ . Find the amplitudes of electric and magnetic fields in the beam.



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**185.** A piece of wood from the ruins of an ancient building was found to have a  $C^{14}$  activity of 12 disintegrations per minute per gram of its carbon content. The  $C^{14}$  activity of the living wood is 16 disintegrations/minute/gram. How long ago did the trees, from which the wooden sample came, die? Given half-life of  $C^{14}$  is 5760 years.



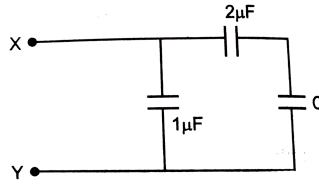
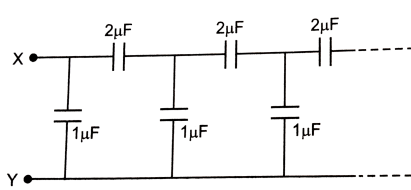
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**186.** A.T.V tower has a height of 150m. How much population is covered by the T.V. broadcast if the average population density around the tower is  $1000 \text{ km}^{-2}$ ? Radius of the earth is  $6.4 \times 10^6 \text{ m}$ .



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**187.** Find the capacitance of the infinite ladder between points X and Y, Fig.



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**188.** Two wires of resistance  $R_1$  and  $R_2$  have temperature coefficient of resistance  $\alpha_1$  and  $\alpha_2$  respectively. These are joined in series. The effective temperature coefficient of resistance is



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**189.** A  $60^\circ$  prism has a refractive index of 1.5. Calculate (a) the angle of incidence for minimum deviation (b) angle of minimum deviation (c) the angle of emergence of light at maximum deviation (d) angle of maximum deviation.



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**190.** In an n-p-n transistor  $10^{10}$  electrons enter the emitter in  $10^{-6}$ s. If 2% of the electrons are lost in the base, find the current transfer ratio and the current amplification factor.



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**191.** A Choke coil is needed to operate an arc lamp at  $160V$  (rms) and  $50Hz$ . The lamp has an effective resistance of  $5\Omega$  when running at  $1A$ (rms). Calculate the inductance of the choke coil. If the same arc lamp is to be operated on  $160V(DC)$ , what additional resistance is required ? Compare the power losses in both cases.



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**192.** Rohan, a Science student purchased a few cells from a shop keeper for his torch. He noticed that the torch was not working well with these new cells. He thought of checking the emf of each cell. Using a potentiometer he measured their emfs and noticed that the emf of each

cell was less than the value of oblige him. He then lodged a complaint with consumer forum and got theredressal.

Read the above passage and answer the following question:

- (i) What are the basic values displayed by Rohan?
- (ii) Why rohan used potentiometer instead of voltmeter to measure emf of the cells?
- (iii) If the length of potentiometer wire is (a) doubled and (b) halved, what will be the effect on the position of zero deflection in a potentiometer.



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**193.** What do you understand by fringe width ?

Derive an expression for fringe width in the interference pattern.



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**194.** (a) Show that a bubble AND gets is equivalent ot a NOE gate.

(b) The number of electron-hole pairs in an intrinsic semiconductor is  $2 \times 10^{19} m^{-3}$  at  $27^\circ C$  and  $E_g$  is 1eV. Calculate the number of electron-

hole pairs at  $227^{\circ}C$ . Given that Boltzmann constant is  $8.65 \times 10^{-5} eV/K$

or With the help of neat and labelled diagram, discuss the working of common emitter p-n-p junction transistor amplifier. Obtain expressions for voltage gain and current gain.



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### Multiple Choice Questions

1. The height of communication satellite from the surface of the earth is approximately

A.  $36 \times 10^3 km$

B.  $36 km$

C.  $36 \times 10^4 km$

D.  $36 \times 10^2 km$

**Answer: A**



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2. Which of the following communication system has maximum band width ?

- A. Optical fibre communication
- B. Skywave communication
- C. Line communication
- D. Statellite communication

**Answer: A**



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3. The fraction of world's human population using the services of internet is

- A.  $1/2$

B.  $1/3$

C.  $1/4$

D.  $1/5$

**Answer: B**

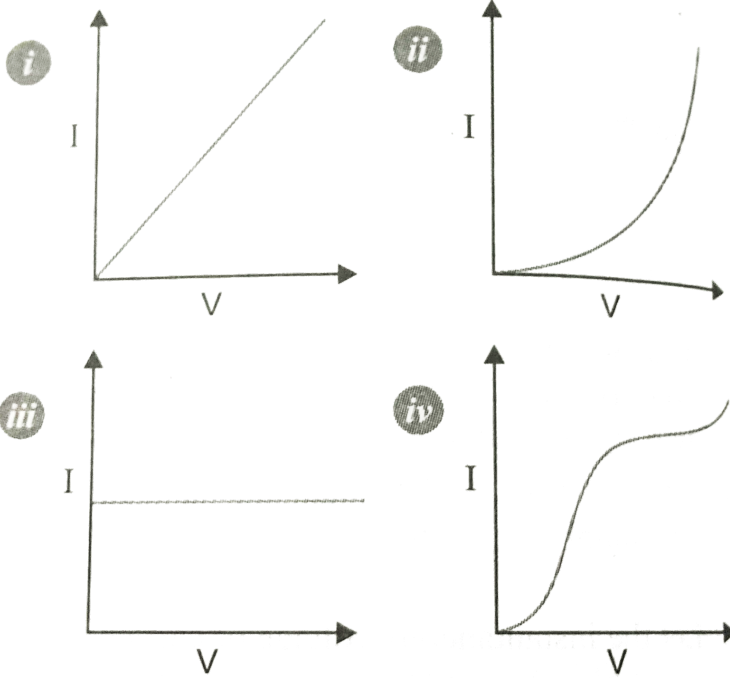


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**Multiple Choice Question**



