DPP - Daily Practice Problems

Name : _____ Date : _____

Start Time : _____ End Time : _____

PHYSICS 57

SYLLABUS : SEMICONDUCTOR ELECTRONICS - 1 (Semiconductors, LED, Photodiode, Zener diode)

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

Q.1 When a semiconductor is heated, its resistance
(a) decreases (b) increases
(c) reamins unchanged (d) nothing is definite

Q.2 The energy band gap of *Si* is
(a) 0.70 *eV*
(b) 1.1 *eV*
(c) between 0.70 *eV* to 1.1*eV*
(d) 5 *eV*

Q.3 The forbidden energy band gap in conductors, semiconductors and insulators are EG_1, EG_2 and EG_3 respectively. The relation among them is
(a) $EG_1 = EG_2 = EG_3$ (b) $EG_1 < EG_2 < EG_3$
(c) $EG_1 > EG_2 > EG_3$ (d) $EG_1 < EG_2 > EG_3$

Q.4 Let n_h and n_e be the number of holes and conduction electrons respectively in a semiconductor. Then
(a) $n_h > n_e$ in an intrinsic semiconductor
(b) $n_h = n_e$ in an extrinsic semiconductor
(c) $n_h = n_e$ in an intrinsic semiconductor
(d) $n_e > n_h$ in an intrinsic semiconductor

Q.5 Which statement is correct?
(a) *N*-type germanium is negatively charged and *P*-type germanium is positively charged
(b) Both *N*-type and *P*-type germanium are neutral
(c) *N*-type germanium is positively charged and *P*-type germanium is negatively charged
(d) Both *N*-type and *P*-type germanium are negatively charged

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

Q.6 Wires P and Q have the same resistance at ordinary (room) temperature. When heated, resistance of P increases and that of Q decreases. We conclude that
(a) P and Q are conductors of different materials
(b) P is n-type semiconductor and Q is p-type semiconductor
(c) P is semiconductor and Q is conductor
(d) P is conductor and Q is semiconductor

Q.7 In extrinsic P and N-type, semiconductor materials, the ratio of the impurity atoms to the pure semiconductor atoms is about
(a) 1 (b) 10^{-1} (c) 10^{-4} (d) 10^{-7}

Q.8 At zero Kelvin a piece of germanium
(a) becomes semiconductor
(b) becomes good conductor
(c) becomes bad conductor
(d) has maximum conductivity

Q.9 Electronic configuration of germanium is 2, 8, 18 and 4, To make it extrinsic semiconductor small quantity of antimony is added
(a) The material obtained will be N-type germanium in which electrons and holes are equal in number
(b) The material obtained will be P-type germanium
(c) The material obtanied will be N-type germanium which has more electrons than holes at room temperature
(d) The material obtained will be N-type germanium which has less electrons than holes at room temperature

Q.10 The intrinsic semiconductor becomes an insulator at
(a) 0°C (b) –100°C
(c) 300 K (d) 0 K

Q.11 Energy bands in solids are a consequence of
(a) Ohm's Law
(b) Pauli's exclusion principle
(c) Bohr's theory
(d) Heisenberg's uncertainty principle

Q.12 The energy gap for diamond is nearly
(a) 1 ev (b) 2 ev (c) 4 ev (d) 6 ev

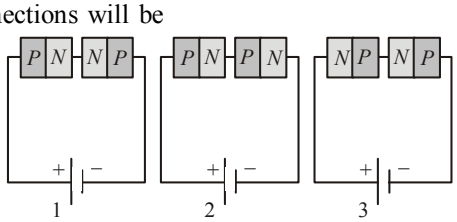
Q.13 The valence band and conduction band of a solid overlap at low temperature, the solid may be
(a) metal (b) semiconductor
(c) insulator (d) None of these

Q.14 Choose the correct statement
(a) When we heat a semiconductor its resistance increases
(b) When we heat a semiconductor its resistance decreases
(c) When we cool a semiconductor to 0 K then it becomes super conductor
(d) Resistance of a semiconductor is independent of temperature

Q.15 If n_e and v_d be the number of electrons and drift velocity in a semiconductor. When the temperature is increased
(a) n_e increases and v_d decreases
(b) n_e decreases and v_d increases
(c) Both n_e and v_d increases
(d) Both n_e and v_d decreases

