Reg. No.

SY-24

Name : ...

SECOND YEAR HIGHER SECONDARY EXAMINATION, MARCH 2020

Part – III

Time : 2 Hours

PHYSICS

Cool-off time : 15 Minutes

Maximum : 60 Scores

General Instructions to Candidates :

- There is a 'Cool-off time' of 15 minutes in addition to the writing time.
- Use the 'Cool-off time' to get familiar with questions and to plan your answers.
- Read questions carefully before answering.
- Read the instructions carefully.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Malayalam version of the questions is also provided.
- Give equations wherever necessary.
- Electronic devices except non-programmable calculators are not allowed in the Examination Hall.

വിദ്യാർത്ഥികൾക്കുള്ള പൊതുനിർദ്ദേശങ്ങൾ :

- നിർദ്ദിഷ്ട സമയത്തിന് പുറമെ 15 മിനിറ്റ് 'കൂൾ ഓഫ് ടൈം' ഉണ്ടായിരിക്കും.
- 'കൂൾ ഓഫ് ടൈം' ചോദ്യങ്ങൾ പരിചയപ്പെടാനും ഉത്തരങ്ങൾ ആസൂത്രണം ചെയ്യാനും ഉപയോഗിക്കുക.
- ഉത്തരങ്ങൾ എഴുതുന്നതിന് മുമ്പ് ചോദ്യങ്ങൾ ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- നിർദ്ദേശങ്ങൾ മുഴുവനും ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- കണക്ക് കൂട്ടലുകൾ, ചിത്രങ്ങൾ, ഗ്രാഫുകൾ, എന്നിവ ഉത്തരപേപ്പറിൽ തന്നെ ഉണ്ടായിരിക്കണം.
- ചോദ്യങ്ങൾ മലയാളത്തിലും നല്കിയിട്ടുണ്ട്.
- ആവശ്യമുള്ള സ്ഥലത്ത് സമവാക്യങ്ങൾ കൊടുക്കണം.
- പ്രോഗ്രാമുകൾ ചെയ്യാനാകാത്ത കാൽക്കുലേറ്ററുകൾ ഒഴികെയുള്ള ഒരു ഇലക്ട്രോണിക് ഉപകരണവും പരീക്ഷാഹാളിൽ ഉപയോഗിക്കുവാൻ പാടില്ല.

Answer any 5 questions from 1 to 6. Each carries 1 score. **(5 × 1 = 5)**

1. How capacitance changes if the distance between the plates of a parallel plate capacitor is halved ?

   (a) Does not change
   (b) Becomes half
   (c) Doubled
   (d) Becomes one fourth

2. The path of a charged particle entering parallel to uniform magnetic field will be

   (a) circular
   (b) helical
   (c) straight line
   (d) None of these

3. Coefficient of mutual inductance of two coils is 1 H. Current in one of the coils is increased from 4 to 5 A in 1 ms. What average emf will be induced in the other coil ?

   (a) 1000 V
   (b) 2000 V
   (c) 100 V
   (d) 200 V

4. Total internal reflection may be observed if

   (a) light ray is travelling from denser medium to rarer medium
   (b) light ray is travelling from rarer medium to denser medium
   (c) light ray is travelling from any medium to another medium

5. Optical fibres make use of the phenomenon of

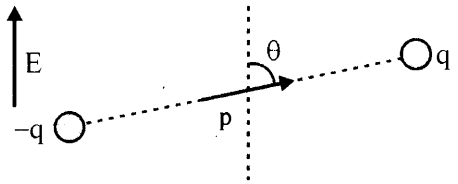
   (a) refraction
   (b) total internal reflection
   (c) interference
   (d) diffraction

6. The size of the atom in Thomson's model is _____ the atomic size in Rutherford's model.

   (a) much greater than
   (b) not different from
   (c) much less than

Answer any 7 questions from 7 to 15. Each carries 2 scores. **(7 × 2 = 14)**

7. A permanent electric dipole of dipole moment **p** is placed in a uniform external electric field **E**, as shown in Figure.



