Pre Board -1 Examination – December 2019

Roll No. | | | | | | | |

Series SSR / 1 **Code No. 042/ 1 / 2**

- Please check that this question paper contains 9 printed pages.
- Code number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains 38 questions.
- Please write down the serial number of the question before attempting it.

PHYSICS

Class : XII Time allowed : 3 hrs.
Date : 11-12-2019 Max marks : 70

General instructions:

i. All questions are compulsory. There are 37 questions in all.
ii. This question paper has four sections ; Section -A, Section-B , Section- C and Section – D.
iii. Section -A contains 20 questions of **one** mark, Section- B contains seven questions of **two** marks, Section –C contains seven questions of **three** marks , Section –D contains three questions of **five** marks each.
iv. There is **no overall choice**. However, an internal choice(s) is provided in two question of one mark, Two questions of two marks, one question of three marks and Three questions of five marks. You have to attempt only one of the choices in such questions.
v. Use of calculator is not permitted. However, you may use log tables if necessary.
vi. You may use the following physical constants wherever necessary.

$c = 3 \times 10^8\ ms^{-1}$
$h = 6.6 \times 10^{-34}\ J\ s$
$e = 1.6 \times 10^{-19}\ C$
mass of electron, $m_e = 9.1 \times 10^{-31}\ kg$
$\mu o = 4\pi \times 10^{-7}\ TmA^{-1}$
$\varepsilon_o = 8.85 \times 10^{-12}\ C^2 N^{-1} m^{-2}$
$\frac{1}{4\pi\varepsilon o} = 9 \times 10^9\ Nm^2C^{-2}$

SECTION – A

Directions (Q1-Q10) Select the most appropriate option from those given below each question.

1. Two charges of magnitude -3Q and +2Q are located at points (a, 0) and (4a , 0) respectively. The electric flux due to these charges through a sphere of radius '5a' with its centre at the origin is

(a) $-3Q/\varepsilon_0$ (b) $+2Q/\varepsilon_0$ (c) $+Q/\varepsilon_0$ (d) $-Q/\varepsilon_0$.

2. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system ;

(a) decreases by a factor 2
(b) increases by a factor 2
(c) remains the same
(d) increases by a factor of 4 .

3. A carbon resistor of (47 $\pm$ 4.7) KΩ is to be marked with rings of different colours for its identification. The colour code sequence will be

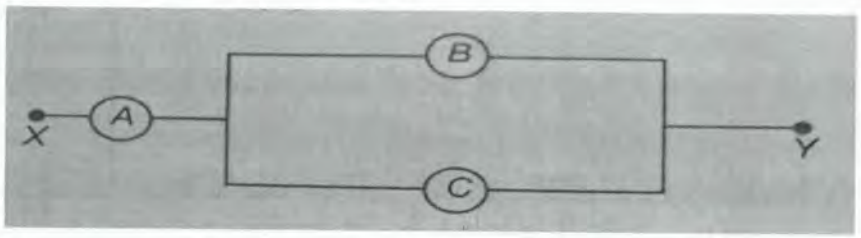
(a) violet- yellow- orange – silver

(b) yellow- violet – orange – silver

(c) yellow- green – violet – gold

(d) green – orange – violet – gold.

4. A, B and C are voltmeters of resistance R, 1.5R and 3R respectively as shown in the figure. When some potential difference is applied between X and Y, the voltmeter readings are V_A, V_B and V_C respectively. Then



(a) $V_A = V_B \neq V_C$ (b) $V_A \neq V_B \neq V_C$ (c) $V_A = V_B = V_C$ (d) $V_A \neq V_B = V_C$

5. Current sensitivity of a moving coil galvanometer is 5 div / mA and its voltage sensitivity is 20 div / V. The resistance of the galvanometer is

(a) 40Ω (b) 25Ω (c) 250Ω (d) 500 .

6. The angle of incidence for a ray of light at a refracting surface of a prism is 45°. The angle of prism is 60°. If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively are:
(a) 45° ; $\sqrt{2}$ (b) 30° ; $1/\sqrt{2}$ (c) 45° ; $1/\sqrt{2}$ (d) 30° ; $\sqrt{2}$

7. A linear aperture whose width is 0.02 cm is placed immediately in front of a lens of focal length 60cm. The aperture is illuminated by a parallel beam of wavelength 5×10^{-5} cm. The distance of the first dark band of the diffraction pattern from the centre of the screen is

(a) 0.01 cm (b) 0.25 cm (c) 0.20 cm (d) 0.15 cm

8. Unpolarised light is incident from air on a plane surface of a material of refractive index n . At a particular angle of incidence 'i', it is found that the reflected and refracted rays are perpendicular to each other. Which of the following option is correct for this situation?

