SAMPLE CONTENT

MHT-CET TRIUMPH PHYSICS

PART 2

BASED ON THE LATEST SYLLABUS OF MHT-CET

4861 MCQs

In butterflies like morpho butterfly, interference and diffraction of light produce varying colours on the wings instead of pigmentation.

Std. XII

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Target Publications® Pvt. Ltd.

Written in accordance with the latest MHT-CET Paper Pattern prescribed by
State Common Entrance Test Cell, Maharashtra State

MHT-CET TRIUMPH PHYSICS

4861 MCQs

Based on the latest Syllabus of MHT-CET

PART 2 **Std. XII**

Salient Features

- Includes all the chapters of Std. XII as per the latest MHT-CET Syllabus
- Includes '4861' MCQs
- Quick Review and exhaustive subtopic wise coverage of MCQs
- Compilation of all 'Important Formulae' & 'Fundamental Constants' in relevant chapters
- Solved Previous Years' MHT-CET questions till 2023
- Evaluation Test for each chapter
- Two Model Question Papers with answer keys (Solutions provided through Q.R. codes)
- Two Question Papers & Answer Keys of MHT-CET 2023 (Solutions provided through Q.R. codes)
- Includes **Smart Keys** (Key Notes For Good Practice, Shortcuts, Mindbenders, Caution, Thinking Hatke)
- 'Real-world applications' in each chapter
- Special inclusion: 'The physics of ….' to engage students in scientific enquiry.
- Video/pdf links via QR codes for boosting conceptual retention
- Answer keys for all the chapters and Evaluation Tests at the end of book
- *Solutions to MCQs and Evaluation Test can be accessed through Q.R. code given at the end of each chapter*

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PREFACE

"Don't follow your dreams; chase them!" A quote by Richard Dumbrill is perhaps the most pertinent for one who is aiming to crack entrance examinations held after Std. XII. We are aware of the aggressive competition a student appearing for such career-defining examinations experiences and hence wanted to create books that develop the necessary knowledge, tools, and skills required to excel in these examinations.

For the syllabus of **MHT-CET**, 80% of the weightage is given to the syllabus for XII^{th} standard while only 20% is given to the syllabus for XI^{th} standard (with inclusion of only selected topics).

We believe that although the syllabus for Std. XII and XI and MHT-CET is aligned, the outlook for studying the subject should be altered based on the nature of the examination. To score well in the MHT-CET, a student has to be not just good with the concepts but also quick to complete the test successfully. Such ingenuity can be developed through sincere learning and dedicated practice.

As a first step to MCQ solving, students should start with elementary questions. Once momentum is gained, complex MCQs with a higher level of difficulty should be practised. Such holistic preparation is the key to succeeding in the examination!

Target's **Triumph MHT-CET Physics Standard XII** book which covers all the chapters of Std. XII has been designed to achieve the above objectives. Beginning with basic MCQs, the book proceeds to develop competence to solve complex MCQs. It offers ample practice of recent questions from MHT-CET examinations. It also includes solutions (via QR codes) that provide explanations to help students learn how to solve the MCQs.

The sections of **Quick Review, Formulae, Fundamental Constants** and **MCQs (Classical, Critical, Concept Fusion, Previous Years' MHT-CET Questions, Evaluation Test)** form the backbone of every chapter and ensure adequate revision.

To optimise learning efficiency, multiple study techniques are included in every chapter in the form of **Smart Keys** *(Key Notes For Good Practice, Shortcuts, Mindbenders, Caution, Thinking Hatke)*.

The two **Model Question Papers** given at the end of the book are specially prepared to gauge the student's preparedness to appear for the MHT-CET examination. Two **MHT-CET 2023 Question Papers** have been provided to offer students a glimpse of the complexity of the questions asked in the examination.

All the features of this book pave the way for a student to excel in the examination. The features are designed keeping the following elements in mind: Time management, easy memorization or revision, and non-conventional yet simple methods for MCQ solving. The features of the book presented on the next page will explain more about them!

We hope the book benefits the learner as we have envisioned.

Publisher
Edition: Second

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: mail@targetpublications.org

FEATURES

Quick Review

Quick Review includes tables/charts to summarize the key points of important concepts in the chapter.
This is our attempt to help students to reinforce key concepts.

Formulae & Fundamental Constants

Formulae & Fundamental Constants cover all of the key formulae and constants in the chapter.
This is our attempt to make tools of formulae and constants accessible for students while solving problems and revising at last minute at a glance.

Sub-topic wise Segregation

Every section is **segregated sub-topic wise.**
This is our attempt to cater to individualistic pace and preferences of studying a chapter in students and enable easy assimilation of questions based on the specific concept.

Classical Thinking

Classical Thinking section encompasses straight forward questions including knowledge based questions.
This is our attempt to revise chapter in its basic form and warm up students to deal with complex MCQs.

Critical Thinking

Critical Thinking section encompasses challenging questions which test understanding, rational thinking and application skills of students.
This is our attempt to take students from beginner to proficient level in smooth steps.

Concept Fusion

Concept Fusion section encompasses questions whose solutions require knowledge of concepts covered in different sub-topics of same chapter or from different chapters.
This is our attempt to develop cognitive thinking in the students essential to solve questions involving fusion of multiple key concepts.

MHT-CET Previous Years' Questions

MHT-CET Previous Years' Questions section encompasses questions from MHT-CET examinations.
This is our attempt to give students practice of MHT-CET questions and advance them to acquire knack essential to solve such questions.

Continued…

FEATURES

Evaluation Test

Evaluation Test encompasses questions based on concepts covered in the entire chapter.
This is our attempt to allow self-assessment of the chapter

Smart Keys

Smart Keys comprise a set of remarkable study techniques contrived to benefit students.
This is our attempt to promote quick, innovative, and divergent thinking as well as enable the students to perceive the underlying depth and implications of concepts.

Key Notes For Good Practice

Key Notes For Good Practice consolidate critical information, useful facts and tips about the key concepts.

Shortcuts

Shortcuts incorporate important theoretical or formula based short tricks, beneficial in solving MCQs.

Mindbenders

Mindbenders present thought provoking snippets of concepts.

Caution

Caution apprises students about mistakes often made while solving MCQs.

Thinking Hatke

Thinking Hatke reveals quick witted approach to crack the specific question.

The physics of …..

The physics of ….. illustrates real life applications or examples related to the concept discussed.
This is our attempt to link learning to the life and make the students conscious of how Physics has touched entire spectrum of life.

QR Code

QR Code includes
- Video/pdf links for boosting conceptual retention
- Solutions to MCQs and Evaluation Test for each chapter
- Solutions to Model Question Papers I and II
- Solutions to MHT-CET 2023 Question Papers

MHT-CET PAPER PATTERN

- There will be three papers of Multiple Choice Questions (MCQs) in 'Mathematics', 'Physics and Chemistry' and 'Biology' of 100 marks each.
- Duration of each paper will be 90 minutes.
- Questions will be based on the syllabus prescribed by Maharashtra State Board of Secondary and Higher Secondary Education with approximately 20% weightage given to Std. XI and 80% weightage will be given to Std. XII curriculum.
- Difficulty level of questions will be at par with JEE (Main) for Mathematics, Physics, Chemistry and at par with NEET for Biology.
- There will be no negative marking.
- Questions will be mainly application based.
- Details of the papers are as given below:

Paper	Subject	Approximate No. of Multiple Choice Questions (MCQs) based on		Mark(s) Per Question	Total Marks
		Std. XI	Std. XII		
Paper I	Mathematics	10	40	2	100
Paper II	Physics	10	40	1	100
	Chemistry	10	40		
Paper III	Biology	20	80	1	100

- Questions will be set on
  i. the entire syllabus of Std. XII of Physics, Chemistry, Mathematics and Biology subjects prescribed by Maharashtra Bureau of Textbook Production and curriculum Research, Pune, and
  ii. chapters / units from Std. XI curriculum as mentioned below:

Sr. No.	Subject	Chapters / Units of Std. XI
1	Physics	Motion in a plane, Laws of motion, Gravitation, Thermal properties of matter, Sound, Optics, Electrostatics, Semiconductors
2	Chemistry	Some Basic Concepts of Chemistry, Structure of Atom, Chemical Bonding, Redox Reactions, Elements of Group 1 and Group 2, States of Matter: Gaseous and Liquid States, Basic Principles of Organic Chemistry, Adsorption and Colloids, Hydrocarbons
3	Mathematics	Trigonometry - II, Straight Line, Circle, Measures of Dispersion, Probability, Complex Numbers, Permutations and Combinations, Functions, Limits, Continuity
4	Biology	Biomolecules, Respiration and Energy Transfer, Human Nutrition, Excretion and osmoregulation

CONTENTS

Chapter

16 Semiconductor Devices

Hearing Aid

Hearing aid is an electronic device which helps hearing-impaired people listen to the sounds. Within the hearing aid, a microphone takes audio signals from the environment and converts them into electric signals. This electrical signal is further transferred to a transistor where it is amplified, smoothened and filtered out thereby enhancing the audio characteristics of the input signal. As, the transistors are smaller in size, light-weight and requires low current and low voltage values, they are considered as excellent for use.

Chapter Outline

Key Notes For Good Practice

- *Magnitude of direct current which can be handled by diode is called current rating of diode.*
- *The use of transformer in a rectifier circuit has two advantages:*

  i. *it helps to step up or step down the AC input voltage as per the requirement of the circuit*

  ii. *it isolates the rectifier circuit from the mains supply to reduce the risk of electric shock*
- *In a common base transistor amplifier,*

  i. *the input and output signals are in the same phase.*

  ii. *there is no amplification in current of a given signal.*

  iii. *there is an amplification in voltage and power of the given signal.*
- *In a common emitter transistor amplifier,*

  i. *the input and output signals are out of phase by π or 180°.*

  ii. *there is amplification in the current, voltage and power of the given signal.*
- *Common emitter transistor amplifier is preferred over common base transistor amplifier due to large current gain.*
- *The d.c. current gain is always less than 1.*
- *NOR and NAND gates are called universal gates.*

Quick Review

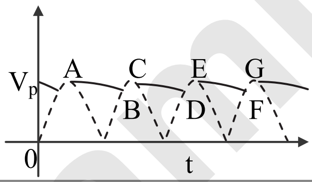
p-n Junction Diode

Diode as a rectifier
- Converts AC signal into DC signal
- Has to be used with filter circuit and voltage regulators

Half-wave Rectifier
- Consists of one p-n junction diode
- The diode functions as switch
- Alternate pulses of AC input are rectified
- Maximum efficiency: 40.6%
- Output frequency is same as that of input.

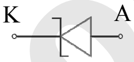
Full-wave Rectifier
- Consists of two p-n junction diodes
- Both the pulses of AC input are rectified
- Maximum efficiency: 81.2%
- Produces less ripple
- Output frequency is twice that of input.