(a) Redraw the figure and show the magnitude and direction of force acting on the charges.

(b) Write an expression of the torque acting on this dipole in vector form.

8. Ampere's theorem helps to find the magnetic field in a region around a current carrying conductor.

(a) Write the expression of Ampere's theorem.

(b) Draw a graph showing the variation of intensity of magnetic field with the distance from the axis of a current carrying conductor.

9. A magnetised needle in uniform magnetic field experiences a torque but no net force. An iron nail near a bar magnet, however, experiences a force of attraction in addition to a torque. Why ?

10. What is the magnitude of the equatorial and axial fields due to a bar magnet of length 5.0 cm at a distance of 50 cm from its mid-point ? The magnetic moment of the bar magnet is 0.40 Am^2.

11. A magician during a show makes a glass lens with n = 1.47 disappear in a trough of liquid.

(a) What is the refractive index of the liquid ?

(b) Could the liquid be water ?

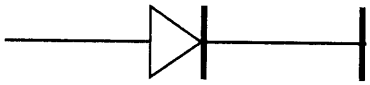
12. Explain why the bluish colour predominates in a clear sky.

13. Match the following :

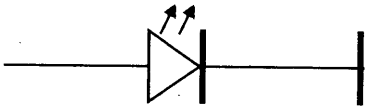
	A	B
(i)	Nuclear fission	β-decay
(ii)	Nuclear fusion	Hydrogen spectrum
(iii)	Transition between atomic energy levels	Nuclei with low atomic numbers
(iv)	Electron emission from nucleus	Generally possible for nuclei with high atomic number
		Photo electric emission

14. Diodes are one of the building elements of electronic circuits. Some type of diodes are shown in the figure.

(i)



(ii)



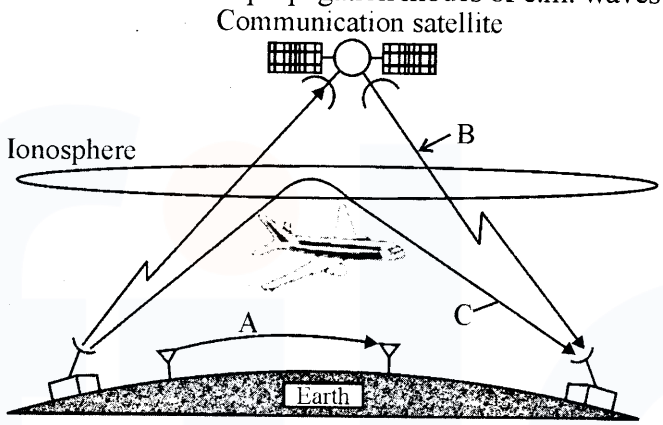
(iii)



(a) Identify rectifier diode from the figure.

(b) Draw the circuit diagram of a forward biased rectifier diode by using a battery.

15. The given figure shows the various propagation modes of e.m. waves in communication.

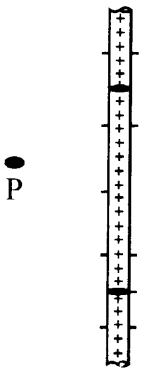


(a) Write the names of propagation modes in A, B, C.

(b) Why transmission of TV signals via sky wave is not possible ?

Answer any 6 questions from 16 to 23. Each carries 3 scores. **(6 × 3 = 18)**

16. An infinitely long thin straight wire with uniform linear charge density is shown in figure.



(a) Draw a Gaussian surface in order to calculate the electric field at P and mark direction of electric field at this point.

(b) Derive an expression to calculate electric field at this point P. **(2 + 1)**

17. Three resistors R_1, R_2, R_3 are to be combined as shown in the figures.

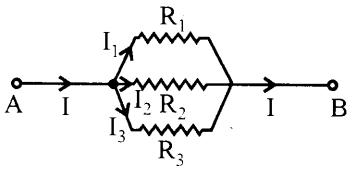


Fig. 1

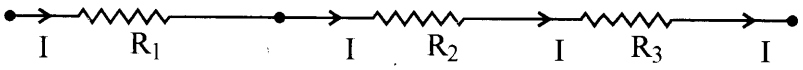


Fig. 2

(a) Identify the series and parallel combinations.

