Board Exam Desk

Electronics Engineering Reviewer

Electronics Engineering Licensure Examination | PRC | 120 original questions

2026 Edition | Updated November 2026

Original board-style practice questions with an answer key.

Practice questions

Mathematics

1. The roots of $2x^2 - 7x + 3 = 0$ are r and s. What is $r^2 + s^2$?

A. 9.25
B. 12.25
C. 15.25
D. 10.75

2. If $y = x^3e^{(2x)}$, what is dy/dx at x = 1?

A. 22.17
B. 36.95
C. 14.78
D. 44.33

3. Evaluate the definite integral of $\sin^2 x$ from x = 0 to $x = \pi$.

A. 3.1416
B. 1.5708
C. 0.7854
D. 1.0000

4. What is the area of the region bounded by the parabola $y = x^2$ and the line y = 4?

A. 5.333 square units
B. 10.667 square units
C. 16.000 square units
D. 8.000 square units

5. Simplify the complex quotient (3 + j4)/(1 − j2).

A. –1 – j2
B. –1 + j2
C. 1 + j2
D. 2.2 + j0.4

6. What is the product of the phasors $5\angle 30°$ and $2\angle -75°$?

A. $7\angle -45°$
B. $10\angle 105°$
C. $10\angle -45°$
D. $2.5\angle 105°$

7. Two fair six-sided dice are rolled. What is the probability that the sum is 9?

A. 1/6
B. 5/36
C. 1/12
D. 1/9

8. A 4-member committee is drawn from 7 engineers and 5 technicians. How many committees contain exactly 2 engineers?

A. 495
B. 840
C. 31
D. 210

9. In an arithmetic progression the 5th term is 17 and the 12th term is 45. What is the sum of the first 20 terms?

A. 820
B. 1540
C. 780
D. 770

10. Find the sum of the infinite geometric series 6 + 4 + 8/3 + 16/9 + …

A. 18
B. 12
C. 9
D. 24

11. What is the Laplace transform of f(t) = e^(–3t) sin 2t?

A. 2/[(s + 3)² + 4]
B. 2/[(s – 3)² + 4]
C. (s + 3)/[(s + 3)² + 4]
D. 3/[(s + 2)² + 9]

12. If dy/dx = 3y and y(0) = 2, what is y(1)?

A. 40.17
B. 20.09
C. 5.44
D. 5.00

13. Find the determinant of the 3×3 matrix with rows (2, 1, 3), (0, 4, –1) and (5, 2, 1).

A. 53
B. –23
C. –53
D. 8

14. What is the perpendicular distance from the point (3, –2) to the line 4x – 3y + 2 = 0?

A. 4.0
B. 20.0
C. 1.6
D. 2.9

15. What is the eccentricity of the ellipse 9x² + 25y² = 225?

A. 0.80
B. 0.60
C. 1.25
D. 0.75

16. Evaluate the limit of (1 – cos 4x)/x² as x approaches 0.

A. 8
B. 4
C. 16
D. 2

17. A rectangle has a fixed perimeter of 60 m. What is the largest area it can enclose?

A. 225 m²
B. 200 m²
C. 900 m²
D. 250 m²

18. A triangle has sides 7 cm, 8 cm and 9 cm. What is its largest interior angle?

A. 58.41°
B. 73.40°
C. 48.19°
D. 90.00°

19. Solve for x: log■x + log■(x − 2) = 3.

A. x = −2
B. x = 4
C. x = 5
D. x = 6

20. What is the population standard deviation of the data set 4, 8, 6, 10, 12?

A. 3.162
B. 8.000
C. 1.265
D. 2.828

21. A periodic function has odd symmetry, f(−t) = −f(t). Which terms appear in its Fourier series?

A. Cosine terms only
B. Sine terms only
C. A dc term and cosine terms
D. Only odd-numbered cosine terms

22. What is the angle between the vectors A = 2i + 3j − k and B = i − j + 4k?

A. 108.36°
B. 71.64°
C. 88.86°
D. 90.00°

23. The polar equation r = 2 sin θ describes which curve in rectangular coordinates?

A. A circle of radius 2 centered at the origin
B. A circle of radius 1 centered at (1, 0)
C. A circle of radius 1 centered at (0, 1)
D. A parabola opening upward from the origin

24. What is the Z-transform of the discrete sequence x[n] = a■u[n]?

A. z/(z − a), for |z| < |a|
B. 1/(z − a), for |z| > |a|
C. z/(z − a), for |z| > |a|
D. a/(z − 1), for |z| > 1

25. Newton's method is applied to f(x) = x² − 5 starting at x■ = 2. What is x■?

A. 2.250
B. 2.500
C. 2.200
D. 2.236

26. The region under $y = \sqrt{x}$ from $x = 0$ to $x = 4$ is revolved about the x-axis. What is the volume generated?

A. 25.13 cubic units
B. 50.27 cubic units
C. 12.57 cubic units
D. 33.51 cubic units

27. Pipe A alone fills a tank in 6 hours and pipe B alone in 9 hours. How long do both pipes together take?

A. 7.5 hours
B. 3.6 hours
C. 3.0 hours
D. 4.5 hours

28. For $f(x, y) = x^2y + 3xy^3$, what is the mixed partial derivative $\partial^2 f/\partial x \partial y$ at (1, 2)?

A. 40
B. 74
C. 38
D. 14

29. How many liters of pure acid must be added to 20 L of a 30% acid solution to make a 50% solution?

A. 10 L
B. 4 L
C. 12 L
D. 8 L

30. Five percent of resistors from a line are defective. In a random sample of 10, what is the probability that exactly one is defective?

