A. G. High School and G. & D. Parikh Higher Secondary School

Navrangpura, Ahmedabad - 380 009.

Semester - IV : Prelim Examination : 2014

Date : 17-02-2014	Std. : 12	Marks	: 100
Day : Monday	Subject : Physics	Time	: 3:00 Hrs.

Part - A (Time : 1 Hour) **Marks : 50**

1 to 50 Questions are multiple choice question. Each is of ONE mark.
Choose the correct answer from the given options.

1. 800mJ energy is required to established 2A current in a coil. The self inductance of the coil is _____.
   (A) 0.4 H (B) 0.2 H
   (C) 0.4 mH (D) 0.1 H
2. The lenz's force acting on a conducting rod is _____ the velocity of the rod.
   (A) directly propertional to (B) directly propational to the square of
   (C) inversely proportional to (D) inversely proportional to the square of
3. A coil of area $10\ cm^2$ and 10 turns in a uragnetic field directed perpendicular to the plane and changing at a rate of 10^8 Gauss/s. The resistance of coil is 10Ω. The current in the coil will be _____.
   (A) 0.1A (B) 10^{-2}A
   (C) 10A (D) 1A
4. A wheel with 10 metalic spokes each $0.5\ m$ long rotated with a speed of $60\ rev/min$ in a plane normal to the horizontal component of earth's magnetic field B_h at a place. If $B_h = 0.4G$ at the place what is the included *emf* betweeen the axle and the rim of the wheel ?
   (A) 0 V (B) 0.0314 mV
   (C) 0.314 μv (D) 62.8 μV
5. The self inductance of two solenoids A and B having equal length are same. If the number of turns in two solenoids A and B are 200 and 100 respectively the ratio of the radii of their cross-section will be _____
   (A) 2:1 (B) 1:2
   (C) 1:4 (D) 4:1
6. An A.C. voltage V=282 sin (120πt) is connected with a resistance of 20Ω and an ammeter. What will be the reading of ammeter ?
   (A) 14.1 A (B) 10A
   (C) 7.05 A (D) 5A
7. Keeping resistance constant the power factor in an A.C. series L-C-R circuit can be increase by increasing _____.
   (A) inductance (B) inductance capacitance
   (C) Capacitance (D) None of the above
8. What will be the phase difference between virtual voltage and virtual current when the current in the circuit is waltless ?
   (A) 45° (B) 180°
   (C) 60° (D) 90°

9. V and I are given by the following equation in an A.C. circuit $V=100\sin(100t)\ V$ and $I = 100\sin\left(100t + \pi/4\right) mA$. The power in the circuit is equal to _____ W.

(A) 10^4 (B) 3.5
(C) 2.5 (D) 5.0

10. Current of $15.92\ Hz$ frequency is passing through an A.C. circuit having series combination of Resistance $R=100\ \Omega$ and inductor $L=1H$, then phase difference between voltage and current is _____.

(A) 45° (B) 60°
(C) 30° (D) 90°

11. In an oscillating L-C circuit the maximum charge on the capacitor is Q. What will be the charge on the plate of the capacitor, when energy stored in magnetic field and electric field are equal ?

(A) 0.5Q (B) 0.707Q
(C) 0.666Q (D) 0.333Q

12. Astronomers have found that the electromagnetic waves of wavelength 21m are continuously reaching the Earth's surface. The frequency of this radiation is _____.

(A) 1.43 GHz (B) 1.43 MHz
(C) 0.0143 GHz (D) 1.43 Hz

13. An electromagnetic wave pasing through the space is given by equations $E = E_o\sin(\omega t - kx)$ and $B = B_o\sin(\omega t - kx)$ which of the following is true ?

(A) $BoEo=\omega k$ (B) $BoK=Eo\omega$
(C) $\frac{B_o}{E_o} = \frac{K}{\omega}$ (D) $\frac{E_o}{B_o} = \frac{1}{\omega k}$

14. The frequency of an electromagnetic wave in free space is $2MHz$ when it passes through a region or relative permittivity $E_r=9.0$ then its wavelength _____.

(A) becomes one third (B) becomes double
(C) becomes one fourth (D) becomes half

15. The rms value of electric field of the radiation coming from the sun is 72 N/C. The average radiation density is _____ Jm^{-3}.

(A) 81.35×10^{-12} (B) 3.3×10^{-3}
(C) 4.58×10^{-6} (D) 4.58×10^{-8}

16. At room temperature if the relative permittivity of water be 80 and the relative permeability be 2.22×10^{-2} then the velocity of light in water is _____ ms^{-1}.