(b) Which combination has lowest effective resistance ?

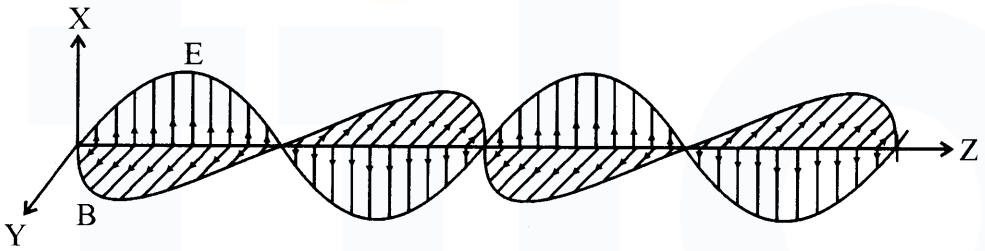
(c) Arrive at the expression for the effective resistance of parallel combination.

(1 + ½ + 1½)

18. (a) State Faraday's law of electromagnetic induction.

(b) How does the magnetic energy stored in an inductor and electrostatic energy stored in a capacitor related to their respective field strengths ? **(1½ + 1½)**

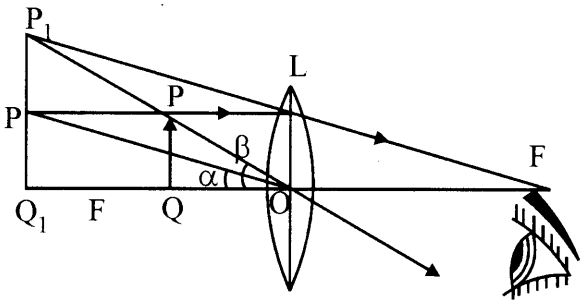
19. A typical plane electromagnetic wave propagating along the Z direction is shown in figure.



(a) Write the equation for electric and magnetic fields.

(b) Write the methods of production of radio waves and microwaves. Write any one use of these waves. **(1 + 2)**

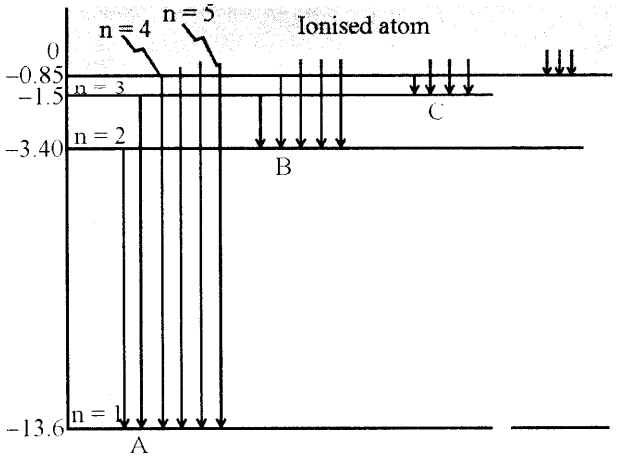
20. The figure shows the image formation of an object in simple microscope.



(a) Find out the object distance and image distance from the figure.

(b) Derive an equation for magnifying power of the simple microscope. **(1 + 2)**

21. The atomic line spectra of hydrogen atom is shown in figure.



Write the names of the series A, B and C.

22. Spontaneous and continuous disintegration of a nucleus of a heavy element with the emission of certain types of radiation is known as radioactivity.

(a) The radioactive isotope 'D' decays according to the sequence

$$D \xrightarrow{\beta^-} D_1 \xrightarrow{\alpha} D_2$$

If the mass number and atomic number of D_2 are 172 and 71 respectively, what are the (i) Mass number, (ii) atomic number of D.

(b) State radioactive decay law.