1.  $I - V$  characteristics of four devices are shown in Fig.



Identify devices that can be used for modulation :

A. ' $I$ ' and ' $iii$ '

B. *only* ' $iii$ '

C. ' $ii$ ' and *some region of* ' $iv$ '

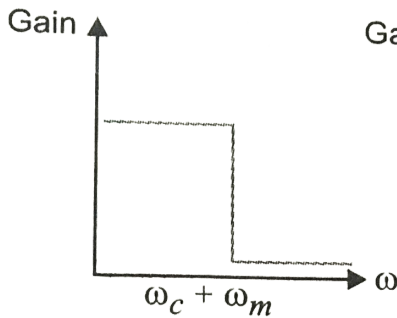
D. All the devices can be used

Answer: C

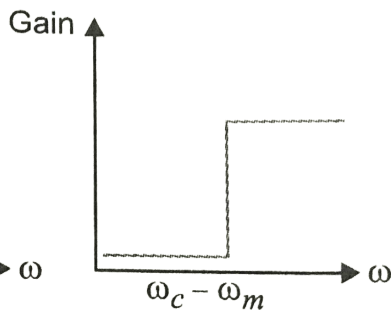


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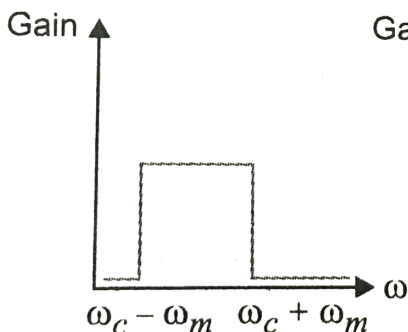
2. The frequency response curve ( Fig. ) for the filter circuit used for production of  $AM$  wave should be



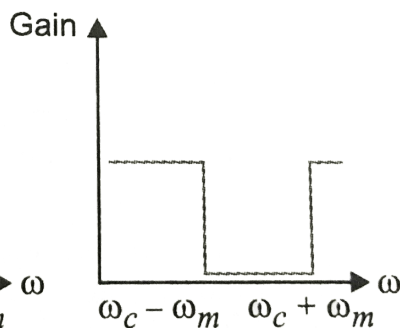
i



ii



iii



iv



A. (i) followed by (ii)

B. (ii) followed by (i)

C. (iii)

D. (iv)

**Answer: A::B::C**



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**3. Choose the correct statement:**

A. In amplitude modulation, the amplitude of the high frequency carrier waves is made to vary in proportion to the amplitude of the audio signal

B. In amplitude modulation the frequency of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal

C. In frequency modulation the frequency of the high frequency of the high frequency carrier wave is made to vary in proportional to the amplitude of the audio signal

D. In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportional to the frequency of the audio signal

**Answer:**



**View Text Solution**

4. Arrange the following communication frequency bands in the increasing order of frequencies

a. AM broadcast

- b. Cellular mobile radio
- c. FM broadcast
- d. Television UHF
- e Satellite communication

A. 1,3,4,2,5

B. 1,2,3,4,5

C. 5,2,4,3,1

D. 1,3,2,4,5

**Answer:**



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**Model Test Paper**

1. How does the random motion of the electrons in a conductor get affected when potential difference is applied across its ends?

A. How does one explain the emission of electrons from a photosensitive surface with the help of Einstein's photoelectric equation?

B.

C.

D.

**Answer:**



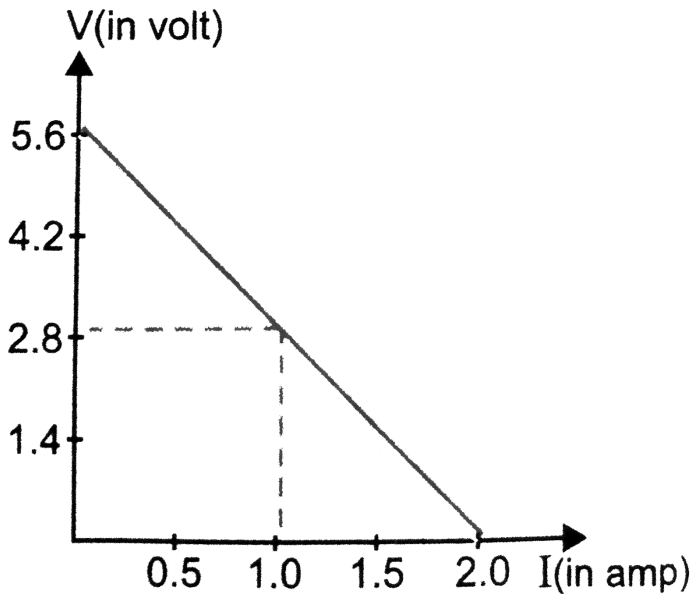
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2. 4 cells of identical emf  $E$  and internal resistance  $r$ , are connected in series to a variable resistor. The following graph shows the variation of terminal voltage of the combination with the current output. Fig. MTP 1.2.