A. 0.0500
B. 0.5987
C. 0.0746
D. 0.3151

General Engineering and Applied Sciences

31. A projectile is launched at 25 m/s at 35° above level ground. What is its horizontal range? Use $g = 9.81$ m/s².

A. 59.87 m
B. 36.54 m
C. 63.71 m
D. 29.93 m

32. An object is dropped from rest from a height of 45 m. How long does it take to reach the ground? Use $g = 9.81$ m/s².

A. 4.59 s
B. 3.03 s
C. 2.14 s
D. 9.17 s

33. PHP 50,000 is deposited at 8% compounded quarterly. What is the amount after 5 years?

A. PHP 73,466.40
B. PHP 70,000.00
C. PHP 55,204.04
D. PHP 74,297.37

34. What is the effective annual interest rate of a nominal 12% compounded monthly?

A. 12.00%
B. 12.68%
C. 12.55%
D. 12.75%

35. What is the present worth of PHP 10,000 received at the end of each year for 8 years if money is worth 6% per year?

A. PHP 50,192.99
B. PHP 62,097.94
C. PHP 80,000.00
D. PHP 98,974.68

36. Test equipment costs PHP 250,000, has a salvage value of PHP 25,000 and a life of 9 years. Using straight-line depreciation, what is its book value after 4 years?

A. PHP 100,000.00
B. PHP 138,888.89
C. PHP 125,000.00
D. PHP 150,000.00

37. Two moles of an ideal gas at 300 K occupy 0.05 m^3. What is the pressure? Use R = 8.314 J/mol·K.

A. 49.9 kPa
B. 99.8 kPa
C. 9.0 kPa
D. 997.7 kPa

38. What is the maximum possible efficiency of a heat engine operating between 527°C and 27°C?

A. 94.9%
B. 37.5%
C. 56.9%
D. 62.5%

39. How much heat is needed to warm 3 kg of water from 20°C to 80°C? Use c = 4,186 J/kg·°C.

A. 1,004.6 kJ
B. 251.2 kJ
C. 1,255.8 kJ
D. 753.5 kJ

40. A 1-kg mass hangs from a spring of stiffness 400 N/m. What is the natural frequency of oscillation?

A. 20.00 Hz
B. 63.66 Hz
C. 125.66 Hz
D. 3.18 Hz

41. A block slides down a 30° incline with a coefficient of kinetic friction of 0.20. What is its acceleration? Use g = 9.81 m/s^2.

A. 4.91 m/s^2
B. 6.60 m/s^2
C. 3.21 m/s^2
D. 3.92 m/s^2

42. A 2-kg cart moving at 6 m/s couples with a stationary 4-kg cart and they move together. How much kinetic energy is lost?

A. 12 J
B. 36 J
C. 18 J
D. 24 J

43. 11.7 g of NaCl (molar mass 58.44 g/mol) is dissolved to make 500 mL of solution. What is the molarity?

A. 0.20 M
B. 0.0004 M
C. 0.40 M
D. 0.80 M

44. What is the pH of a 0.001 M solution of hydrochloric acid, a strong acid?

A. 11
B. 3
C. 0.001
D. 1

45. A steel rod 12 mm in diameter carries an axial tensile load of 20 kN. What is the normal stress?

A. 176.8 MPa
B. 44.2 MPa
C. 707.4 MPa
D. 138.9 MPa

46. A 2-m steel bar with a cross-sectional area of 100 mm² carries a 10-kN axial load. If E = 200 GPa, what is its elongation?

A. 0.5 mm
B. 10 mm
C. 2.0 mm
D. 1.0 mm

47. What is the gauge pressure at a depth of 15 m in fresh water? Use $\gamma = 9.81$ kN/m³.

A. 147.15 kPa
B. 248.48 kPa
C. 14.72 kPa
D. 1.53 kPa

48. A solid block with a density of 600 kg/m³ floats in fresh water (1,000 kg/m³). What fraction of its volume is submerged?