(c) Write the relation connecting half-life and mean life of radioactive element. **(1 + 1 + 1)**

23. In the broadcast of communication modulation is necessary.

(a) What do you mean by modulation ?

(b) Explain any two reason why modulation is necessary ? **(2 + 1)**

Answer any 2 questions from 24 to 26. Each carries 4 scores. **(2 × 4 = 8)**

24. Three capacitors of capacitances 2 pF, 3 pF and 4 pF are connected in parallel.

(a) Write the SI unit of capacitance.

(b) Calculate the effective capacitance of the combination.

(c) Determine the charge on each capacitor if the combination is connected to a 100 V supply. **(½ + ½ + 3)**

25. A rectangular loop of area A and carrying a steady current I is placed in a uniform magnetic field.

(a) Derive the expression of torque, $\tau = \vec{m} \times \vec{B}$, acting on the loop.

(b) Increasing the current sensitivity may not necessarily increase the voltage sensitivity of a galvanometer. Justify. **(2½ + 1½)**

26. The work function of caesium metal is 2.14 eV. When light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs. ($h = 6.6 \times 10^{-34}$ js)

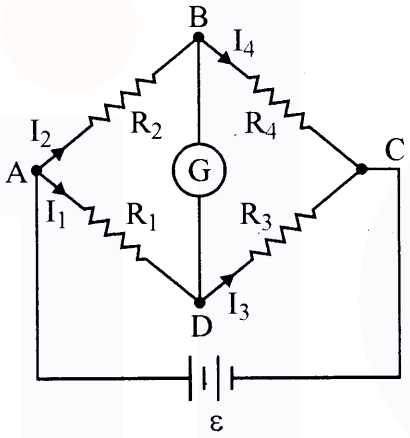
(a) Define work function.

(b) Calculate the maximum kinetic energy of the emitted electrons.

(c) Calculate the stopping potential.

Answer any 3 questions from 27 to 30. Each carries 5 scores. **(3 × 5 = 15)**

27. A Wheatstone bridge is shown in figure.



(a) Derive a relation connecting the four resistors for the galvanometer to give zero or null deflection.

(b) Name a practical device which uses this principle. **(4 + 1)**

28. The current through an AC circuit depends on the magnitude of the applied voltage and impedance of the circuit.

(a) Write any two factors on which the impedance of a series LCR circuit depends.

(b) Draw and impedance diagram of a series LCR circuit and write the expression for the power factor from the diagram.

(c) A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which R = 3 Ω, L = 25.48 mH, and C = 796 μF. Find the impedance of the circuit. **(1 + 1 + 3)**

29. A long narrow slit is illuminated by blue light and the diffraction pattern is obtained on a white screen.

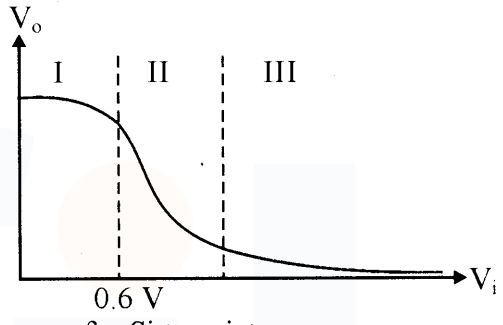
(a) How the width of bands change as the distance from the centre increases ?

(b) What happens to the width of pattern, if yellow light is used instead of blue light ?

(c) In a double slit experiment, the slits are separated by 0.03 cm and the screen is placed 1.5 m away. The distance between the central fringe and the fourth bright fringe is 1 cm. Determine the wavelength of light used in the experiment.