Filter Circuit
- Ripple factor = $\frac{\text{r.m.s. value of AC component}}{\text{value of DC component}}$
- Filter circuit is used to remove the ripple component in rectifier output.
- Most commonly used filter is capacitor filter. Output of which is:



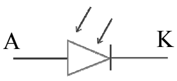
Special purpose Junction Diodes
- There are mainly four commonly used special purpose junction diodes:

Zener Diode
- Heavily doped p-n junction diode
- Works in reverse biased mode
- Used as a voltage regulator



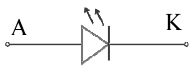
Zener Regulator
- When operated in breakdown region, voltage across Zener remains almost constant regardless of variations in the applied input voltage and variations in the load current.
- The supply voltage V_S must be greater than V_Z.

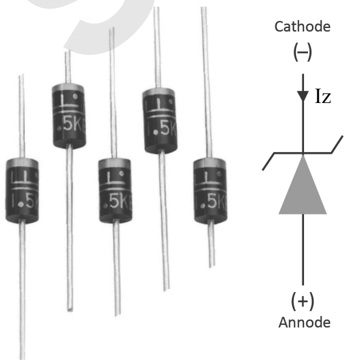
Photodiode
- Works on principle of photoelectric effect
- Works in reverse biased mode
- Used in electronic counters and switches



Solar Cell
- Works on principle of Photovoltaic effect. Hence, also known as Photovoltaic cell
- Used for charging batteries in electronic equipments

LED
- Light emitting diode works in forward biased mode
- Wavelength of light emitted depends on the semiconductor materials used





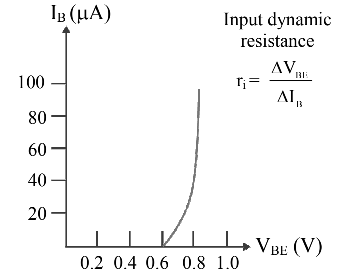
Zener Diode

Zener diode is a unique form of a bipolar device which permits the current flow in the reverse direction when the voltage applied is above a certain characteristic value called zener voltage or break down voltage, most commonly finds applications in voltage regulators to protect other semiconductor devices from fluctuations in voltage.

Bipolar Junction Transistor

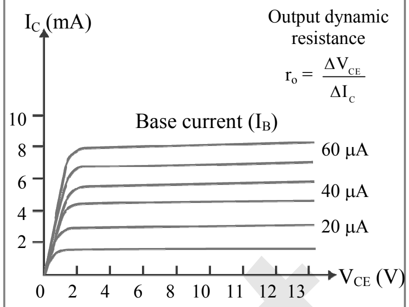
- A junction transistor is a semiconductor device having two junctions and three terminals.
- The current in a transistor is carried by both the electrons and the holes. Hence, the name Bipolar.

Input characteristics



- Till the V_{BE} is less than the barrier potential, the current is very small (nearly zero).
- When V_{BE} is more than the barrier potential, the characteristic is similar to that of a forward biased diode.

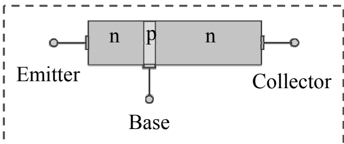
Output characteristics

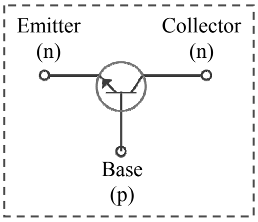


- I_C is independent of V_{CE} as long as the collector-emitter junction is reverse biased.
- I_C is large for large values of I_B when V_{CE} is constant.

n-p-n Transistor

- A p-type semiconductor (base) layer separates two layers of the n-type semiconductor (emitter and collector)

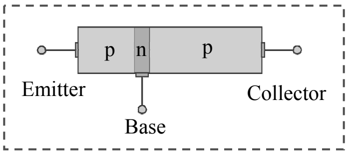


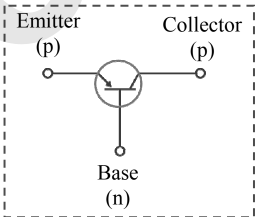


- In circuit symbol of n-p-n transistor, arrow is drawn from base pointing towards emitter.

p-n-p Transistor

- A n-type semiconductor (base) layer separates two layers of the p-type semiconductor (emitter and collector)

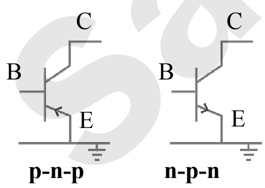




- In circuit symbol of p-n-p transistor, arrow is drawn from emitter pointing towards base.

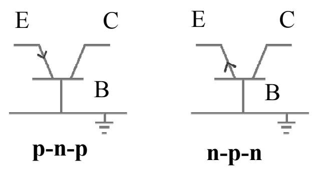
CE configuration

- The emitter of the transistor is common to both the input and the output.



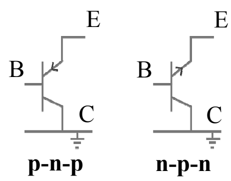
CB configuration

- The base of the transistor is common to both the input and the output.



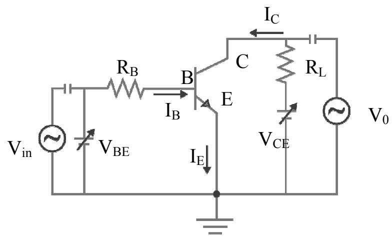
CC configuration

- The collector of the transistor is common to both the input and the output.



CE transistor as an amplifier

- For transistor operating as an amplifier, the E-B junction is forward biased while C-B junction is reverse biased.



Current amplification factor (α)

AC gain

Ratio of a small change in collector current (ΔI_c) to the small change in emitter current (ΔI_E) at constant emitter-base voltage (V_{EB}) is known as ac current gain (α_{ac}).

DC gain

Ratio of collector current (I_C) to emitter current (I_E) is known as dc current gain (α_{dc} or α).
Practical value of α_{dc} lies between 0.95 to 0.99 i.e., less than 1.

Base current amplification factor (β)

AC gain

Ratio of a small change in collector current (ΔI_C) to small change in base current (ΔI_B) at constant collector emitter voltage (V_{CE}) is known as ac current gain (β_{ac}).

DC gain

Ratio of collector current (I_C) to base current (I_B) is known as dc current gain (β_{dc}).
β_{dc} always has value > 1.

Voltage Gain (A_v)

Ratio of change in output voltage (ΔV_o) to change in input voltage (ΔV_i) is known as voltage gain (A_v).

Power Gain

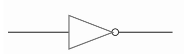
Ratio of change in output power (ΔP_o) to the change in input power (ΔP_i) is known as power gain.

Logic Gates

- **Analog signal:** Signal has continuous values.
- **Digital Signal:** Signal has only two states

NOT gate

X	Y
0	1
1	0



OR gate

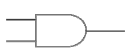
A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

NOR gate

A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

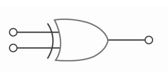
AND gate

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1



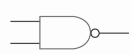
X-OR gate: $C = A \oplus B$

A	B	C
0	0	0
1	0	1
0	1	1
1	1	0



NAND gate

A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0



Formulae

1. Zener diode:

i. Zener current:

a. $\left(I_{Z_{min}}\right) = \left(I_{Z_{max}}\right) - I_L$ b. $I_L = \frac{V_Z}{R_L}$

c. $\left(I_{Z_{max}}\right) = \frac{V_s - V_Z}{R_s}$

ii. Series resistance: $R_s = \frac{\left(V_s - V_Z\right)}{I_{Z_{max}}}$

iii. Zener voltage: $V_Z = I_L R_L$

2. Current in the transistor: $I_E = I_B + I_C$

3. Current Gain of transistor:

i. DC current gain (α_{DC}): $\alpha_{DC} = \frac{I_C}{I_E}$

ii. Current amplification factor (β): $\beta_{DC} = \frac{I_C}{I_B}$

iii. Relation between α and β:

a. $\alpha_{DC} = \frac{\beta_{DC}}{1+\beta_{DC}}$ b. $\beta_{DC} = \frac{\alpha_{DC}}{1-\alpha_{DC}}$

iv. AC current gain: $\beta_{AC} = \frac{\Delta I_C}{\Delta I_B} = \frac{i_C}{i_B}$

4. Resistance of transistor:

i. Input dynamic resistance: $r_i = \frac{\Delta V_{BE}}{\Delta I_B}$

ii. Output dynamic resistance: $r_o = \frac{\Delta V_{CE}}{\Delta I_C}$

5. Voltage gain:

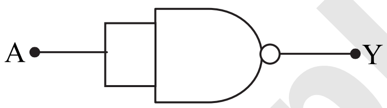
i. $A_V = \frac{V_o}{V_{in}}$ ii. $A_V = -\frac{\Delta V_{CE}}{r_i \Delta I_B}$

iii. $A_V = -\frac{\beta_{AC} R_L}{r_i}$

Shortcuts

1. The output frequency for an AC signal of input frequency "f" is,
f = For half wave rectifier
2f = For full wave rectifier.

2. If both inputs of NAND gates are shorted, then it becomes NOT gate (similar is applicable for NOR gate).



NOT gate

Mindbenders

1. Practical diodes have some finite internal resistance. Hence there is always some internal voltage drop across the diode in a rectifier circuit resulting in some power loss.

Classical Thinking

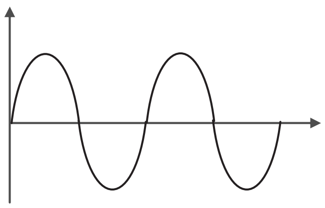
16.1 Introduction

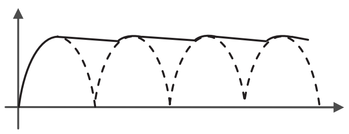
1. Under which of the following conditions does an avalanche breakdown in a semiconductor diode occur?
(A) When potential barrier is reduced to zero.
(B) When reverse bias exceeds a certain value.
(C) When forward bias exceeds a certain value.
(D) When forward current exceeds a certain value.

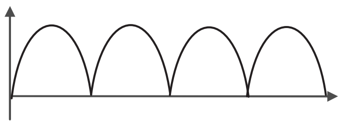
2. AC signal is preferred over DC signal because
(A) Generation of AC at a power station is more cost effective than producing DC power.
(B) The transmission of AC power is also more economic than transmitting DC power.
(C) many electronic gadgets require an AC supply.
(D) both (A) and (B).

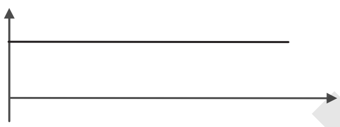
3. Constant DC voltage is required from a variable AC voltage. Which of the following is correct order of operation?
(A) Regulator, filter, rectifier
(B) Rectifier, regulator, filter
(C) Rectifier, filter, regulator
(D) Filter, regulator, rectifier

4. Which of the following waveforms represent the wave after passing through a diode rectifier?

(A)


(B)


(C)


(D)


16.2 p-n Junction Diode as a Rectifier

1. The use of diode for rectification is:
(A) to produce a steady multidirectional current.
(B) to produce undirectional current from an alternating one.
(C) to rectify any phase difference between the current and voltage.
(D) all of these.