Q.16 The reverse biasing in a PN junction diode
(a) decreases the potential barrier
(b) increases the potential barrier
(c) increases the number of minority charge carriers
(d) increases the number of majority charge carriers

Q.17 Two PN-junctions can be connected in series by three *different* methods as shown in the figure. If the potential difference in the junctions is the same, then the correct connections will be



(a) In the circuit (1) and (2)
(b) In the circuit (2) and (3)
(c) In the circuit (1) and (3)
(d) Only in the circuit (1)

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ			

Space for Rough Work

Q.18 The approximate ratio of resistances in the forward and reverse bias of the *PN*-junction diode is

(a) $10^2 : 1$ (b) $10^{-2} : 1$

(c) $1 : 10^{-4}$ (d) $1 : 10^4$

Q.19 The dominant mechanisms for motion of charge carriers in forward and reverse biased silicon *P-N* junctions are

(a) Drift in forward bias, diffusion in reverse bias

(b) Diffusion in forward bias, drift in reverse bias

(c) Diffusion in both forward and reverse bias

(d) Drift in both forward and reverse bias

Q.20 In a triclinic crystal system

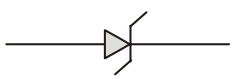
(a) $a \neq b \neq c, \alpha \neq \beta \neq \gamma$

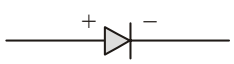
(b) $a = b = c, \alpha \neq \beta \neq \gamma$

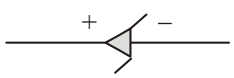
(c) $a \neq b \neq c, \alpha \neq \beta = \gamma$

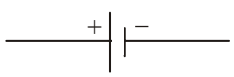
(d) $a = b = c, \alpha = \beta = \gamma$

Q.21 The correct cymbol for zener diode is

(a) 

(b) 

(c) 

(d) 

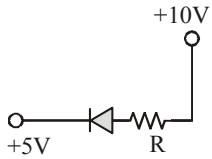
DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

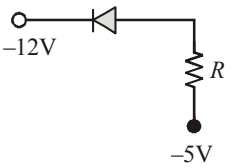
Codes :

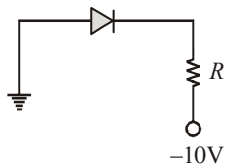
(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct

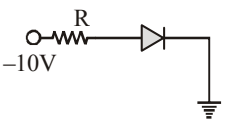
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 In the given figure, which of the diodes are forward biased?

(1) 

(2) 

(3) 

(4) 

Q.23 Which of the following materials are crystalline?

(1) Copper (2) Sodium chloride

(3) Diamond (4) Wood

Q.24 A piece of copper and the other of germanium are cooled from the room temperature to 80 K, then which of the following would be wrong statements?

(1) Resistance of each increases

(2) Resistance of each decreases

(3) Resistance of copper increases while that of germanium decreases

(4) Resistance of copper decreases while that of germanium increases

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

A student performs an experiment for drawing the static characteristic curve of a triode valve in the laboratory. The following data were obtained from the linear portion of the curves:

Grid voltage V_g (volt)	−2.0	−3.5	−2.0
Plate voltage V_p (volt)	180	180	120
Plate current I_P (mA)	15	7	10

Q.25 Calculate the plate resistance r_p of the triode valve?

(a) 0.12×10^4 ohm (b) 1.2×10^4 ohm

(c) 1.3×10^4 ohm (d) 1.4×10^4 ohm

RESPONSE GRID					
	18. ⓐⓑⓒⓓ	**19.** ⓐⓑⓒⓓ	**20.** ⓐⓑⓒⓓ	**21.** ⓐⓑⓒⓓ	**22.** ⓐⓑⓒⓓ
	23. ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ	**25.** ⓐⓑⓒⓓ		

Space for Rough Work

Q.26 Calculate the mutual conductance g_m of the triode valve?

(a) 5.33×10^{-3} ohm^{-1} (b) 53.3×10^{-3} ohm^{-1}

(c) 4.32×10^{-3} ohm^{-1} (d) 5.00×10^{-3} ohm^{-1}

Q.27 Calculate the amplification factor μ, of the triode valve?

(a) 64 (b) 52

(c) 54 (d) 62

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement -1 is False, Statement-2 is True.

(d) Statement -1 is True, Statement-2 is False.