(A) 3×10^8 (B) 2.5×10^8
(C) 0.0225×10^{10} (D) 3.5×10^8

17. An electromagnetic wave coming from infinity enters a medium from the vaccum For this wave _____ is independent of the medium.

(A) K (B) $\frac{\omega}{k}$
(C) ω (D) λ

18. The distance between two slits in Young's experiment is *0.1mm* and the distance of the screen from the slits is *100cm*, if the wavelength of light is *6000A°* the width of the fringe is
(A) *3 mm* (B) *0.3 cm*
(C) *0.3mm* (D) *3 cm*

19. In Young's experiments the distance between two slits is double and the distance between the screen and slits is double. The width of the fringe _____.
(A) becomes half (B) becomes double
(C) remains the same (D) becomes 4 times

20. A person finds that the sun rays reflected by the still surface of glass plate are polorized. If the refractive index of glass plate is *1.54*, the sun willbe seen at the angle of _____ with the horizon.
(A) 57° (B) 33°
(C) 37° (D) 53°

21. Ordinary light incident on a glass slab at the polarizing angle suffers a deviation of 22°. The value of angle of refraction is _____.
(A) 74° (B) 90°
(C) 34° (D) 22°

22. The ratio of resolving power of telescope, when lights of wavelengths *5000A°* and *4000A°* are used is _____.
(A) 16:25 (B) 5:4
(C) 4:5 (D) 9:1

23. Unpolarized light falls on two polorizers placed one on top the other. What must be the angle between the characteristic directions. (Optic axis) of the polarizer. If the intensity of the transmitted light is one third of the incident beam.
(A) 54.7° (B) 0°
(C) 60° (D) 35.3°

24. In fraunhoffer diffraction by a single slit, the width of the slit is 0.01cm if the wavelength of light incident normally on the slit is *6000A°* the angle distance of second minima from the mid line of central maximum is _____ rad.
(A) 0.012 (B) 0.15
(C) 0.075 (D) 0.0012

25. According to Bohr's hypothesis, the angular momentum of the electron in any stationary orbit of radius r is proportional to _____.
(A) r (B) $\frac{1}{r}$
(C) r^2 (D) $r^{1/2}$

26. The radius of second orbit in an atom of hydrogen is R. What is its radius in fourth orbit.
(A) *3 R* (B) *4 R*
(C) *0.25 R* (D) *9 R*

27. The wavelength of the first line of Lyman series is λ. The wavelength of the first line in Balmer series is _____.

(A) $\frac{27}{5}\lambda$ (B) $\frac{5}{27}\lambda$

(C) $\frac{2}{5}\lambda$ (D) $\frac{9}{2}\lambda$

28. The frequency of characteristic x-ray determines _____ property of the target.

(A) atomic weight (B) melting point

(C) conductivity (D) atomic number

29. In which of the following system will the radius of the 2nd orbit be minimum ?

(A) H-atom (B) Me^{+}

(C) B-atom (D) Mg^{+2}

30. If f_1, f_2 and f_3 are the frequencies corresponding to K_α, K_β *and* L_α x-rays for the given target, then _____.

(A) $f_1=f_2=f_3$ (B) $f_2=f_1-f_3$

(C) $f_2=f_1+f_3$ (D) $f_2=f_3-f_1$

31. The binding energy per nucleon for deuteron ($_1H^2$) nucleus is *1.4MeV* and that for $_2He^4$ nucleus is *7 MeV*. If two deuteron nuclei fuse to form $_2He^4$ nucleus, how much energy will be produced ?

(A) *11.8 MeV* (B) *22.4 MeV*

(C) *23.6 MeV* (D) *32.4 MeV*

32. *1g* radioactive element reduces to *1/3 g* after 2 days. After total 6 days how much mass will remain ?

(A) $\frac{1}{6}g$ (B) $\frac{1}{9}g$

(C) $\frac{1}{12}g$ (D) $\frac{1}{27}g$

33. If the half-lives of a radioactive element for α-decay and β-decay are 4 yr and 12 yr respectively what percent would its total activity be of its initial activity after 9 yrs.

(A) 50 (B) 25

(C) 12.5 (D) 6.25

34. Out of cd, molten Na-metal and graphite which can be used respectively as moderator, the material for control rods and coolant in a reactor ?

(A) Molten Na-metal, graphite, Cd (B) graphite, molten Na-metal, Cd

(C) Cd, molten Na-metal, graphite (D) graphite, cd, molten Na-metal

35. In the radioactive transformation ${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}X_1 \rightarrow {}^{A-4}_{Z-1}X_2 \rightarrow {}^{A-4}_{Z}X_3$, which are the successively emitted radioactive radiations ?