2. A diode rectifier
(A) converts A.C. into D.C.
(B) converts D.C. into A.C.
(C) amplifies A.C. signals.
(D) amplifies D.C. signals.

3. When output of a rectifier is in one direction only, but it's continuously varying in magnitude, then it is called
(A) alternating current
(B) pulsating direct current
(C) direct current
(D) pulsating alternating current

4. In a half wave rectifier, the r.m.s value of the A.C. component of the wave is
(A) equal to D.C. value.
(B) more than D.C. value.
(C) less than D.C. value.
(D) zero.

5. The transformer is used in rectifier circuit,
(A) to isolate the rectifier circuit.
(B) to protect the diode.
(C) to step up or step down the AC input as per requirement.
(D) All of these.

6. In half wave rectifier, the diode
(A) allows current from both positive and negative half cycles from the input.
(B) blocks the current from all the positive half cycles.
(C) blocks the current from all the negative half cycles.
(D) allows current from alternate positive and negative half cycles.

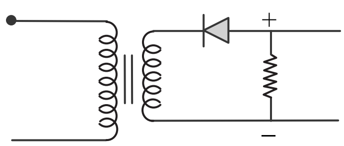
7. In a half wave rectifier the AC input source of frequency 50 Hz is used. The fundamental frequency of the output is
(A) 50 Hz (B) 150 Hz
(C) 200 Hz (D) 75 Hz

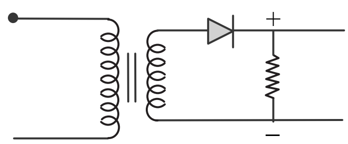
8. To obtain full wave rectification, we require
(A) only one diode (B) triode
(C) two diodes (D) transistor

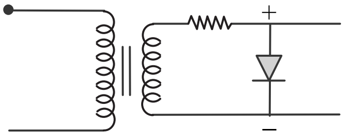
9. What can be said about the output frequency of a rectifier circuit?
(A) it is always zero.
(B) it is more in case of half wave rectifier.
(C) it is more in case of full wave rectifier.
(D) it is always equal to the input frequency.

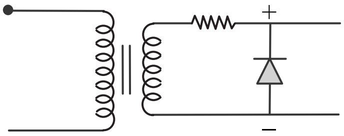
10. The effectiveness of a rectifier depends upon the
(A) the magnitude of ripple component in its output.
(B) the value of input voltage.
(C) the magnitude of reverse voltage of the diode.
(D) the value of the input frequency.

11. Which is the correct diagram of a half-wave rectifier?

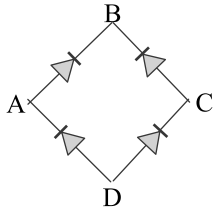
(A)


(B)


(C) 

(D) 

12. In the diagram, the input is across the terminals A and C and the output is across B and D. Then the output is



(A) zero
(B) same as input
(C) full-wave rectified
(D) half-wave rectified

13. The maximum efficiency of full-wave rectifier is
(A) 100 % (B) 25.20 %
(C) 40.6 % (D) 81.2 %

16.3 Special Purpose Junction Diodes

1. Which of the following semi-conducting devices is used as voltage regulator?
(A) LASER diode (B) Zener diode
(C) Solar cell (D) Photo diode

2. A Zener diode
(A) has negative temperature coefficient of resistance.
(B) has sharp breakdown at low reverse voltage.
(C) rectifies Zener voltage.
(D) works only in forward bias.

3. Zener breakdown takes place if
(A) doped impurity is low.
(B) doped impurity is high.
(C) less impurity in N-type.
(D) less impurity in P-type.

4. When used in a circuit, Zener diode is always
(A) forward biased.
(B) reverse biased.
(C) both forward and reverse.
(D) connected in series.

5. Breakdown voltage of a zener diode is 5 volt. It can regulate the voltage output of a power supply
(A) below 5 volt only.
(B) above 5 volt upto a certain maximum voltage.
(C) from zero volt to a certain maximum voltage.
(D) from zero volt to infinite volt.

6. When a zener diode is used as a voltage stabiliser, it is connected
i. in series with a load.
ii. in parallel with a load.
iii. in forward bias.
iv. in reverse bias.
(A) i and iii are correct
(B) i and iv are correct
(C) ii and iv are correct
(D) ii and iii are correct

7. Electron hole pairs are generated in a photodiode
(A) when light enters in its depletion region.
(B) when light enters in its junction.
(C) when photon energy $h\nu > E_g$.
(D) (A) and (C)

8. Photocurrent in a photodiode depends upon
(A) biasing of junction.
(B) number of electron holes.
(C) density of diode material.
(D) intensity of incident radiation.

9. In photodiode, dark current is
(A) the leakage current.
(B) the current due to minority charge carriers.
(C) the current when light energy emerges out of the diode.
(D) the current when no light energy falls on the diode.

10. In remote controlled receivers, the sensor are
(A) LEDs (B) Solar cells
(C) Photodiodes (D) Zener diodes

11. Which of the following is NOT an application of photodiode?
(A) Detection of optical signal
(B) Object counters
(C) Optocouplers
(D) Data profiling

12. Usually Si is used in the designing of photodiodes because
(A) it is portable.
(B) it is easily available.
(C) it requires less forward biasing.
(D) current due to thermally generated minority carriers is quite small.

13. Solar cell is based on the principle of
(A) formation of electron-hole pairs with incident light.
(B) formation of electron-hole pairs with heating.
(C) formation of electron-hole pairs with potential.
(D) all of these

14. A solar cell works on the principle of
(A) photoelectricity.
(B) photographic camera.
(C) photovoltaic conversion.
(D) photosynthesis.

15. A solar cell is a p-n junction operating in
(A) reverse bias condition.
(B) unbiased condition.
(C) forward bias condition.
(D) in both forward and reverse bias condition.

16. In LED, intensity of emitted light
(A) increases with forward current.
(B) decreases with forward current.
(C) increases with reverse current.
(D) decreases with reverse current.

17. A light emitting diode is
(A) always used in forward biased condition.
(B) always used in reverse biased condition.
(C) never used in forward biased condition.
(D) used in both forward and reverse biased position depending upon its application.

18. Colour of light emitted by LED depends on
(A) its reverse bias.
(B) its forward bias.
(C) type of semiconductor.
(D) rectifier.

19. Barrier potential in LED depends on type of
(A) impurity (B) junction
(C) biasing (D) semiconductors

20. The brightness of LED can be controlled by
(A) applied potential differences.
(B) by changing the value of series resistance.
(C) by changing the value of parallel resistance.
(D) none of these

21. Barrier potential in Ga-As-P LED is about
(A) 5 volt (B) 0.5 volt
(C) 1.5 volt (D) 2.5 volt

22. In a Zener-regulated power supply, a 10 V battery is connected in series with a resistance of 200 Ω and a zener diode. The zener diode maintains a constant voltage drop of 5 V across a load resistance of 500 Ω. The current drawn by the load resistance will be
(A) 0.025 A (B) 0.050 A
(C) 0.01 A (D) 0.015 A

16.4 Bipolar Junction Transistor (BJT)

1. Transistor consists of two junction diodes which are connected
(A) one after another.
(B) back to back.
(C) one across another.
(D) one upon other.

2. Transistors are essentially
(A) power driven devices.
(B) current driven devices.
(C) voltage driven devices.
(D) resistance driven devices.

3. How many electrodes are there in a transistor?
(A) 2 (B) 3 (C) 4 (D) 5

4. The amplifier converts
(A) A.C. into D.C. voltage.
(B) D.C. into A.C. voltage.
(C) low input signal to high output signal.
(D) high input signal to low output signal.

5. The arrow head on the transistor symbol always points in the direction of
(A) flow of holes in the emitter region.
(B) flow of electrons in the emitter region.
(C) minority carriers flow in the emitter region.
(D) majority carriers flow in the emitter region.

6. In a transistor, the emitter current is
(A) slightly more than collector current.
(B) slightly less than collector current.
(C) equal to the collector current.
(D) equal to the base current.

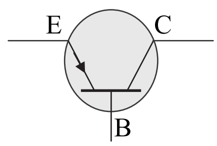
7. The transistors provide good power amplification when they are used in
(A) common collector configuration.
(B) common emitter configuration.
(C) common base configuration.
(D) any configuration.

8. The part of a transistor which is heavily doped to produce a large number of majority carriers is
(A) Base (B) Emitter
(C) Collector (D) All of these

9. Least doped region in a transistor
(A) Collector
(B) Base
(C) Emitter
(D) Either emitter or collector

10. In the three parts of a transistor, 'Emitter' is of
(A) large size and lightly doped.
(B) moderate size and heavily doped.
(C) thin size and heavily doped.
(D) large size and moderately doped.

11. The symbol given in figure represents
(A) npn transistor
(B) pnp transistor
(C) Forward biased p-n junction diode
(D) Reverse biased p-n junction diode



12. A transistor can be used as _______.
(A) a full-wave rectifier
(B) an amplifier
(C) a half-wave rectifier
(D) an insulator

13. In a CE amplifier, the input ac signal to be amplified is applied across
(A) forward biased emitter-base junction
(B) reverse biased collector-base junction
(C) reverse biased emitter-base junction
(D) forward biased collector-base junction

14. In CE transistor amplifier, the collector junction has _______ bias and emitter junction has _______ bias.
(A) reverse, reverse
(B) forward, forward
(C) reverse, forward
(D) forward, reverse

15. In npn transistor, if I_E = emitter current, I_B = base current and I_C = collector current, then
(A) $I_C = I_E + I_B$ (B) $I_B = I_C + I_E$
(C) $I_E = I_C + I_B$ (D) $I_E = I_C - I_B$

16. When n-p-n transistor is used as an amplifier,
(A) electrons move from base to collector.
(B) holes move from emitter to base.
(C) electrons move from collector to base.
(D) holes move from base to collector.

17. In case of n-p-n transistors, the collector current is always less than the emitter current because
(A) collector side is reverse biased and emitter side is forward biased.
(B) after electrons are lost in the base, only remaining ones reach the collector.
(C) collector side is forward biased and emitter side is reverse biased.
(D) collector being reverse biased attracts less electrons.

18. The input characteristics of a transistor in CE mode is the graph obtained by plotting
(A) I_B against I_C at constant V_{CE}
(B) I_B against V_{BE} at constant V_{CE}
(C) I_B against I_C at constant V_{BE}
(D) I_B against V_{CE} at constant V_{BE}

19. The dynamic output resistance (r_o) of p-n-p transistor in a common emitter mode is given by
(A) $r_o = \left.\frac{\Delta V_{EB}}{\Delta I_E}\right|_{V_{CE} = \text{constant}}$
(B) $r_o = \left.\frac{\Delta V_{CB}}{\Delta I_C}\right|_{V_{CE} = \text{constant}}$
(C) $r_o = \left.\frac{\Delta V_{CE}}{\Delta I_C}\right|_{V_B = \text{constant}}$
(D) $r_o = \left.\frac{\Delta V_{CE}}{\Delta I_C}\right|_{I_B = \text{constant}}$

20. A transistor when connected in common emitter mode has a
(A) high input resistance and a low output resistance.
(B) low input resistance and low output resistance.
(C) low input resistance and a high output resistance.
(D) high input resistance and a high output resistance.