(a) Reflected light is polarized with its electric vector parallel to the plane of incidence.
(b) Reflected light is polarized with its electric vector perpendicular to the plane of incidence.
(c) $i = \sin^{-1}\left(\frac{1}{n}\right)$
(d) $i = \tan^{-1}\left(\frac{1}{n}\right)$

9. A photoelectric cell is illuminated by a point source of light 1m away. The plate emits electrons having stopping potential V. Then

(a) V decreases as distance increases
(b) V increases as distance increases
(c) V is independent of distance
(d) V becomes zero when distance increases or decreases.

10. The ratio of the speed of the electrons in the ground state of hydrogen to the speed of light in vacuum is

(a) ½ (b) 2/237 (c) 1/137 (d) 1/237

Directions (Q11- Q 15) Fill in the blanks with appropriate answer.

11. In a plane perpendicular to the magnetic meridian, the dip needle will be .....

OR

The permeability of a magnetic material is 0.9983. The magnetic material is .....

12. The physical quantity which is the ratio of magnetic flux and induced current is .....

13. The quality factor of a series LCR cir cuit with L = 2 H, C = 2μF and R = 10 is .....

14. Photoelectric emission occurs only when the incident light has more than a certain minimum.....

15. The redistribution of light energy on account of superposition of light waves coming from two coherent sources of light is known as.....

Directions (Q16-Q20) Answer the following.

16. Two nuclei have mass numbers in the ratio 2 : 5. What is the ratio of nuclear densitiies ?

17. Zener diodes have higher dopant densities as compared to ordinary p-n junction diodes. How does it affect the (a) width of depletion layer (b) junction field ?

18. Why is it found experimentally difficult to detect neutrinos in nuclear β- decay?

19. Two metals A and B have work functions 4eV and 10eV respectively. Which metal has the higher threshold wavelength ?

20. Sn, C, Si and Ge are all group 14 elements. Yet Sn is a conductor, C is an insulator, while Si and Ge are semiconductors. Why?

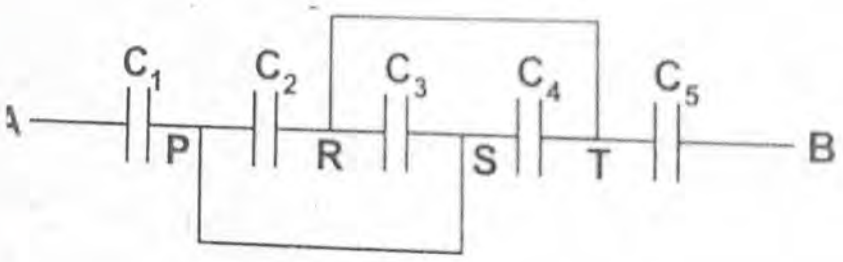
OR

State the reason, why a photodiode is usually operated at a reverse bias.

SECTION - B

21. (a) Show on plot, variation of resistivity of (i) a conductor and a (ii) typical semiconductor as a function of temperature.
(ii) Using the expression for the resistivity in terms of number density and relaxation time between the collisions, explain how resistivity in case of a conductor increases while it decreases in a semiconductor, with rise in temperature.

22. (a) Find equivalent capacitance between A and B in the combination given below. Each capacitor is of 2μF capacitance.
(b) If a dc source of 7V is connected across AB, how much charge is drawn from the source and what is the energy stored in the network?



23. Plot a graph showing the variation of de- Broglie wavelength 'λ' versus $\frac{1}{\sqrt{V}}$, where V is the accelerating potential for two particles A and B carrying same charge but of different masses m1 and m2 (m1 > m2). Which one of the two represents a particle of smaller mass and why?

24. Two polaroids P1 and P2 are placed with their pass axes perpendicular to each other. Unpolarised light of intensity I_0 is incident on P1. A third polaroid P3 is kept in between

P1 and P2 such that its pass axis makes an angle of 30° with that of P1. Determine the intensity of light transmitted through P1, P2 and P3.