(a) What is the emf of each cell used?

(b) For what current from the cells, does maximum power dissipation occur in the circuit?

(c) Calculate the internal resistance of each cell.



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3. When two cells of emf  $E_1$   $E_2$  and internal resistance  $r_1$  and  $r_2$  are connected in parallel between two points A and B, find the values of effective internal resistance of two cells and their effective emf.



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4. A long solenoid connected to a 12 V d.c. source carries a steady current of 2A. When the same solenoid is connected to an a.c. source of 12 V at 50 Hz, the current flowing is 1A. Why is the current reduced in latter case? Calculate inductance of the solenoid.



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5. Find the expression for capacitance of a parallel plate capacitor when (i) a thin dielectric slab is inserted between the plates, (ii) a thin conducting slab is inserted between the plates.

or Explain the concept of electric potential energy. Derive an expression for potential energy of a system of two point charges. Generalise the expression for N discrete charge.



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6. State and explain Faraday's laws of electromagnetic induction .

Define magnetic permeability and magnetic susceptibility. Establish



relation between them.



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## Model Test Paper 2

1. A galvanometer of resistance  $G$  is converted into a voltmeter to measure upto  $V$  volts by connecting a resistance  $R_1$  in series with the coil. If a resistance  $R_2$  is connected series with it, then it can measure upto  $1/2$  volts. Find the resistance, in terms of  $R_1$  and  $R_2$ , required to be connected to convert in into a voltmeter that can read upto  $2V$ . Also find the resistance  $G$  of the galvanometer in terms of  $R_1$  and  $R_2$



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2. An uncharged capacitor is connected to a battery. Show that half the energy supplied by the battery is lost as heat while charging the capacitor.

Draw an equipotential surface for a uniform electric field. Can two equipotential surfaces intersect each other?



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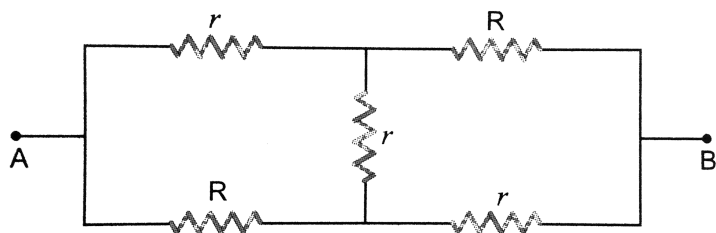
3. A photon and an electron have got same deBroglie wavelength ( $= 1^{-10}m$ ). Which has greater kinetic energy? Explain.

or Two different radioactive elements with half lives  $T_1$  and  $T_2$  have  $N_1$  and  $N_2$  (undecayed) atoms respectively present at a given instant. Determine the ratio of their activities at this instant.



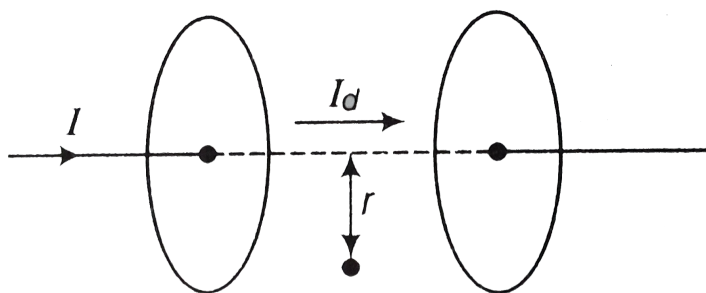
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4. Calculate the equivalent resistance between the points A and B of the network shown in Fig. MTP 2.1.



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5. Show that the magnetic field  $B$  at a point in between the plates of a parallel plate capacitor during charging is  $\frac{\mu_0 \epsilon_0 r}{2} \frac{dE}{dt}$  (symbols having usual meaning).,



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6. when a constant potential difference is applied across the ends of a conductor, the temperature of the conductor increases after sometime, then what is the effect on drift velocity of electron? Discuss it.



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7. With what consideration in view, a photodiode is fabricated ? State its working with the help of a suitable diagrams.

Even though the current in the forward biased is known to be more than in the reverse bias, yet the photodiode works in reverse bias. what is the reason?



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8. What is meant by activity of a radioactive substance? Name and define the units in which it is measured.



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9. Explain the concept of nuclear binding energy. Draw a curve between mass number and average binding energy per nucleon. Explain the energy release in the process of nuclear fission from this plot.

or Discuss briefly the phenomenon of  $\alpha$  – decay. How do you account for it?



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