21. In the study of transistor as an amplifier, if $\alpha = I_C/I_E$ and $\beta = I_C/I_B$ where, I_C, I_B and I_E are the collector, base and emitter currents, then
(A) $\beta = \frac{1-\alpha}{\alpha}$ (B) $\beta = \frac{\alpha}{1-\alpha}$
(C) $\beta = \frac{\alpha}{1+\alpha}$ (D) $\beta = \frac{1+\alpha}{\alpha}$

22. For a transistor, in a common emitter arrangement, the alternating current gain β is given by
(A) $\beta = \frac{\Delta I_C}{\Delta I_B}$ (B) $\beta = \frac{\Delta I_B}{\Delta I_C}$
(C) $\beta = \frac{\Delta I_C}{\Delta I_E}$ (D) $\beta = \frac{\Delta I_E}{\Delta I_C}$

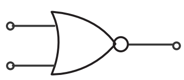
16.5 Logic gates

1. Logic gates are the building blocks of a
(A) digital system.
(B) analog system.
(C) abacus system.
(D) communication system.

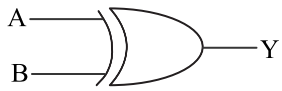
2. Boolean algebra is essentially based on
(A) symbol (B) logic
(C) numbers (D) truth

3. The Boolean expression for OR function is
(A) $Y = A + B$ (B) $Y = A \cdot B$
(C) $Y = A - B$ (D) $Y = A$

4. Which logic gate is similar to a function of two series switches?
(A) AND gate (B) OR gate
(C) NAND gate (D) XOR

5. Symbol  represents
(A) NAND gate (B) NOR gate
(C) NOT gate (D) XNOR gate

6. The figure represents a digital
(A) XOR gate.
(B) OR gate.
(C) AND gate.
(D) NOR gate.



7. An OR gate gives a logic 1 output
(A) only when all inputs are logical 1.
(B) only when any two inputs are logical 1.
(C) when all inputs are logical 0.
(D) when any one input is logical 1.

8. The logic behind 'NOR' gate is that which gives
(A) high output when both the inputs are low.
(B) low output when both the inputs are low.
(C) high output when both the inputs are high.
(D) high output when one of the inputs are is high.

9. The output of a NAND gate is 0
(A) if both inputs are 0.
(B) if one input is 0 and the other input is 1.
(C) if both inputs are 1.
(D) either if both inputs are 1 or if one of the inputs is 1 and the other 0.

10. Which gate can be obtained by shorting both the input terminals of a NOR gate.
(A) OR (B) NOT
(C) AND (D) NAND

11. **Assertion:** NAND or NOR gates are called digital building blocks.
Reason: The repeated use of NAND (or NOR) gates can produce all the basic or complicated gates.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False but, Reason is True.

12. Truth table given below represents

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

(A) AND gate (B) OR gate
(C) NAND gate (D) NOR gate

13. The given truth table is for

Input		Output
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(A) NAND gate (B) AND gate
(C) NOR gate (D) OR gate

The physics of …..
Solar cell….

When sunlight strikes a solar cell formed using a p-n junction, it acts like a battery, with + and − terminals. How does a solar cell convert solar energy into electricity?

The answer is at the end of this chapter.

Critical Thinking

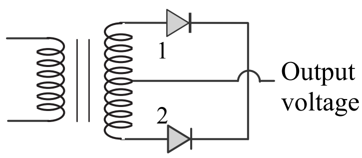
16.2 p-n Junction Diode as a Rectifier

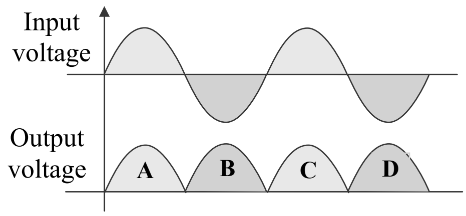
1. In half-wave rectifier, if in the output waveform pattern (starting from T = 0) the time for first waveform is indicated by T / 2, then the time for third wave form is,
(A) T (B) $\frac{3T}{2}$ (C) 2T (D) $\frac{5T}{2}$

2. In a full wave rectifier, input A.C. current has a frequency 'ν'. The output frequency of current is
(A) $\frac{\nu}{2}$ (B) ν
(C) 2ν (D) 320 Hz

3. Ripple frequency at the output of bridge rectifier when the transformer primary is connected to A.C. mains supply is
(A) 100 Hz (B) 50 Hz
(C) 25 Hz (D) 75 Hz

4. A full wave rectifier circuit along with the input and output voltages is shown in the figure





The contribution to output voltage from diode 2 is

(A) A, C (B) B, D
(C) B, C (D) A, D

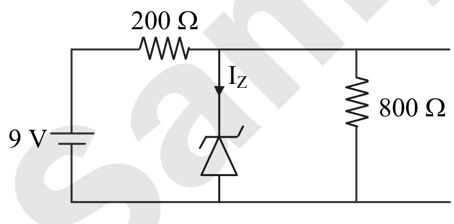
16.3 Special Purpose Junction Diodes

1. Consider the following statements (i) and (ii) and identify the correct choice of the given answers.
(i) A Zener diode is always connected in reverse bias.
(ii) The potential barrier of a p-n junction lies between 0.1 to 0.3 V approximately.
(A) (i) and (ii) are correct.
(B) (i) and (ii) are wrong.
(C) (i) is correct but (ii) is wrong.
(D) (i) is wrong but (ii) is correct.

2. A Zener diode has a breakdown voltage of 5 V with a maximum power dissipation of 240 mW. The maximum current the diode can handle will be
(A) 50 mA (B) 48 mA
(C) 46 mA (D) 44 mA

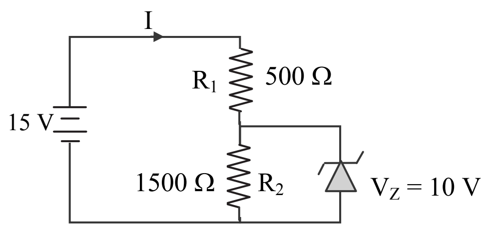
3. In a Zener regulator, if source voltage is 30 V, series resistance is of 1.5 kΩ, load resistance is of 2 kΩ and V_Z = 10 V, the Zener current will be
(A) 13.33 mA (B) 5 mA
(C) 10 mA (D) 8.33 mA

4. The reverse breakdown voltage of a Zener diode is 5.6 V in the given circuit.



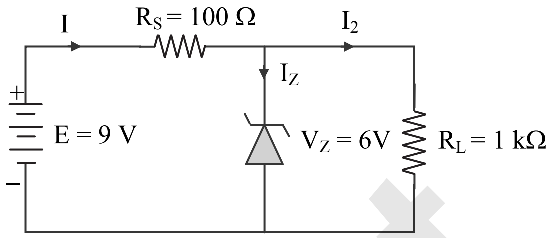
The current I_z through the Zener is:
(A) 10 mA (B) 17 mA
(C) 15 mA (D) 7 mA

5. In the circuit given, the current through the zener diode is



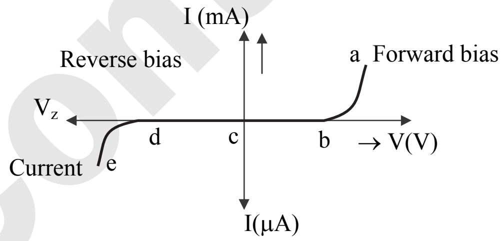
(A) 10 mA (B) 6.67 mA
(C) 5 mA (D) 3.33 mA

6. In the circuit shown below, the power dissipated in Zener diode is,



(A) 0.0144 W (B) 0.144 W
(C) 1.44 W (D) 14.4 W

7. The graph given below represents the I – V characteristics of a Zener diode. Which part of the characteristics curve is most relevant for its operation as a voltage regulator?



(A) ab (B) bc (C) cd (D) de

8. For obtaining maximum power from a solar cell, it should be operated in
(A) knee portion of V-I characteristics.
(B) any portion of V-I characteristics.
(C) level part of V-I characteristics.
(D) falling part of V-I characteristics.

9. A typical solar cell develops a voltage of about
(A) 5 V (B) 10 V to 15 V
(C) 0.5 V to 1 V (D) 0.5 mV

10. LED constructed by Silicon carbide, Zinc selenide emit radiation of ________.
(A) blue colour (B) red colour
(C) orange colour (D) brown colour

16.4 Bipolar Junction Transistor (BJT)

1. In transistor, forward bias is always smaller than the reverse bias. The correct reason is
(A) to avoid excessive heating of transistor.
(B) to maintain a constant base current.
(C) to produce large voltage gain.
(D) to provide high current.

2. If α-current gain of a transistor is 0.98. What is the value of β-current gain of the transistor?
(A) 0.49 (B) 49
(C) 4.9 (D) 5

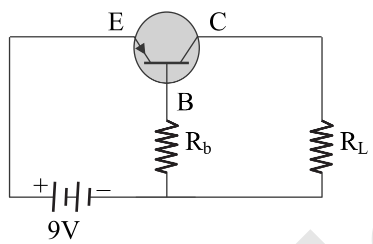
3. Current amplification factor in CE mode amplifier is 99. If the input base current is 20 microampere, the current through emitter is
(A) 20 μA (B) 2000 μA
(C) 1980 μA (D) 2020 μA

4. The current gain of a transistor in common emitter circuit is 25, then the ratio of emitter current to base current is
(A) $\frac{25}{26}$ (B) 26
(C) $\frac{1}{25}$ (D) $\frac{26}{25}$

5. In an npn transistor the collector current is 24 mA. If 80% of electrons reach collector its base current in mA is
(A) 36 (B) 26 (C) 16 (D) 6

6. In the case of constants α and β of a transistor,
(A) $\alpha = \beta$ (B) $\beta < 1, \ \alpha > 1$
(C) $\alpha\beta = 1$ (D) $\beta > 1, \ \alpha < 1$

7. In a transistor circuit shown here, the base current is 35 μA. The value of the resistor R_b is



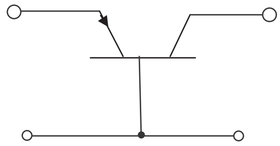
(A) 123.5 kΩ (B) 257 kΩ
(C) 380.05 kΩ (D) 280.0 kΩ

8. The input resistance of a common emitter transistor amplifier, if the output resistance is 500 kΩ, the current gain α = 0.98 and power gain is 6.0625×10^6, is
(A) 198 Ω (B) 300 Ω
(C) 100 Ω (D) 400 Ω

9. The collector supply voltage in CE transistor amplifier is 10V. The base current is 10 μA in the absence of the signal voltage and the voltage between the collector and the emitter is 4 V. The current gain (β) of a transistor is 200, then the value of the load resistance R_L _______.
(A) 1 kΩ (B) 2 kΩ
(C) 3 kΩ (D) 4 kΩ