(A) β^-, α, β^- (B) α, β^-, β^-

(C) β^-, β^-, α (D) α, α, β^-

36. The elements X_1 and X_2 have decay constants 11λ and λ respectively. If initially they have equal number of nuclei, then after what time would the ratio of numbers of nuclei of X_1 and X_2 be $\frac{1}{e}$.

(A) $\frac{1}{10\lambda}$ (B) $\frac{1}{11\lambda}$

(C) $\frac{1}{10\lambda}$ (D) $\frac{1}{9\lambda}$

37. For conductor band gap energy is _____
(A) less than *3ev* (B) greater than *3ev*
(C) zero (D) None of them

38. For detecting the light
(A) The photodiode has to be forward biased
(B) The LED has to be connected in forward bias mode
(C) The LED has to be connected in a reverse bias mode
(D) The photodiode has to be reverse biased.

39. A potential barrier of 0.5V exists across of PN junction. If the depletion region is $25\times10^{-7}\,m$ wide the intensity of the electric field in this region is _____.

(A) $1.0\times10^{9}\,V/m$ (B) $1.0\times10^{6}\,V/m$

(C) $2.0\times10^{5}\,V/m$ (D) $2.0\times10^{6}\,V/m$

40. The frequency of the output signal becomes _____ times by doubling the value of the capacitance in the LC oscillator circuit.

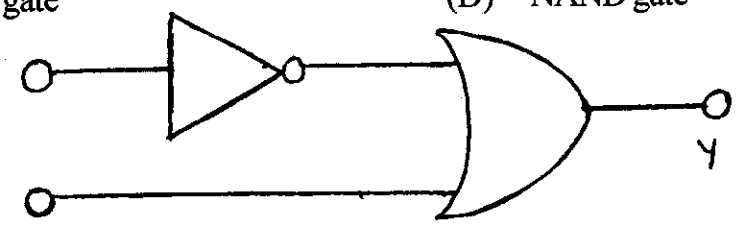
(A) $\sqrt{2}$ (B) $\frac{1}{\sqrt{2}}$

(C) $\frac{1}{2}$ (D) 2

41. The amplifier has voltage gain equal to 1 and its input signal is $0.5\cos(313\,t)\,V$. The output signal will be equal to _____ volt.
(A) $0.5\cos(313t+90^{o})$ (B) $100\cos(313t+180^{o})$
(C) $100\cos(493\,t)$ (D) $0.5\cos(313t+180^{o})$

42. α=0.98 for a CE transistor amplifier circuit the input resistance is equal to 1000Ω and the load resistance is equal to $1\,k\Omega$. The voltage gain of the circuit is
(A) 490 (B) 990
(C) 4900 (D) 49

43. The logic circuit shown in the figure represents characteristics of which logic gate ?
(A) OR gate (B) AND gate
(C) NOR gate (D) NAND gate



44. For an efficient transmission of 30 MHz frequency, the minimum required length of antenna should be _____
(A) $3m$ (B) $2.5m$
(C) $7.5m$ (D) $\frac{3}{4}m$

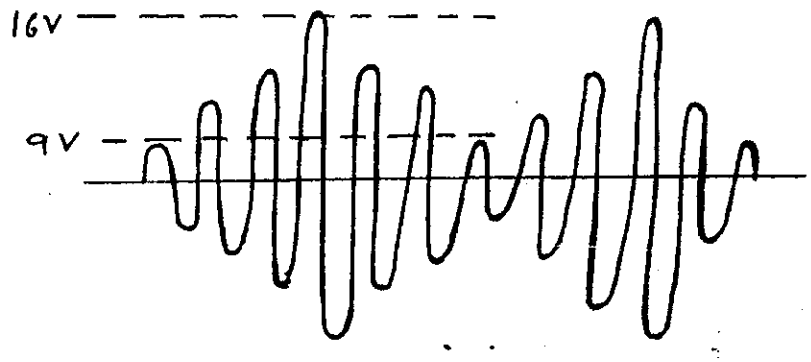
45. In which section of the communication system the noise signal get admixed with the information signal ?
(A) Source of information (B) Transmitter
(C) Communication channel (D) Receiver

46. The band width of an optical fibre communication system is approximately.
(A) *10 GHz* (B) *1000 GHz*
(C) *1 GHz* (D) *0.1 THz*

47. If the height of a TV transmitter tower is doubled, then the region covered by this transmitter.
(A) becomes double (B) becomes four times
(C) becomes three times (D) no change

