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Continuing Education Course #621
Electronics
Course I Fundamentals

1. Germanium [Ge] is in Period 4 and Group 14 of the periodic table. How many electrons are in the outer shell?
- ○ a. 2
- ○ b. 4
- ○ c. 8
- ○ d. 18

2. Intrinsic germanium has a concentration of electrons of $2.5 \times 10^{13}\ \mathrm{cm}^{-3}$. Most nearly, what is the concentration of holes?
- ○ a. $1.2 \times 10^{13}\ \mathrm{cm}^{-3}$
- ○ b. $1.5 \times 10^{13}\ \mathrm{cm}^{-3}$
- ○ c. $2.0 \times 10^{13}\ \mathrm{cm}^{-3}$
- ○ d. $2.5 \times 10^{13}\ \mathrm{cm}^{-3}$

3. For extrinsic semiconductors, the mass action law is probably better understood as indicating that the product ____ remains constant regardless of position in the semiconductor or doping level.
- ○ a. nn
- ○ b. pp
- ○ c. np
- ○ d. ni

4. What type of semiconductor material results if phosphorus is the only impurity?
- ○ a. acceptor
- ○ b. donor
- ○ c. n-type
- ○ d. p-type

5. The subscripts on currents in a given model indicate the direction _____ which current flows.
- ○ a. into
- ○ b. out of
- ○ c. away from
- ○ d. depends on pn junction

6. The term Ultra Large-Scale Integration (ULSI) indicates a chip with at least _____ components per chip.
- ○ a. 100
- ○ b. 1000
- ○ c. 10 000
- ○ d. 1 000 000

7. A germanium semiconductor is doped with an impurity having three valence electrons. What are the majority carriers?

○ a. conduction band electrons
○ b. conduction band holes
○ c. valence band electrons
○ d. valence band holes

8. A silicon semiconductor is doped with 10^{15} atoms/cm^{-3} of phosphorus. What is the concentration of electrons?

○ a. $1.6 \times 10^{-5}\ \text{cm}^{-3}$
○ b. $2.6 \times 10^{5}\ \text{cm}^{-3}$
○ c. $0.5 \times 10^{15}\ \text{cm}^{-3}$
○ d. $1.0 \times 10^{15}\ \text{cm}^{-3}$

9. A silicon semiconductor is doped with a concentration of 10^{15} atoms/cm^{-3} of phosphorus as in the previous problem. The intrinsic concentration of phosphorus is $1.6 \times 10^{10}\ \text{cm}^{-3}$.

What is most nearly the concentration of holes?

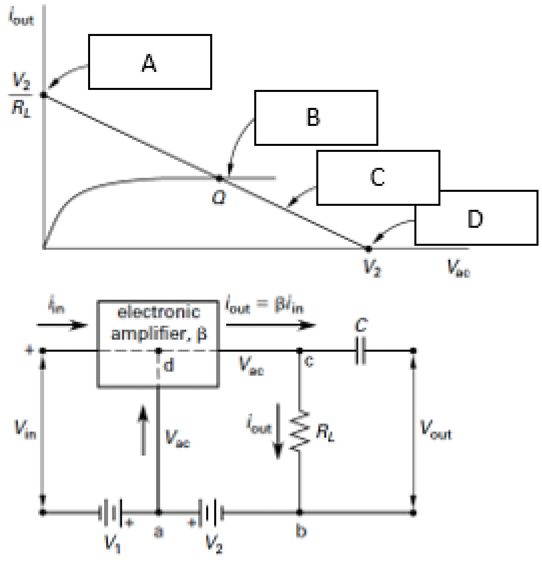
○ a. $1.6 \times 10^{-5}\ \text{cm}^{-3}$
○ b. $2.6 \times 10^{5}\ \text{cm}^{-3}$
○ c. $0.5 \times 10^{15}\ \text{cm}^{-3}$
○ d. $1.0 \times 10^{15}\ \text{cm}^{-3}$

10. The energy gap for germanium at room temperature (300K) is 0.66 eV. The energy density states are $N_c = 1.04 \times 10^{19}\ \text{cm}^{-3}$ and $N_v = 5.0 \times 10^{18}\ \text{cm}^{-3}$.

What is most nearly the intrinsic carrier concentration assuming thermal equilibrium?

○ a. $2 \times 10^{13}\ \text{cm}^{-3}$
○ b. $4 \times 10^{13}\ \text{cm}^{-3}$
○ c. $5 \times 10^{13}\ \text{cm}^{-3}$
○ d. $8 \times 10^{13}\ \text{cm}^{-3}$

11. Considered the figure shown\ for a general amplifier.

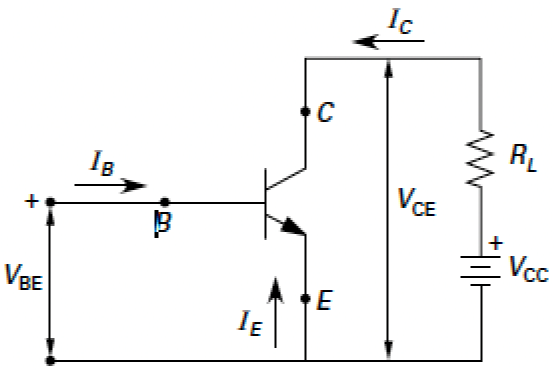


Which letter indicates the line of constant current?