10. V_e, V_b and V_c are emitter, base and collector voltage respectively for npn transistor in CE mode. Amplifier works for the combination of biasing voltage equal to
(A) $V_e = +5V, V_b = +2V, V_c = +5V$
(B) $V_e = -5V, V_b = +2V, V_c = -5V$
(C) $V_e = -5V, V_b = +2V, V_c = +5V$
(D) $V_e = +5V, V_b = +2V, V_c = -5V$

11. For circuit shown in figure, $I_E = 4$ mA, $I_B = 40$ μA. What are the values of α and I_C respectively?



(A) 0.99, 3.96 mA
(B) 0.97, 4.04 mA
(C) 1.01, 3.96mA
(D) 0.99, 4.04 mA

12. In a common-emitter transistor, the current gain is 80. What is the change in collector current when the change in base current is 250 μA?
(A) 80 × 250 μA (B) (250 – 80) μA
(C) (250 + 80) μA (D) 250/80 μA

13. For a common base configuration of p-n-p transistor, $\frac{I_C}{I_E} = 0.96$. Then maximum current gain in common emitter configuration will be
(A) 12 (B) 24
(C) 6 (D) 5

14. For a transistor, the current gain is 0.8. The transistor is connected in common emitter configuration. The change in the collector current when the base current changes by 6 mA is
(A) 6 mA (B) 4.8 mA
(C) 24 mA (D) 8 mA

15. In CE NPN transistor 10^{10} electrons enter the emitter in 10^{-6} s when it is connected to battery. About 5% electrons recombine with holes in the base. The current gain of the transistor is _______. ($e = 1.6 \times 10^{-19}$ C)
(A) 0.98 (B) 19
(C) 49 (D) 0.95

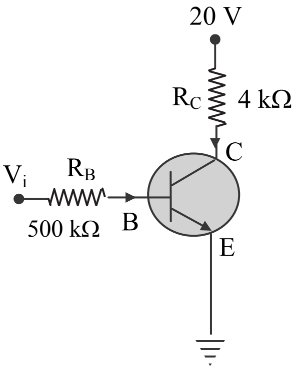
16. In a common base amplifier circuit, calculate the change in base current if that in the emitter current is 2 mA and α = 0.98.
(A) 0.04 mA (B) 1.96 mA
(C) 0.98 mA (D) 2 mA

17. Consider an npn transistor amplifier in common-emitter configuration. The current gain of the transistor is 100. If the collector current changes by 1 mA, what will be the change in emitter current
(A) 1.1 mA (B) 1.01 mA
(C) 0.01 mA (D) 10 mA

18. The current gain of a transistor in common-emitter configuration is 80. If the emitter current be 8.1 mA, then what is the collector current?
(A) 8.1 mA (B) 8.0 mA
(C) 0.1 mA (D) 1.0 mA

19. The r.m.s. value of the base current of a transistor is 10 μA. What is the current gain (β) if the peak value of the a.c. collector current is 1.414 mA?
(A) 50 (B) 75 (C) 100 (D) 125

20. In the circuit shown in the figure, the input voltage V_i is 20 V, V_{BE} = 0 and V_{CE} = 0. The values of I_B, I_C and β are given by



(A) I_B = 40 μA, I_C = 10 mA, β = 250
(B) I_B = 25 μA, I_C = 5 mA, β = 200
(C) I_B = 20 μA, I_C = 5 mA, β = 250
(D) I_B = 40 μA, I_C = 5 mA, β = 125

21. A change of 0.04 V takes place between the base and the emitter when an input signal is connected to the CE transistor amplifier. As a result, 20 μA change takes place in the base current and a change of 2 mA takes place in the collector current. Find the input resistance and A.C. current gain.
(A) 2kΩ, 100 (B) 1kΩ, 100
(C) 2kΩ, 200 (D) 1kΩ, 200

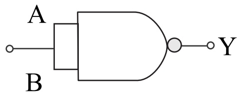
22. The dc common emitter current gain of a n-p-n transistor is 50. The potential difference applied across the collector and emitter of a transistor used in CE configuration is, V_{CE} = 2 V. If the collector resistance, R_C = 4 kΩ, the base current (I_B) and the collector current (I_C) are
(A) I_B = 10 μA, I_C = 0.5 mA
(B) I_B = 0.5 μA, I_C = 10 mA
(C) I_B = 5 μA, I_C = 1 mA
(D) I_B = 1 μA, I_C = 0.5 mA

23. For CE transistor amplifier, the audio signal voltage across the collector resistance of 2 kΩ is 4 V. If the current amplification factor of the transistor is 100 and the base resistance is 1 kΩ, then the input signal voltage is
(A) 15 mV (B) 10 mV
(C) 20 mV (D) 30 mV

24. A npn transistor is connected in common emitter configuration in a given amplifier. A load resistance of 800 Ω is connected in the collector circuit and the voltage drop across it is 0.8 V. If the current amplification factor is 0.96 and the input resistance of the circuit is 192 Ω, the voltage gain and the power gain of the amplifier will respectively be
(A) 4, 4 (B) 4, 3.69
(C) 4, 3.84 (D) 3.69, 3.84

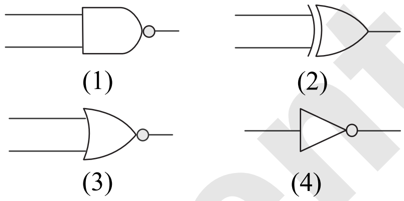
16.5 Logic gates

1. This symbol represents



(A) NOT gate
(B) OR gate
(C) AND gate
(D) NOR gate

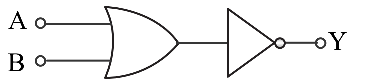
2. Given below are symbols for some logic gates



The XOR gate and NOR gate respectively are
(A) 1 and 2 (B) 2 and 3
(C) 3 and 4 (D) 1 and 4

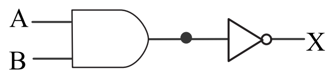
3. In negative logic, logic state 1 corresponds to
(A) negative voltage.
(B) zero voltage.
(C) more negative voltage.
(D) lower voltage level.

4. What is the name of the gate obtained by the combination shown in figure?



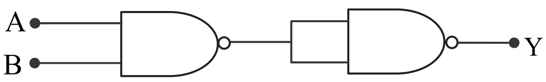
(A) XOR
(B) NOR
(C) NAND
(D) NOT

5. What is the Boolean expression for the gate circuit shown in the figure?



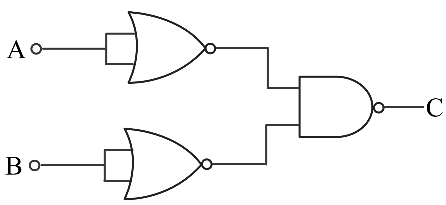
(A) $\overline{A \cdot B} = X$
(B) $A + B = X$
(C) $A \cdot B = X$
(D) $\overline{A + B} = X$

6. The output (Y) of the combination of gates is



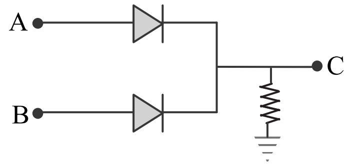
(A) $Y = A \cdot B$ (B) $Y = A + B$
(C) $Y = \overline{A} \cdot \overline{B}$ (D) $X = \overline{A} + \overline{B}$

7. The combination of the gates shown in the figure produces



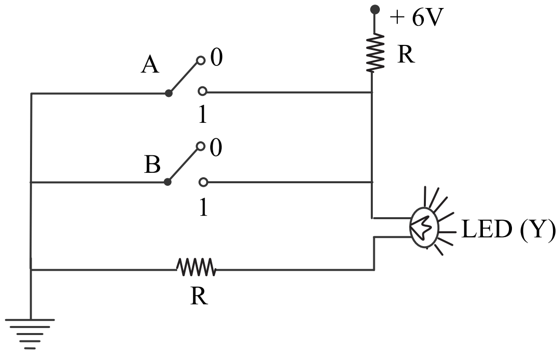
(A) NOR (B) AND
(C) OR (D) NAND

8. In the circuit below, A and B represent two inputs and C represents the output. The circuit represents



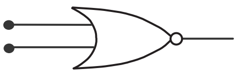
(A) OR gate (B) NOR gate
(C) AND gate (D) NAND gate

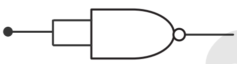
9. The circuit diagram shown here corresponds to the logic gate,

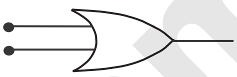


(A) NAND (B) NOR
(C) AND (D) OR

10. Which of the following gives reversible operation?

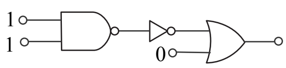
(A) 

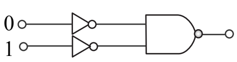
(B) 

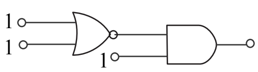
(C) 

(D) 

11. In the following combinations of logic gates, the outputs of i, ii and iii are respectively

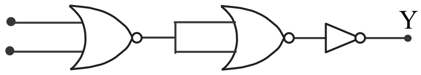
(i) 

(ii) 

(iii) 

(A) 0, 1, 1 (B) 0, 1, 0
(C) 1, 1, 0 (D) 1, 0, 1

12. The given electrical network is equivalent to



(A) AND gate (B) OR gate
(C) NOR gate (D) NOT gate

13. Which one of the following truth table represents an AND gate?

i.

A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

ii.

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

iii.