(d) What do you mean by limit of resolution of an optical instrument ? **(1 + 1 + 2 + 1)**

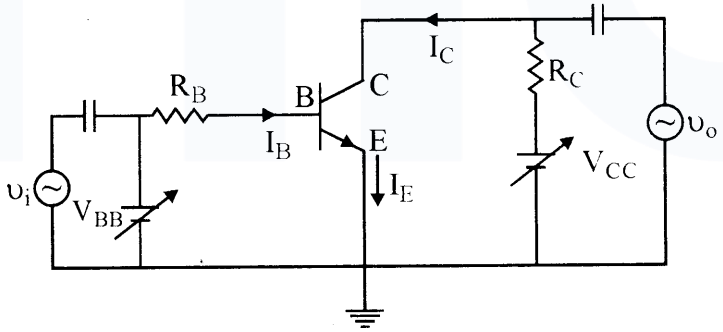
30. The transfer characteristic of n-p-n transistor in CE configuration is shown in the figure



(a) Find the cut off region, active region and saturation region from it.

(b) In which of these regions, a transistor is said to be switched off.

(c) A CE transistor amplifier is shown in figure.



In this, the audio signal voltage across collector resistance of 2.0 kΩ is 2.0 V. Suppose the current amplification factor of the transistor is 100. Then calculate the value of signal current through the base.

(d) In the working of a transistor, the emitter-base (EB) junction is forward biased while collector base (CB) junction is reverse biased. Why ? **(1½ + ½ + 2 + 1)**

SECOND YEAR HSE - MARCH 2020

PHYSICS

① (c) doubled $\left(C = \frac{\varepsilon A}{d}\right)$

② (c) Straight line

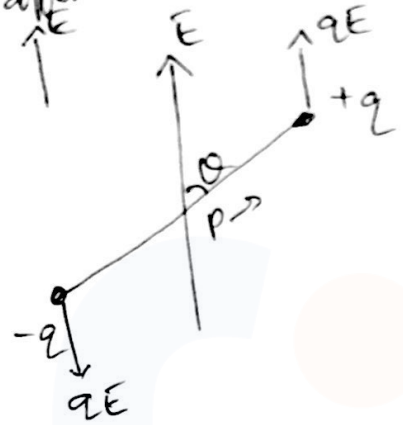
③ $e = N\frac{dI}{dt} = 1 \times \frac{(5-4)}{10^{-3}s} = 1000V$

④ (a) denser to rarer

⑤ (b) TIR

⑥ No difference

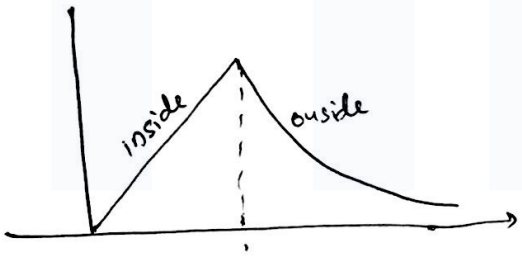
⑦ ⑧



⑤ $\vec{\tau} = \vec{p} \times \vec{E}$

⑧ ⑨ $\int \vec{B}.d\vec{l} = \mu_0 \Sigma I$

⑥



⑨ The magnetic moment induced in the nail experiences a non-uniform magnetic field which produces torque (rotational motion) as well as translational motion (Net force)

~~(10) $E_{axial} = q \times 10^{9} \times 2R$~~

⑩ $B_{axial} = \frac{\mu_0}{4\pi}\frac{2M}{r^3}$

$= 10^{-7} \times \frac{2\pi \times 0.4}{0.5^3}$

$= 6.4 \times 10^{-7}\ T$

$B_{eq} = \frac{\mu_0}{4\pi}\frac{M}{r^3} = \frac{B_{axial}}{2}$

$= 3.2 \times 10^{-7}\ T$

⑪ (a) $n = 1.47$

(b) No, $n_{water} = \frac{4}{3} = 1.33$

⑫ ~~During day time~~, According to Rayleigh, Intensity of scattered light - $I \propto \frac{1}{\lambda^4}$.

during day time, sun rays has to travel less distance through atmosphere and lower wave lengths like Violet, indigo, blue scattered more and have high intensity. The combination of these seems like blue.

⑬ (i) Nuclear fission - Nuclei with high atomic Number

(ii) Nuclear fusion - Nuclei with low atomic No.