○ a. A
○ b. B
○ c. C
○ d. D

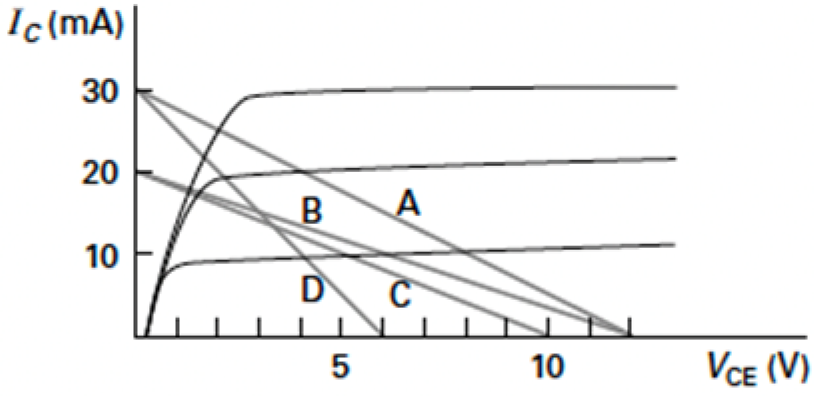
12. What type, class, of amplifier has the greatest linearity and least distortion?
○ a. Class A
○ b. Class AB
○ c. Class B
○ d. Class C

13. Consider the Common Emitter (CE) circuit shown.



The silicon bipolar junction transistor (BJT) used in the circuit has a collector supply voltage of 12 V. The load resistance is $R_{L1} = 400\Omega$.

Which load line shown corresponds to the circuit?



○ a. Load Line A
○ b. Load Line B
○ c. Load Line D
○ d. Load Line D

14. What is the region of a *pn* junction in which no mobile charge carriers exist called?
○ a. acceptor side
○ b. donor side

○ c. junction
○ d. space-charge region

15. At what condition is the space-charge region the largest?
○ a. barrier biased
○ b. forward biased
○ c. no applied voltage
○ d. reverse biased

16. At 20°C, a germanium diode passes 70 μA when the reverse bias is -1.5 V.

What most nearly is the magnitude of the saturation current?
○ a. 70 μA
○ b. 70 mA
○ c. 70 A
○ d. 140 A

17. At 20°C, a germanium diode passes 70 μA when the reverse bias is -1.5 V.

What is the current that flows when a forward bias of +0.2 V is applied at 20°C.
○ a. 0.2 A
○ b. 0.7 A
○ c. 1.0 A
○ d. 2.7

18. Assume a saturation current is 0.5 A at 20°C.

What is the expected current at 30°C?
○ a. 0.5 A
○ b. 1.0 A
○ c. 1.5 A
○ d. 2.0 A

19. What is the voltage equivalent of temperature for a room temperature of 20°C?
○ a. 0.024 V
○ b. 0.025 V
○ c. 0.24 V
○ d. 0.25 V

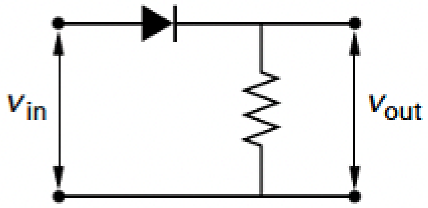
20. What is a diode's dynamic forward resistance when operating at 20°C and 0.2 A?
○ a. 0.025 Ω
○ b. 0.125 Ω
○ c. 0.20 Ω
○ d. 1.00 Ω

21. What type of diode operates in the breakdown region?
○ a. LED
○ b. Schottky
○ c. Tunnel
○ d. zener

22. Gallium phosphide (GaP), with an energy gap of 2.26 eV, is to be used in an LED. What is the expected wavelength of the emitted photons?

○ a. 8.79×10^{-26} m
○ b. 5.49×10^{-7} m
○ c. 3.42×10^{12} m
○ d. 5.46×10^{14} m

23. What is the name of the diode circuit shown?



○ a. clipper
○ b. full-wave rectifier
○ c. half-wave rectifier
○ d. peak clipper

24. Which diode uses a metal semiconductor contact?

○ a. Schottky
○ b. simple
○ c. tunnel
○ d. Zener

25. A variable frequency drive (VFD) requires an electronic device to shape an incoming waveform so that only a portion of the power is passed to a downstream motor. Furthermore, the amount of the waveform passed must be controllable in order to vary the motor speed.

Which electronic component is widely used in VFDs?

○ a. IGBT
○ b. Schottky
○ c. SCR
○ d. either IGBT or SCR

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