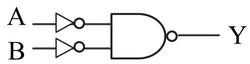
A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0

iv.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(A) iv (B) iii
(C) ii (D) i

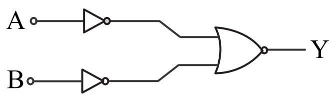
14. The output of digital circuit shown in the figure is



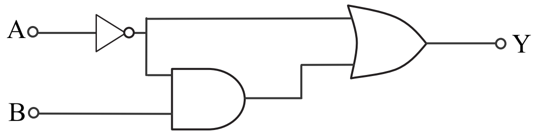
(A) $\overline{A}\cdot\overline{B}$ (B) $\overline{A\cdot B}$
(C) $A+B$ (D) $A\cdot B$

15. Which logic gate is represented by the following logic gates?

(A) NOR
(B) NAND
(C) AND
(D) OR

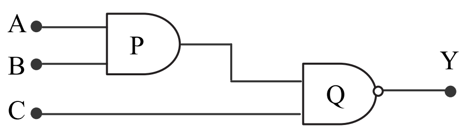


16. The output Y of the logic circuit given below is



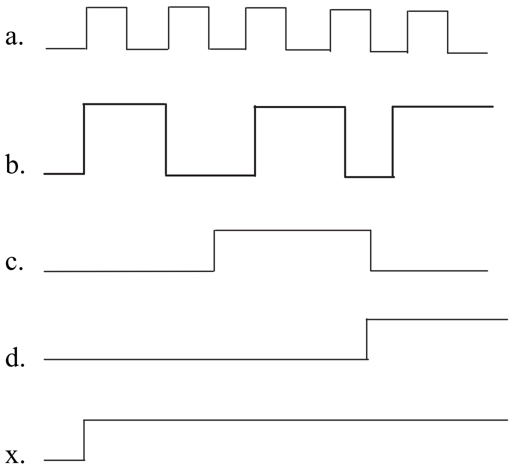
(A) $\overline{A}+B$ (B) $\overline{A}$
(C) $\overline{\left(\overline{A}+B\right)}\cdot\overline{A}$ (D) $\overline{\left(\overline{A}+B\right)}\cdot A$

17. What is the output Y in the following circuit, when all the three inputs A, B, C are first 0 and then 1?



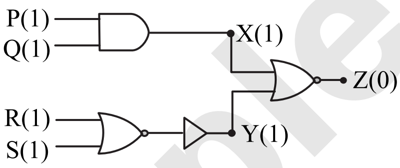
(A) 1, 1 (B) 0, 1
(C) 0, 0 (D) 1, 0

18. If a, b, c, d are inputs to gate and x is its output, then, as per the following time graph, the gate is:



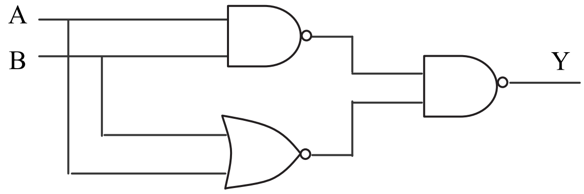
(A) AND
(B) OR
(C) NAND
(D) NOT

19. The circuit diagram shows a logic combination with the states of outputs X, Y and Z given for inputs P, Q, R and S all at state 1. When input P and R change to state 0 with input Q and S still at 1, the states of outputs X, Y and Z change to



(A) 1, 0, 0
(B) 1, 1, 1
(C) 0, 1, 0
(D) 0, 0, 1

20. The truth table of the combination of the logic gates shown in the figure is



(A)

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

(B)

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

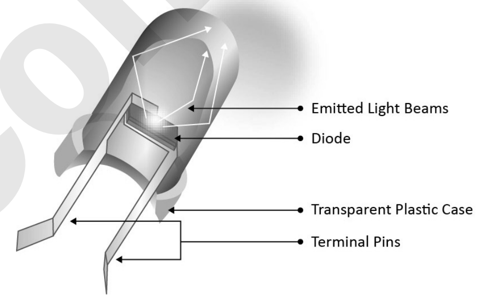
(C)

A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

(D)

A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0

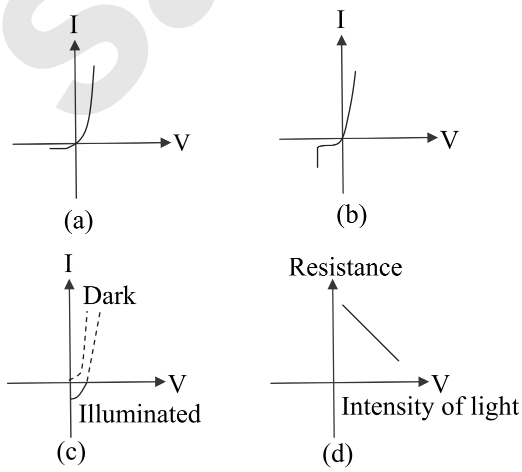
Semiconductor light emitting diode



A diode which finds extensive use in rolling displays, traffic control light system etc. A light emitting diode can emit light of a particular colour when forward biased.

Concept Fusion

1. Identify the semiconductor devices whose characteristics are given below, in the order (a), (b), (c), (d) :



(A) Zener diode, Simple diode, Light dependent resistance solar cell
(B) Solar cell, Light dependent resistance, Zener diode, Simple diode
(C) Zener diode, Solar cell, Simple diode, Light dependent resistance
(D) Simple diode, Zener diode, Solar cell, Light dependent resistance

2. In a Zener diode, the reverse bias voltage is 3 V and the width of the depletion region is 300 Å, the electric field intensity will be ________ $\frac{V}{cm}$.

(A) 10^4 (B) 10^6 (C) 10^8 (D) 10^{-2}

3. An LED is constructed from a p-n junction diode using GaAsP. The energy gap is 1.9 eV. The wavelength of the light emitted will be equal to

(A) 654×10^{-11} m (B) 10.4×10^{-26} m
(C) 654 nm (D) 654 Å

MHT-CET Previous Years' Questions

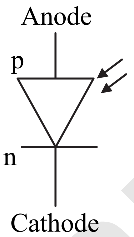
1. Which of the following is correct, about doping in a transistor? **[2005]**
   (A) Emitter is lightly doped, collector is heavily doped and base is moderately doped.
   (B) Emitter is lightly doped, collector is moderately doped and base is heavily doped.
   (C) Emitter is heavily doped, collector is lightly doped and base is moderately doped.
   (D) Emitter is heavily doped, collector is moderately doped and base is lightly doped.

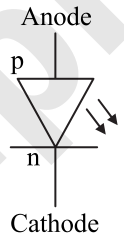
2. How many NAND gates are needed to form an AND gate? **[2010]**
   (A) 2 (B) 3 (C) 4 (D) 5

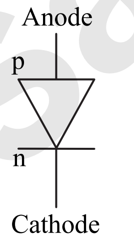
3. In common base circuit of a transistor, current amplification factor is 0.95. Calculate the emitter current if base current is 0.2 mA **[2014]**
   (A) 2 mA (B) 4 mA
   (C) 6 mA (D) 8 mA

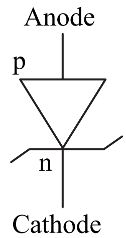
4. Which logic gate produces 'LOW' output when any of the inputs is 'HIGH'? **[2015]**
   (A) AND (B) OR
   (C) NAND (D) NOR

5. The schematic symbol of light emitting diode is (LED) **[2016]**

(A)


(B)


(C)


(D)


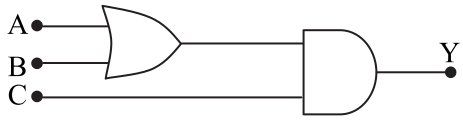
6. Photodiode is a device **[2017]**
   (A) which is always operated in reverse bias.
   (B) which is always operated in forward bias.
   (C) in which photo current is independent of intensity of incident radiation.
   (D) which may be operated in forward or reverse bias.

7. For a transistor, α_{dc} and β_{dc} are the current ratios, then the value of $\frac{\beta_{dc} - \alpha_{dc}}{\alpha_{dc} \cdot \beta_{dc}}$ is **[2017]**
   (A) 1 (B) 1.5 (C) 2 (D) 2.5

8. A transistor is used as a common emitter amplifier with a load resistance 2 kΩ. The input resistance is 150 Ω. Base current is changed by 20 μA which results in a change in collector current by 1.5 mA. The voltage gain of the amplifier is **[2018]**
   (A) 900 (B) 1000 (C) 1100 (D) 1200

9. An n-p-n transistor conducts when **[2019]**
   (A) both collector and emitter are positive with respect to the base.
   (B) both collector and emitter are negative with respect to the base.
   (C) collector is positive and emitter is negative with respect to the base.
   (D) collector is positive and emitter is at same potential as the base.

10. To obtain an output Y = 1 from the following circuit, the inputs must be **[2019]**

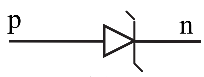


(A) A B C: 1 0 1 (B) A B C: 0 1 0
(C) A B C: 1 0 0 (D) A B C: 1 1 0

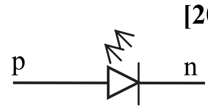
11. For which logic gate the following statement is true? The output is high if and only if all inputs are high. **[2020]**
    (A) OR (B) NAND
    (C) AND (D) NOR

12. In light emitting diode (LED), light is given out due to **[2020]**
    (A) emission of holes and electrons
    (B) recombination of holes and electrons
    (C) diffusion of holes
    (D) drifting of electrons

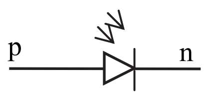
13. Which one of the following symbols represents a photodiode? **[2020]**



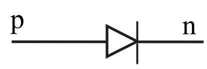
(1)



(2)



(3)

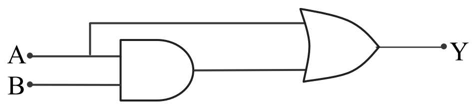


(4)

(A) (3) (B) (1) (C) (2) (D) (4)

14. For a transistor, the current ratio $\alpha_{dc} = \frac{69}{70}$.
The current gain β_{dc} is **[2021, 2015]**
(A) 66 (B) 67 (C) 69 (D) 71

15. The output Y in the following circuit will be 'ONE' if and only if **[2021]**



(A) B is 'ONE' (1) (B) A is 'ZERO' (0)
(C) A is 'ONE' (1) (D) B is 'ZERO' (0)

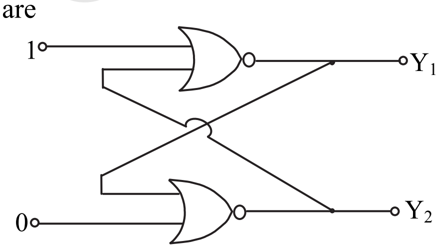
16. For a transistor, $\left(\frac{1}{\alpha} - \frac{1}{\beta}\right)$ is equal to **[2021]**
(A) two (B) three
(C) one (D) zero

17. A semiconductor with band gap energy of 3.31×10^{-19} J is used to fabricate a p-n junction photo diode. It can detect the signal of wavelength
[Planck's constant = 6.62×10^{-34} Js, velocity of light c = 3×10^{8} ms^{-1}] **[2021]**
(A) 6400 Å (B) 6800 Å
(C) 7000 Å (D) 6000 Å

18. In the (C.E.) transistor, emmiter current is 16 mA and base current is 2 mA. The value of (current ratio) α_{dc} and β_{dc} respectively is **[2021]**
(A) $\frac{8}{7}, \frac{1}{7}$ (B) $7, \frac{7}{8}$
(C) $\frac{7}{8}, 7$ (D) $\frac{8}{7}, 7$

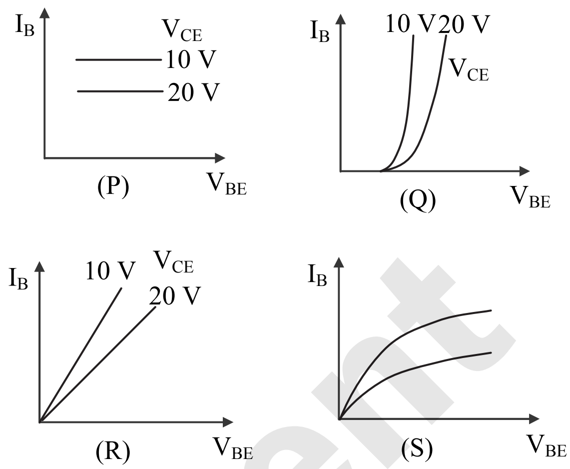
19. The frequency of a given a.c. signal is 'N' Hz. When it is connected to a half wave rectifier, the number of output pulses given by the rectifier in 1 second is **[2021]**
(A) $\frac{N}{4}$ (B) $\frac{N}{2}$ (C) N (D) 2N