48. The energy rodiated from the antena is proportional to _____.
(A) λ (B) λ^{-1}
(C) λ^{-2} (D) λ^{2}

49. What will be the modulation index of the following AM wave ?



(A) 7% (B) 28%
(C) 25% (D) 30%

50. Which from the following represents displacement current ?
(A) $\varepsilon_o \frac{dB}{dt}$ (B) $\varepsilon_o \frac{dl}{dt}$
(C) $\varepsilon_o \frac{d\phi_B}{dt}$ (D) $\varepsilon_o \frac{d\phi_E}{dt}$

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Part - B (Time : 2 Hours) **Marks : 50**

Section - A

Answer the following questions 1 to 8 as asked. Each carry 2 mark. **(16)**

1. Explain Lenz's law is a special statement of law of conservation of energy.
2. Draw the graph of $I_{rms} \rightarrow \omega$ for an A.C, L-C-R series circuit and hence explain Q-factor.
3. Drawing necessary figure explain the inductive and radiated components of electromagnetic wave.
4. Prove that the distance between consecutive dark and bright fringes in interference pattern is given by $\frac{\lambda D}{2d}$.

OR

State and prove Brewster's law.

5. Using Bohr's atomic model derive an equation for radius of orbit of an electron.
6. Explain the thermonuclear fusion in the sun and other stars.
7. Write short note on LED.

OR

Draw the logic diagram of a NAND gate. Give the symbol, Boolean expression and truth table for it.

8. What is modulation ? Explain the importance of communication system in modulation.

Section - B

Answer the following question 9 to 14 as asked each carry 3 marks. **(18)**

9. A conducting loop of radius 'r' is placed concentric with another loop of a much larger radius 'R' so that both the loops are coplanar Find the mutual inductance of the system of the two loop. Take $R >> r$.
10. An inductor of $0.5\ H$ and a resistance of $100\ \Omega$ are connected in a series circuit with an A.C. source $V_{rms} = 240\ V$ and $50\ Hz$. Find (1) the maximum current in the inductor (2) the phase difference and the time lag between the current and the voltage.
11. The electric field of an electromagnetic wave travelling along the x-direction is given by $E_y = 48 \sin\left(-10^3 x + 10^{11} t\right)\frac{V}{m}$ then,
    (i) Calculate wavelength and frequency.
    (ii) Write the equation of the magnetic field.
12. The width of slit of $0.012mm$ monochromatic light is incident on it. The angluar position of first bright line is 5.2^o Find the wave-length of incident light.

OR

Obtain the necessary condition with appropriate diagram, to observe minima in the case of Fraunhoffer diffraction due to single slit.

13. Calculate the principal quantum number for which the radius of the orbit of the electron in Be^{+3} would be equal to that for the ground state of electorn in a hydrogen atom and compare the energy of the two states.

OR

A patient has been given a dose of radioactive material. When a counter is brought near him it records 20,000 counts per minute. Under similar conditions the same counter records 625 counts per minute after a lapse of 5 hours. Find the half life of the radiactive material.

14. The collector current changes by *5 mA* when the input voltage of the NPN common emitter amplifier changes by *200 mV*. The A. C. current gain of this circuit is equal to *100*. If we have to obtain a power gain of *5000* then what should be the value of the load resistance ?

Section - C

Answer the following questions Nos.15 to 18 as asked each carry 4 marks. **(16)**

15. An Apparatus of Young's experiment is kept inside a liquid of refractive index 1.66. The distance between two slits is *1.3mm* and the distance between the slit system and the screen is *1.33m*. The wavelength of light used is $6300A^{o}$ in Air.
    (i) Find the distance between two consecutive bright fringes.
    (ii) When one of the slits is covered by a plate of refreactive index 1.75, the first order bright fringe shift to the position of zeroth order bright fringe. Find the thickness of the plates.
16. Define Real power for L-C-R A.C. circuit. Derive expression $P=V_{rms}\,I_{rms}\,cos\delta$ for an A.C. circuit. And discuss the special cases for power consumed in an A.C. circuit.

OR

Write the differential equation for L-C oscillations obtain its solution and show that charge on capacitor and current through inductor changes periodically.

17. A change of *0.02V* takes place between the base and emitter when an input signal is connected to the CE transistor amplifier. As a result $20\mu A$ changes take place in the base current and a change of *2mA* takes place in the collector current. Calculate the following quantities (i) Input resistance, (2) A. C. current gain, (3) Trans conductance, (4) Voltage gain and power gain if Load Resistance is $5\,K\Omega$.
18. Suppose the rate of production of element B from a radioactive element A is α=constant. If at $t=0$ time, the number of atoms of B is No and element B is also radioactive with decay constant λ. Show that the number of B at time t is

$$N=\frac{1}{\lambda}\left[\alpha-(\alpha-\lambda No)e^{-\lambda t}\right].$$

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