Q.28 **Statement-1 :** The number of electrons in a *P*-type silicon semiconductor is less than the number of electrons in a pure silicon semiconductor at room temperature.

Statement-2: It is due to law of mass action.

Q.29 **Statement-1 :** The resistivity of a semiconductor decreases with temperature.

Statement-2 : The atoms of a semiconductor vibrate with larger amplitude at higher temperature there by increasing its resistivity.

Q.30 **Statement-1 :** We can measure the potential barrier of a PN junction by putting a sensitive voltmeter across its terminals.

Statement-2 : The current through the PN junction is not same in forward and reversed bias.

RESPONSE GRID	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 57 - PHYSICS			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	28	Qualifying Score	48
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS

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1. **(a)** With temperature rise conductivity of semiconductors increases.

2. **(b)**

3. **(b)** In insulators, the forbidden energy gap is very large, in case of semiconductor it is moderate and in conductors the energy gap is zero.

4. **(c)** In intrinsic semiconductors, the creation or liberation of one free electron by the thermal energy creates one hole. Thus in intrinsic semiconductors $n_e = n_h$

5. **(b)** Both P-type and N-type semiconductors are neutral because neutral atoms are added during doping.

6. **(d)** Conductor has positive temperature coefficient of resistance but semiconductor has negative temperature coefficient of resistance.

7. **(d)**

8. **(c)** At zero Kelvin, there is no thermal agitation and therefore no electrons from valence band are able to shift to conduction band.

9. **(c)** Antimony is a fifth group impurity and is therefore a donor of electrons.

10. **(d)** At 0K temperature semiconductor behaves as an insulator, because at very low temperature electrons cannot jump from the valence band to conduction band.

11. **(b)** Formation of energy bands in solids are due to Pauli's exclusion principle.

12. **()**

13. **(a)** In conductors valence band and conduction band may overlaps.

14. **(b)** With rise in temperature, conductivity of semiconductor increases while resistance decreases.

15. **(a)** Because $v_d = \frac{i}{(n_e)eA}$

16. **(b)** In reverse biasing, width of depletion layer increases.

17. **(b)** Because in case (1) N is connected with N. This is not a series combination of transistor.

18. **(d)** Resistance in forward biasing $R_{fr} \approx 10\Omega$ and resistance in reverse biasing

$$R_{Rw} \approx 10^5\,\Omega \Rightarrow \frac{R_{fr}}{R_{Rw}} = \frac{1}{10^4}$$

19. **(b)** In forward biasing the diffusion current increases and drift current remains constant so not current is due to the diffusion.
In reverse biasing diffusion becomes more difficult so net current (very small) is due to the drift.

20. **(a)** In a triclinic crystal $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^\circ$

21. **(a)**

22. **(a)** In figure (1), (2) and (3). *P*-crystals are more positive as compared to *N*-crystals.

23. **(a)** Wood is non-crystalline and others are crystalleine.

24. **(a)** Resistance of conductors (*Cu*) decreases with decrease in temperature while that of semi-conductors (*Ge*) increases with decrease in temperature.

25. **(b)** $r_p = \frac{\Delta V_p}{\Delta I_p} = \frac{(180-120)}{(15-10)\times 10^{-3}} = 1.2\times 10^4\ ohm$

26. **(a)** $g_m = \frac{\Delta I_p}{\Delta V_g} = \frac{(15-7)\times 10^{-3}}{(-2.0)-(-3.5)} = 5.33\times 10^{-3}\ \text{ohm}^{-1}$

27. **(a)** $\mu = r_p \times g_m = (1.2\times 10^4)\times(5.33\times 10^{-3}) = 64$

28. **(a)** According to law of mass action, $n_i^2 = n_e n_h$. In intrinsic semiconductors $n_i = n_e = n_h$ and for *P*-type semiconductor n_e would be less than n_i, since n_h is necessarily more than n_i.

29. **(d)** Resistivity of semiconductors decreases with temperature. The atoms of a semiconductor vibrate with larger amplitudes at higher temperatures there by increasing its conductivity not resistivity.

30. **(c)** We cannot measure the potential barrier of a PN-junction by connecting a sensitive voltmeter across its terminals because in the depletion region, there are no free electrons and holes and in the absence of forward biasing, PN- junction offers infinite resistance.