20. In the following logic circuit, output Y_1 and Y_2 are **[2021]**



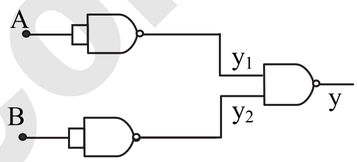
(A) $Y_1 = 1, Y_2 = 0$ (B) $Y_1 = 1, Y_2 = 1$
(C) $Y_1 = 0, Y_2 = 0$ (D) $Y_1 = 0, Y_2 = 1$

21. In common emitter transistor, the input characteristics are shown **[2021]**



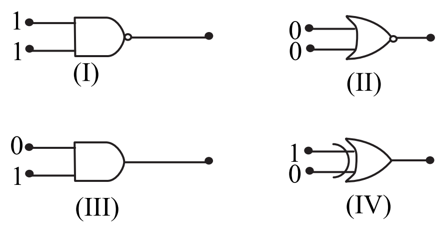
(A) Q (B) S
(C) R (D) P

22. Combination of NAND gates is shown in the figure, it is equivalent to **[2021]**



(A) AND gate (B) NOR gate
(C) OR gate (D) X-OR gate

23. Which of the following gates will give an output '1' for the given inputs? **[2021]**



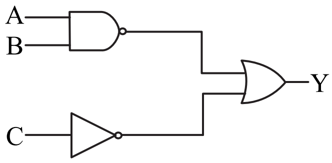
(A) II and III (B) I and IV
(C) I and II (D) II and IV

24. For a two input AND gate, the four entries are shown in the truth table. Identify the correct ones out of these (A, B = input, Y = output)

Entry	A	B	Y
1	0	1	0
2	1	0	0
3	1	1	1
4	0	0	1

[2021]
(A) 1 and 2 only (B) 1, 2 and 3 only
(C) 1, 3 and 4 only (D) 2 and 4 only

25. The output Y when all the three inputs A, B, C are first low and then high will be respectively



[2022]

(A) 0, 1 (B) 1, 0
(C) 1, 1 (D) 0, 0

26. A transistor is used as a common emitter amplifier with a load resistance 2kΩ. The input resistance is 150Ω. Base current is changed by 20μA which results in a change in collector current by 1.5 mA. The voltage gain of the amplifier is **[2022]**

(A) 1100 (B) 1200
(C) 900 (D) 1000

27. Identify the devices which work on solar energy.

i. Photodiode
ii. Photovoltaic cell
iii. LED
iv. Photo thermal devices. **[2022]**

(A) ii, iv (B) ii, iii
(C) i, ii (D) i, iv

28. In common emitter transistor amplifier, the output voltage and input voltage have a phase difference of **[2022]**

(A) π^c (B) 0^c
(C) $\frac{\pi^c}{2}$ (D) $\frac{5\pi^c}{6}$

29. The output characteristic of a transistor in common emitter (CE) mode is the graph obtained by plotting **[2022]**

(A) I_C against I_B at constant V_{CE}.
(B) I_C against V_{CE} at constant I_B.
(C) I_C against I_B at constant V_{BE}.
(D) I_C against V_{BE} at constant I_B.

30. For a NAND gate, the inputs and outputs are given below.

Input A	Input B	Output Y
0	1	C
0	0	D
1	0	E
1	1	F

The values taken by C, D, E, F are respectively **[2022]**

(A) 0, 1, 0, 0 (B) 1, 0, 1, 1
(C) 0, 1, 0, 1 (D) 1, 1, 1, 0

31. In a full wave rectifier circuit without filter, the output current is **[2022]**

(A) a constant direct current.
(B) a sinusoidal current.
(C) an eddy current.
(D) unidirectional but not steady current.

32. The logic gate for which only when an odd number of 'high' or '1' at its inputs gives 'high' or '1' at the output is **[2022]**

(A) Ex – OR gate (B) OR gate
(C) NAND gate (D) NOR gate

33. A common emitter transistor amplifier has a current gain of 50. If the load resistance is 4 kΩ and input resistance is 500 Ω, the voltage gain of the amplifier is **[2022]**

(A) 100 (B) 300
(C) 200 (D) 400

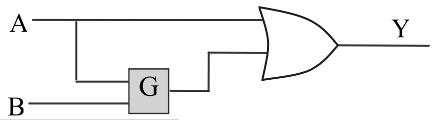
34. A transistor is connected in CE mode. The collector volatage is 6 volt and voltage drop across a resistor of 728 Ω in the collector circuit is 70×10^{-2} volt. If $\frac{I_C}{I_E} = 0.96$ then base current will be approximately **[2022]**

(A) 20 μA (B) 40 μA
(C) 30 μA (D) 60 μA

35. In an n – p – n transistor circuit, the emitter current is 10 mA. If 90% of the emitted electrons reach the collector, the base current is **[2022]**

(A) 9 mA (B) 2 mA
(C) 1 mA (D) 8 mA

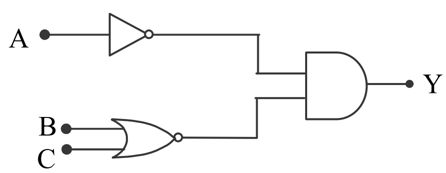
36. To obtain the truth-table shown, from the following logic circuit, the gate G should be **[2023]**



A	B	Y
0	0	1
0	1	0
1	0	1
1	1	1

(A) AND (B) NAND
(C) OR (D) NOR

37. The digital logic circuit is as shown in figure. The Boolean expression for the output Y is. **[2023]**



(A) $\overline{A} + (\overline{B + C})$ (B) $\overline{A} . (\overline{B + C})$

(C) $\overline{A} + (\overline{B . C})$ (D) $\overline{A} . (\overline{B . C})$

38. In a transistor, in common emitter configuration, the ratio of power gain to voltage gain is **[2023]**

(A) α (B) $\frac{\beta}{\alpha}$

(C) $\beta\alpha$ (D) β

39. Choose the CORRECT statement of the following. **[2023]**

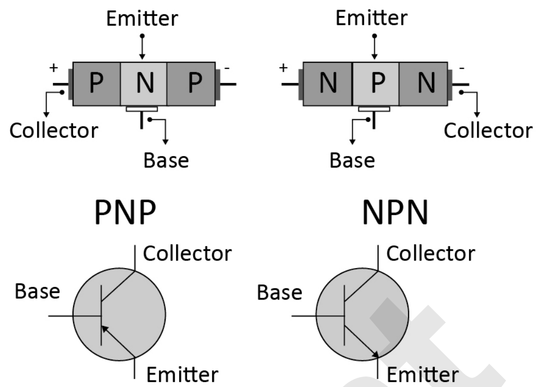
(A) The zener voltage does not depend on amount of doping.

(B) For a heavily doped zener diode, the breakdown occurs at high reverse voltage.

(C) For a heavily doped zener diode the breakdown occurs at a lower reverse voltage.

(D) A lightly doped zener diode has lower breakdown voltage.

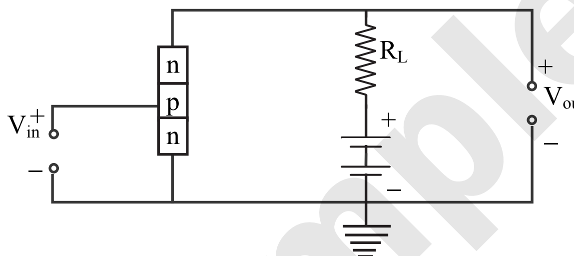
Junction Transistor



A device that helped make a sensational advancement of the field of electronics is a bipolar junction transistor which is commercially available as per the requirement of a circuitary or application. Circuits vividly used in amplifiers, integrated, wireless systems, temperature sensors, logarithmic converters etc. employ transistors.

Evaluation Test

1. An npn transistor circuit is arranged as shown in figure. It is



(A) a common-base amplifier circuit.

(B) a common-emitter amplifier circuit.

(C) a common-collector amplifier circuit.

(D) rectifier circuit.

2. A zener-regulated power supply consists of a 9 V battery connected in series with a resistance of 100 Ω and a zener diode. The zener diode maintains a constant voltage drop of 4 V across a load resistance of 400 Ω. The current drawn by the load resistance will be

(A) 0.025 A

(B) 0.050 A

(C) 0.01 A

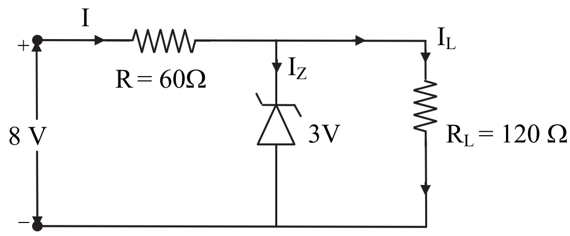
(D) 0.015 A

3. The current gain α of a transistor is 0.94. The change in collector current corresponding to a change of 0.5 mA in the base current in a common emitter arrangement is

(A) 1.52 mA (B) 2.38 mA

(C) 3.45 mA (D) 7.83 Ma

4. In the circuit shown below, current passing through R_L and zener diode is,



(A) $\frac{1}{12}$A , $\frac{3}{40}$A (B) $\frac{1}{40}$A , $\frac{1}{120}$A

(C) $\frac{1}{40}$A , $\frac{7}{120}$A (D) $\frac{1}{30}$A , $\frac{7}{30}$A

5. A solar cell

(A) converts the radiant energy of sun into electrical power.

(B) converts the radiant energy of sun into heat.

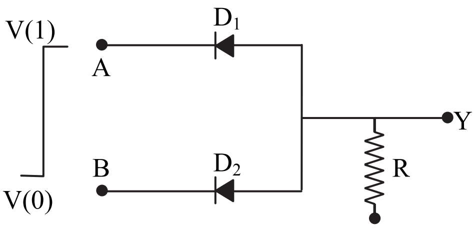
(C) reflects all the light from sun.

(D) absorbs energy and converts into sound energy.