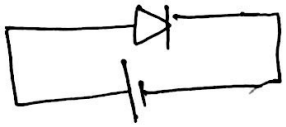
(iii) Transition ... - H-Spectrum

(iv) e - emission from Nucleus - β decay

⑭ (a)



(b)



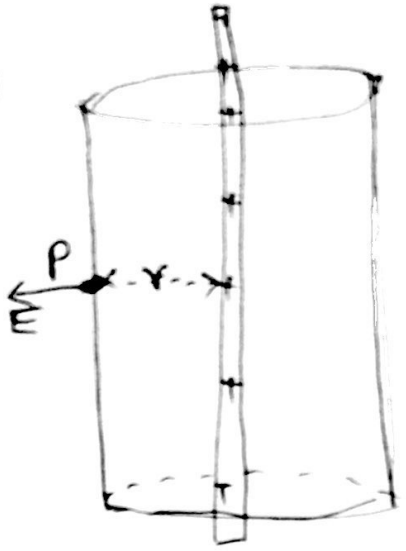
⑮ (a) A - Ground wave

B - Space wave

C - Sky wave

(b) The frequencies below 40 MHz only is reflected by ionosphere Frequency of TV signals is above 54 MHz and they passes through ionosphere

(16) (a)



(b) Derivation of $E = \frac{1}{4\pi\varepsilon} \frac{2\lambda}{r}$

(17) (a) Fig 1 - Parallel
Fig 2 - series

(b) parallel

(c) Derivation, $\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

(18) (a) statement of laws

(b) $U_{mag} = \frac{1}{2} L I^2$

~~$U_{ele} = \frac{1}{2} C V^2$~~

$= \frac{1}{2} L \left(\frac{B}{\mu_0 n}\right)^2$

$= \frac{1}{2} L B^2$
$\frac{}{2\mu_0^2 n^2}$

$U_{ele} = \frac{1}{2} C V^2$

$= \frac{1}{2} C (Ed)^2$

$= \frac{1}{2} C d^2 E^2$

or any relation btw U_{mag} and B and, U_{ele} and E

(19) (a) $E_x = E_0 \sin(\omega t - kz)$

$B_y = B_0 \sin(\omega t - kz)$

(b) (1) Radio waves - Accelerated motion of charges in conducting wire.
uses - mobile communication
- radio and TV broadcasting

(2) Microwaves - produced by special vacuum tubes
use - Radar

(20) (a) $V = \frac{Q}{C}$

$V = \frac{Q_1}{C}$

(b) ~~$\mu = \mu_i$~~ μ_0 Derivation of

$M = \frac{P}{C}$

(21) A) Lymann
B) Balmer
C) Paschen

(22) (a) $\overset{Z}{\underset{A}{D}} \xrightarrow{\beta^-} \overset{Z+1}{\underset{A}{D_1}} \xrightarrow{\alpha} \overset{Z+1-2}{\underset{A-4}{D_2}}$

$A - 4 = 172$

$A = 176$

$Z + 1 - 2 = Z - 1 = 71$

$Z = 72$

(b) $\frac{dN}{dt} \propto N$ OR $\frac{dN}{dt} = -\lambda N$

(c) $T_{mean} = \frac{T_h}{0.693}$

23 (a) Definition of modulation

(b) (i) Impractical length of antenna

(ii) Mixing up of signals from different transmitter

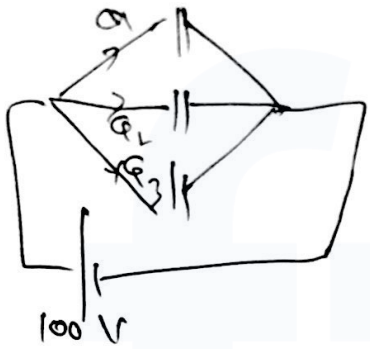
24 (a) Farad

(b) $C_1 = 2pF$

$C_2 = 3pF$

$C_3 = 4pF$

$C_p = C_1 + C_2 + C_3 = 9pF$



$Q_1 = C_1V = 2pF \times 100 = 2 \times 10^{-10} C$

$Q_2 = C_2V = 3pF \times 100 = 3 \times 10^{-10} C$

$Q_3 = C_3V = 4 \times 10^{-10} C$

25 (a) Derivation of $\tau = MB\sin\theta$

$\vec{\tau} = \vec{m} \times \vec{B}$

(b) $S_V = \frac{S_I}{R}$ and $S_I = \frac{NAB}{C}$

If we increase the value of S_I by increasing either N or A, ~~which~~ increases the length of the coil, inturn increase the value of R