25. An electromagnetic wave of wavelength λ is incident on a photosensitive surface of negligible work function. If the photo-electrons emitted from this surface have the de-Broglie wavelength λ_1, prove that $\lambda = \left(\frac{2mc}{h}\right) \lambda_1^{\,2}$.

26. The total energy of an electron in the first excited state of hydrogen atom is about - 3.4 eV,
(a) what is the kinetic energy of the electron in this state?
(b) what is the potential energy of the electron in this state?
(c) which of the answers above would change if the choice of the zero of potential energy is changed?

OR

Find the ratio of minimum to maximum wavelength of radiation emitted by an electron in the ground state of Bohr's hydrogen atom.

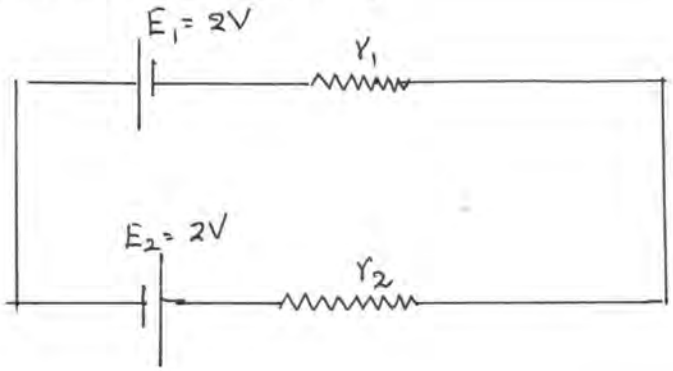
27. (a) Why is a photodiode operated in the reverse bias mode?
(b) For what purpose is a photodiode used?
(c) Draw its I-V characteristics for different intensities of illumination.

OR

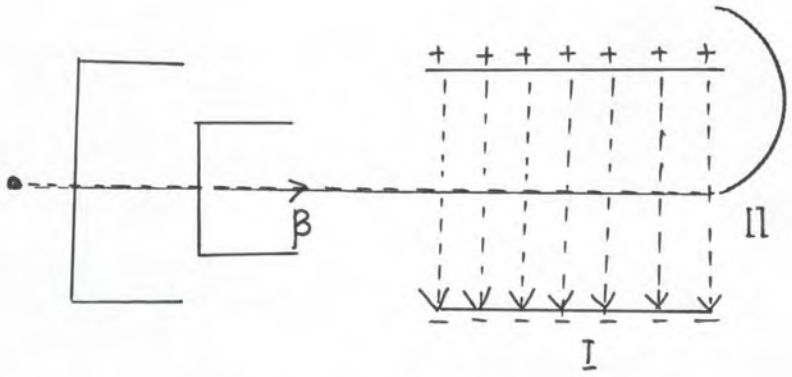
Draw energy band diagram of n and p type semiconductors. Also write two differences between n and p type semiconductors.

SECTION-C

28. (a) State Kirchhoff's rules.
(b) Use Kirchhoff's rules to show that no current flows in the given circuit, when any one of the cells is connected with reverse polarity.



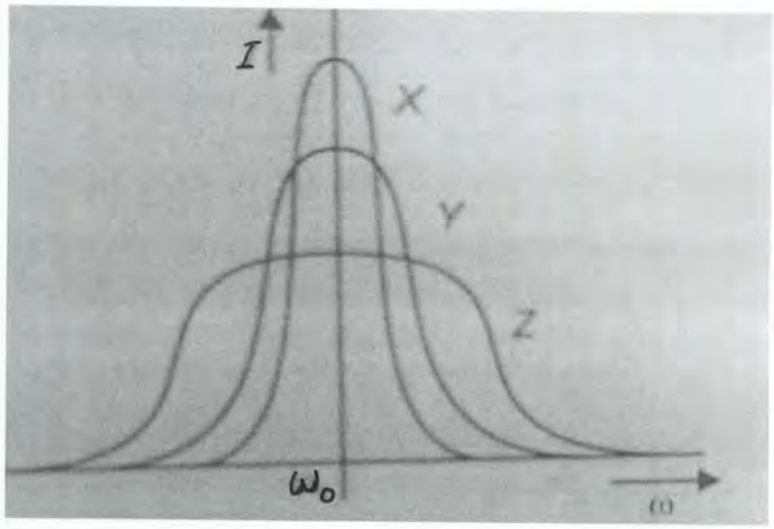
29. (a) A fine pencil beam of β – particles, moving with a speed v, enters a region (region I), where a uniform electric field and a uniform magnetic field both are present. These β – particles then move into region II, where only the magnetic field exists. The path of the β – particles, in the two regions is as shown in the figure.