6. **Assertion:** A transistor has its base made thin.
Reason: A thin base makes the transistor stable.
(A) If both assertion and reason are true and reason is the correct explanation of assertion
(B) If both assertion and reason are true but reason is not be correct explanation of assertion
(C) If assertion is true but reason is false
(D) If assertion is false but reason is true

7. The input resistance of a CE amplifier is 400 Ω and the load resistance is 4 kΩ. A change of base current by 10 μA results in the change of collector current by 2 mA. The voltage gain of the amplifier is
(A) 500 (B) 1000
(C) 1500 (D) 2000

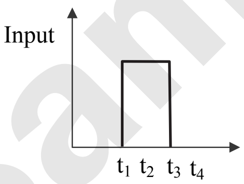
8. The circuit below represents a



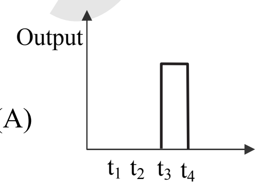
(A) OR gate (B) AND gate
(C) NOR gate (D) NAND gate

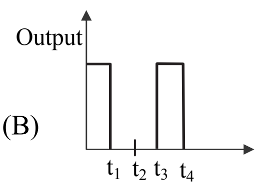
9. Generally, the base of a transistor has a thickness of the order of
(A) 10^{-6} m (B) 10^{-3} m
(C) 0.1 m (D) 1 cm

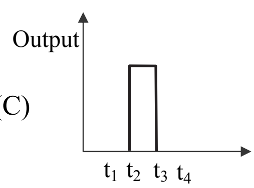
10. The following input voltage is passed through a NOT gate.

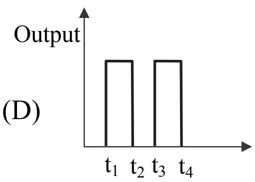


Which one of the following is the output?

(A)


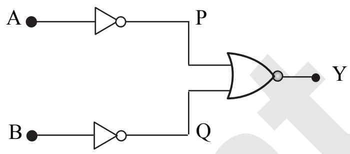
(B)


(C)


(D)


11. In case of a bipolar transistor β = 45. The potential drop across the collector resistance of 1 kΩ is 5 V. The base current is approximately
(A) 222 μA (B) 55 μA
(C) 111 μA (D) 45 μA

12. In the following circuit, Y = 1 for the inputs A and B respectively equal to



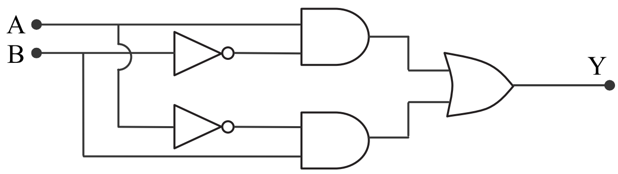
(A) 0, 0 (B) 0, 1
(C) 1, 0 (D) 1, 1

13. A common-emitter amplifier, has an input resistance of 500 Ω and an output resistance of 40 kΩ. If the current gain is 75, then power gain of the transistor is
(A) 1.2×10^5 (B) 2.3×10^5
(C) 3.6×10^5 (D) 4.5×10^5

14. A transistor has α = 0.96. If the emitter current is 8 mA, what are the values of collector and base currents?
(A) 7.8 mA, 0.5 mA (B) 7.7 mA, 0.3 mA
(C) 7.6 mA, 0.2 mA (D) 7.5 mA, 0.1 mA

15. A transistor is connected in common-emitter (CE) configuration. The collector-supply is 10 V and the voltage drop across 500 Ω in the collector circuit is 4 V. If the current-gain factor (α) is 0.96, the base-current is
(A) 0.11 mA (B) 0.22 mA
(C) 0.33 mA (D) 0.44 mA

16. In the combination of the following gates the output Y can be written in terms of inputs A and B as



(A) $\overline{A \cdot B}$ (B) $A \cdot \overline{B} + \overline{A} \cdot B$
(C) $\overline{A \cdot B} + A \cdot B$ (D) $\overline{A + B}$

17. The maximum wavelength which a photodiode can detect with E_g = 0.74 eV is,
(A) 1680 nm (B) 1764 nm
(C) 1847 nm (D) 1932 nm

The Answer to Physics of…..

Solar Cell

Solar cell uses p-n junction to convert sunlight directly into electricity. The solar cell consists of p-type semiconductor surrounding an n-type semiconductor. Charge layers form at the junction between the two types of semiconductors leading to an electric field E pointing from the n-type towards the p-type layer. The outer covering of p-type material is so thin that sunlight penetrates into the charge layers and ionizes some of the atoms there. In the process of ionization, the energy of the sunlight causes a negative electron to be ejected from the atom, leaving behind a positive hole. The electric field in the charge layers causes the electron and the hole to move away from the junction. The electron moves into the n-type material, and the hole moves into the p-type material. As a result, the sunlight causes the solar cell to develop negative and positive terminals much like the terminals of a battery. The current that a single solar cell can provide is small, so applications of solar cells often use many of them mounted to form large panels.

Answer Key of the chapter: *Semiconductor Devices* & Evaluation Test is given at the end of the book.

Solutions to the relevant questions of this chapter & Evaluation Test can be accessed by scanning the adjacent QR code in ***Quill - The Padhai App.***

Chapter 1: Rotational Dynamics

Classical Thinking

1.2:	**1.** (A)	**2.** (C)	**3.** (D)	**4.** (A)	**5.** (D)	**6.** (C)	**7.** (C)	**8.** (D)	**9.**(A)	**10.** (D)
	11. (A)	**12.** (A)	**13.** (B)	**14.** (B)	**15.** (C)	**16.** (C)				
1.3:	**1.** (A)	**2.** (C)	**3.** (B)	**4.** (A)	**5.** (D)	**6.** (C)				
1.4:	**1.** (C)	**2.** (C)	**3.** (B)	**4.** (C)	**5.** (A)	**6.** (A)	**7.** (A)	**8.** (B)	**9.** (B)	**10.** (D)
	11. (C)									
1.5:	**1.** (C)	**2.** (C)	**3.** (A)	**4.** (C)	**5.** (D)	**6.** (A)	**7.** (D)	**8.** (A)	**9.** (C)	**10.** (A)
	11. (D)	**12.** (B)	**13.** (C)							
1.6:	**1.** (A)	**2.** (B)	**3.** (B)	**4.** (D)	**5.** (D)					
1.7:	**1.** (C)	**2.** (C)	**3.** (B)	**4.** (B)	**5.** (D)	**6.** (C)	**7.** (C)	**8.** (A)	**9.** (B)	**10.** (C)
1.8:	**1.** (B)	**2.** (D)	**3.** (C)	**4.** (D)	**5.** (A)	**6.** (C)	**7.** (C)	**8.** (B)		
1.9:	**1.** (B)	**2.** (C)	**3.** (A)	**4.** (A)	**5.** (B)	**6.** (D)	**7.** (A)	**8.** (D)		
1.10:	**1.** (A)	**2.** (C)	**3.** (D)	**4.** (D)	**5.** (B)	**6.** (A)				
1.11:	**1.** (C)	**2.** (C)	**3.** (D)	**4.** (A)	**5.** (A)	**6.** (D)	**7.** (A)	**8.** (D)	**9.** (D)	

Critical Thinking

1.2:	**1.** (D)	**2.** (D)	**3.** (A)	**4.** (B)	**5.** (C)	**6.** (C)	**7.** (D)	**8.** (A)	**9.** (C)	**10.** (C)
	11. (C)	**12.** (B)	**13.** (B)	**14.** (B)	**15.** (D)	**16.** (D)	**17.** (B)	**18.** (B)	**19.** (B)	**20.** (A)
	21. (B)	**22.** (A)	**23.** (D)	**24.** (D)	**25.** (B)	**26.** (A)				

1.3:	**1.** (D)	**2.** (A)	**3.** (A)	**4.** (A)	**5.** (C)	**6.** (D)	**7.** (B)	**8.** (B)	**9.** (A)	**10.** (C)
	11. (D)	**12.** (B)	**13.** (A)	**14.** (A)	**15.** (B)	**16.** (A)	**17.** (B)	**18.** (D)	**19.** (C)	**20.** (D)
	21. (A)	**22.** (C)	**23.** (B)	**24.** (A)	**25.** (B)	**26.** (B)	**27.** (B)	**28.** (C)	**29.** (D)	**30.** (B)
	31. (A)	**32.** (A)								

1.4:	**1.** (B)	**2.** (B)	**3.** (A)	**4.** (B)	**5.** (A)	**6.** (B)	**7.** (A)	**8.** (A)	**9.** (A)	**10.** (C)
	11. (D)	**12.** (C)	**13.** (D)	**14.** (A)	**15.** (A)	**16.** (C)				

1.5:	**1.** (C)	**2.** (C)	**3.** (B)	**4.** (C)	**5.** (D)	**6.** (A)	**7.** (C)	**8.** (B)	**9.** (A)	**10.** (C)
	11. (B)	**12.** (B)	**13.** (B)	**14.** (D)	**15.** (B)	**16.** (B)	**17.** (C)	**18.** (D)	**19.** (C)	**20.** (A)
	21. (A)	**22.** (D)	**23.** (C)	**24.** (C)	**25.** (B)	**26.** (A)	**27.** (B)	**28.** (A)	**29.** (D)	**30.** (B)
	31. (B)	**32.** (A)	**33.** (A)	**34.** (D)						

1.6:	**1.** (A)	**2.** (A)	**3.** (A)	**4.** (D)	**5.** (B)

1.7:	**1.** (B)	**2.** (B)	**3.** (C)	**4.** (D)	**5.** (D)	**6.** (B)	**7.** (B)	**8.** (C)	**9.** (D)	**10.** (D)
	11. (C)	**12.** (C)	**13.** (C)	**14.** (A)	**15.** (B)	**16.** (A)	**17.** (B)	**18.** (B)	**19.** (B)	**20.** (C)
	21. (B)	**22.** (A)								

1.8:	**1.** (A)	**2.** (B)	**3.** (C)	**4.** (D)	**5.** (A)	**6.** (B)	**7.** (D)	**8.** (C)	**9.** (C)	**10.** (A)
	11. (A)	**12.** (D)								

1.9:	**1.** (D)	**2.** (D)	**3.** (C)	**4.** (B)	**5.** (C)	**6.** (B)	**7.** (C)	**8.** (C)	**9.** (C)	**10.** (D)
	11. (D)									

1.10:	**1.** (B)	**2.** (C)	**3.** (C)	**4.** (A)	**5.** (A)	**6.** (B)	**7.** (A)	**8.** (C)	**9.** (D)	**10.** (B)
	11. (C)									

1.11:	**1.** (C)	**2.** (A)	**3.** (D)	**4.** (B)	**5.** (A)	**6.** (C)	**7.** (A)	**8.** (B)	**9.** (A)	**10.** (A)
	11. (A)	**12.** (C)	**13.** (A)	**14.** (C)	**15.** (B)	**16.** (C)	**17.** (D)			

Concept Fusion

1. (B)	**2.** (D)	**3.** (A)	**4.** (A)	**5.** (B)	**6.** (D)	**7.** (A)	**8.** (A)	**9.** (B)	**10.** (C)
11. (A)	**12.** (A)	**13.** (C)	**14.** (A)	**15.** (C)	**16.** (A)	**17.** (B)	**18.** (B)	**19.** (D)	**20.** (C)
21. (A)	**22.** (B)	**23.** (A)	**24.** (D)	**25.** (A)	**26.** (A)	**27.** (C)	**28.** (A)	**29.** (C)	**30.** (C)
31. (A)	**32.** (D)	**33.** (A)	**34.** (B)	**35.** (D)	**36.** (B)	**37.** (C)	**38.** (C)	**39.** (D)	**40.** (A)