So, $S_V = \frac{S_I}{R}$ will not change

26 (a) Definition of work function

(b) $\phi_0 = 2.14\ eV$

$E_i = h\nu$

$= \frac{6.6 \times 10^{-34} \times 6 \times 10^{14}}{1.6 \times 10^{-19}}\ eV$

$= 2.475\ eV$

$KE_{max} = E_i - \phi_0$

$= 2.475 - 2.14$

$= 0.335\ eV$

$= 0.536 \times 10^{-19}\ J$

(c) $KE_{max} = eV_0$

$V_0 = \frac{KE_{max}}{e}$

$= \frac{0.335\ eV}{e}$

$= 0.335\ V$

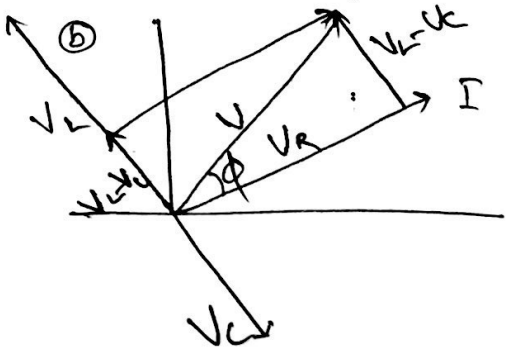
27 (a) Derivation, $\frac{R_1}{R_2} = \frac{R_3}{R_4}$

OR any correct relation.

(b) Metre bridge

28 (a) (i) Values of L and R

(ii) phase difference



④

Power factor = $\cos\phi$

$= \frac{V_R}{V}$

$= \frac{V_R}{\sqrt{V_R^2 + (V_L - V_C)^2}}$

$= \frac{R}{\sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}}$

(c) $V_0 = 283\,V$

$f = 50$

$\omega = 2\pi f = 314$

$Z = \sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}$

$= \sqrt{3^2 + \left(25.48\times10^{-3}\times314 - \frac{1}{796\times10^{-6}\times314}\right)^2}$

$= \sqrt{9 + (8-4)^2}$

$= \sqrt{9+16}$

$= 5\,\Omega$

(29) (a) Decreases

(b) $\omega = \frac{2\lambda D}{a}$

$\lambda_b < \lambda_y$, $W_b > W_y$.

width increases.

(c) $n\beta = 4\beta = 10^{-2}\,m$

$\beta = \frac{10^{-2}}{4}$

$D = 1.5\,m$

$d = 0.03\,cm$

$= 3\times10^{-4}\,m$

$\beta = \frac{\lambda D}{d}$

$\lambda = \frac{\beta d}{D} = \frac{\frac{1}{4}\times10^{-2}\times3\times10^{-4}}{1.5}$

$= 0.5\times10^{-6}\,m$

(d) It is the minimum distance of separation btw two objects, so that we can see them clearly and distinctly.

(30) (a) I - Cut off

II - Active

III - Saturation

(b) Region I

(c) $\beta = 100$

$V_0 = \Delta I_C R_C$

$\Delta I_C = \frac{V_0}{R_C}$

$= \frac{2}{2\times10^3} = 10^{-3}\,A$

$\beta = \frac{\Delta I_C}{\Delta I_B}$

$\Delta I_B = \frac{\Delta I_C}{\beta} = \frac{10^{-3}}{100} = 10^{-5}\,A$

(d) When a current flows through EB junction, a current also flows through collector. But I_C is larger as compared to I_B. The transistor connect in this way only for amplification purpose. (The Qn is not complete or clear).