(i) state the direction of magnetic field.
(ii) State the relation between E and B in region I.
(iii) Derive the expression for the radius of the circular path of the β – particles in region II.
(iv) If the magnitude of magnetic field, in region II is changed to n times its earlier value, (without changing the magnetic field in region I) find the factor by which the radius of this circular path would change.

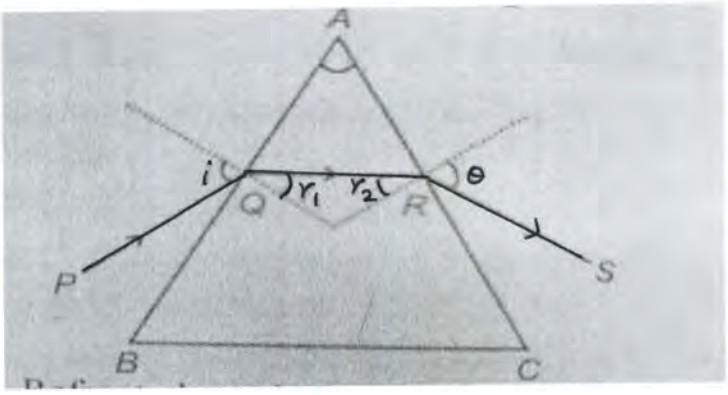
30. Three students X, Y, Z performed an experiment for studying the variation of alternating currents with angular frequency in a series LCR circuit and obtained the graphs shown below. They all used ac sources of the same rms value and inductance of same value. What can we conclude about (i) capacitance values (ii) resistance used by them ? in which case will the quality factor be maximum?

What can we conclude about nature of the impedance of the set up at the frequency ω_0?



31. Draw a ray diagram showing the image formation by a compound microscope. Hence obtain expression for total magnification when the image is formed at infinity.

32. Figure shows a ray of light passing through a prism. If the refracted ray QR is parallel to the base BC, show that (i) $r_1 = r_2 = A/2$, (ii) angle of minimum deviation, $D_m = 2i - A$.

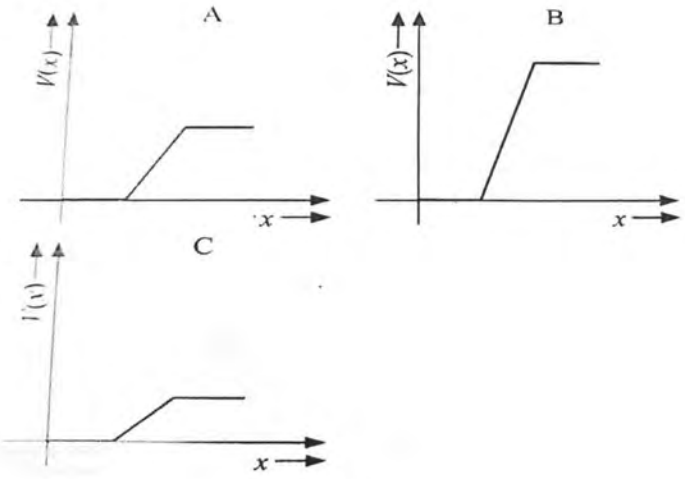


OR

(a) A ray of light incident on face AB of an equilateral glass prism,shows minimum deviation of 30°. Calculate the speed of light through the prism.
(b) Find the angle of incidence at face AB so that the emergent ray grazes along the face AC.

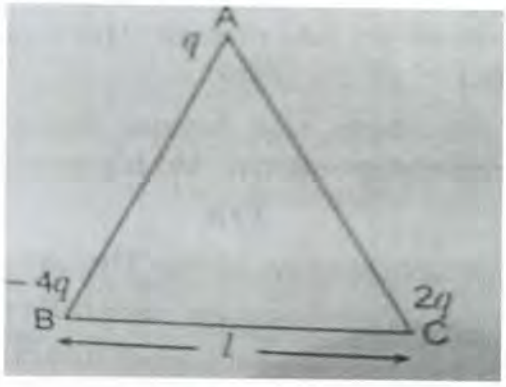
33. (a) What is meant by half -life of a radioactive element?
(b) The half- life of a radioactive substance is 30s. Calculate
(i) The decay constant, and
(ii) Time taken for the sample to decay by $3/4^{th}$ of its initial value.

34. State briefly the processes involved in the formation of p-n junction explaining clearly how depletion region is formed. The graphs of potential barrier versus width of depletion region for an unbiased diode is shown in figure A. In comparison to A, graphs B and C are obtained after biasing the diode in different ways. Identify the type of biasing in B and C.



SECTION- D

35. (a) Three point charges –q, -4q and 2q are placed at the vertices of an equilateral triangle ABC of side 'l' as shown in the figure. Obtain the expression for the magnitude of the resultant electric force acting on q.



(b) Find out the amount of work done to separate the charges at infinite distance.

OR

(a)Obtain an expression for the energy stored per unit volume in a charged parallel plate capacitor..

(b) Find the ratio of the potential difference that must be applied across the parallel and series combination of two capacitors C1 and C2 with their capacitance in the ratio 1:2 so that the energy stored in the two cases becomes the same.

36. (a)A metallic rod of length 'l' and resistance R is rotated with a frequency √ with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 'l' about an axis passing through the centre and perpendicular to the plane of the ring . A constant and uniform magnetic field 'B' parallel to the axis is present everywhere.

(i) Derive the expression for the induced emf and current in the rod.
(ii) Due to the presence of the current in the rod and of the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.
(iii) Hence, obtain an expression for the power required to rotate the rod.

(b)What are eddy currents? In what sense eddy currents are considered undesirable in a transformer? How can they be minimized?

OR

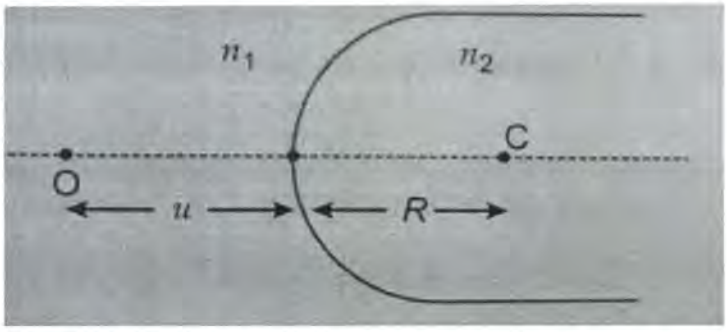
(a) Describe a simple experiment to show that the polarity of emf induced in a coil is always such that it tends to produce an induced current which opposes the change of magnetic flux that produces it.
(b) The current flowing through an inductor of self- inductance L is continuously increasing . Plot a graph showing the variation of

(i) magnetic flux versus current.

(ii) induced emf versus $\frac{dI}{dt}$.

(iii) magnetic potential energy stored versus the current.

37. (a) A point object O is kept in a medium of refractive index n_1 in front of a convex spherical surface of radius of curvature R which separates the second medium of refractive index n_2 from the first one, as shown in figure.

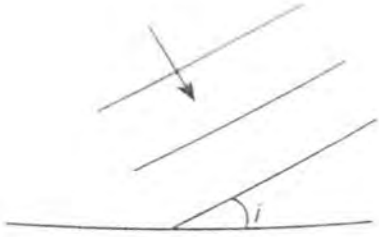


Draw the ray diagram showing the image formation and deduce the relationship between the object distance and the image distance in terms of n_1, n_2 and R

(b) when the image formed above acts as a virtual object for a concave spherical surface separating the medium n_2 ($n_2 > n_1$) , draw this ray diagram and write the similar relation (as in (a)). Hence obtain the expression for the len's maker's formula.

OR

(a)A Plane wavefront propagating in a medium of refractive index n_1 is incident on a plane surface making the angle of incidence 'i' as shown in figure. It enters into a medium or refractive index n_2 ($n_2 > n_1$). Use Huygens' construction of secondary wavelets to trace the propagation of the refracted wavefront. Hence verify Snell's law of refraction.



(b) Draw a ray diagram to show the formation of real image of same size as that of the object placed in front of a converging lens. Using this ray diagram establish the relation between u, v, and f for this lens.

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