A. 0.40
B. 0.67
C. 1.67
D. 0.60

49. Light in air strikes a glass surface (n = 1.50) at 40° from the normal. What is the angle of refraction?

A. 26.7°
B. 25.4°
C. 64.6°
D. 40.0°

50. A sound wave has a frequency of 500 Hz and a wavelength of 0.68 m. What is its speed?

A. 735 m/s
B. 340 m/s
C. 170 m/s
D. 1.36 m/s

51. A 30-m steel rail (α = 12 × 10■■ /°C) warms by 40°C. How much does it lengthen?

A. 1.44 mm
B. 144 mm
C. 0.36 mm
D. 14.4 mm

52. In critical path scheduling, which activities make up the critical path?

A. Activities with the largest cost
B. Activities with the most resources
C. Activities with zero total float
D. Activities that start on day one

53. In management, what does the term span of control refer to?

A. The range of budget a manager may approve alone
B. The number of levels in an organization chart
C. The time a manager has to complete a project
D. The number of subordinates one manager directly supervises

54. A product sells for PHP 250 per unit with a variable cost of PHP 130 per unit and fixed costs of PHP 600,000. What is the break-even quantity?

A. 2,400 units
B. 1,579 units
C. 4,615 units
D. 5,000 units

55. Which crystal structure has a coordination number of 12 and an atomic packing factor of about 0.74?

A. Face-centered cubic
B. Body-centered cubic
C. Simple cubic
D. Diamond cubic

56. For an ideal gas undergoing a reversible isothermal expansion, which statement is true?

A. The work done by the gas is zero
B. No heat is transferred to the gas
C. The internal energy does not change
D. The pressure stays constant

57. A hoist lifts a 500-kg load vertically through 12 m in 20 s at constant speed. What average power does it deliver? Use g = 9.81 m/s².

A. 300 W
B. 58,860 W
C. 8,175 W
D. 2,943 W

58. A 1,200-kg car rounds a flat curve of 80 m radius at 20 m/s. What centripetal force is required?

A. 300 N
B. 1,200 N
C. 6,000 N
D. 24,000 N

59. An engineer evaluating bids discovers that one bidder is owned by a close relative. What is the ethical course of action?

A. Evaluate the bid but quietly score it lower
B. Continue since the relationship is a private matter
C. Disclose the relationship and step aside from the evaluation
D. Award the bid to avoid offending the relative

60. A gas occupies 4.0 L at 100 kPa. If it is compressed isothermally to 250 kPa, what is the new volume?

A. 10 L
B. 2.5 L
C. 1.6 L
D. 0.625 L

Electronics Engineering

61. What is the thermal voltage kT/q of a semiconductor junction at 300 K?

A. 25.85 mV
B. 51.70 mV
C. 23.54 mV
D. 59.53 mV

62. An LED with a forward drop of 2.0 V is to run at 20 mA from a 12-V supply. What series resistance is needed?

A. 500 Ω
B. 600 Ω
C. 100 Ω
D. 400 Ω

63. A 6.2-V Zener diode is fed from 15 V through a 220-Ω resistor and supplies a 1-kΩ load. What is the Zener current?

A. 33.8 mA
B. 40.0 mA
C. 46.2 mA
D. 62.0 mA

64. A BJT has β = 120 and a base current of 25 µA in the active region. What is the emitter current?

A. 3.000 mA
B. 2.975 mA
C. 3.025 mA
D. 0.208 mA

65. A voltage-divider-biased NPN stage has V_{CC} = 12 V, R1 = 47 kΩ, R2 = 10 kΩ, R_E = 1 kΩ and V_{BE} = 0.7 V. Using the approximate (stiff divider) method, what is I_E?

A. 2.11 mA
B. 1.41 mA
C. 1.85 mA
D. 0.20 mA

66. A common-emitter amplifier has $I_E = 2$ mA, $R_C = 3.9$ kΩ, a fully bypassed emitter resistor and no load. Taking $r'_e = 26$ mV/I_E, what is the voltage gain magnitude?

A. 150
B. 1.95
C. 300
D. 600

67. An inverting op-amp amplifier uses $R_f = 47$ kΩ and $R_{in} = 4.7$ kΩ. What is the output for a +0.3 V dc input?

A. +3.0 V
B. –3.3 V
C. +3.3 V
D. –3.0 V

68. A non-inverting op-amp amplifier has $R_f = 33$ kΩ and R1 = 3.3 kΩ to ground. What is the output for a 0.5 V input?

A. 5.0 V
B. –5.0 V
C. 6.0 V
D. 5.5 V

69. An op amp has a slew rate of 0.5 V/µs. What is the highest frequency at which it can deliver an undistorted 10-V peak sine wave?

A. 50.00 kHz
B. 3.98 kHz
C. 15.92 kHz
D. 7.96 kHz

70. An op amp with a gain-bandwidth product of 1 MHz is wired as an amplifier with a closed-loop gain of 50. What is the closed-loop bandwidth?

A. 20 kHz
B. 50 MHz
C. 200 kHz
D. 2 kHz

71. An n-channel JFET has $I_{DSS} = 10$ mA and $V_P = -4$ V. What is the drain current at $V_{GS} = -2$ V?

A. 5.0 mA
B. 7.5 mA
C. 2.5 mA
D. 1.25 mA

72. An enhancement NMOS in saturation obeys $I_D = K(V_{GS} - V_T)^2$ with $K = 0.5$ mA/V² and $V_T = 1$ V. What is I_D at $V_{GS} = 3$ V?

A. 2.0 mA
B. 4.5 mA
C. 1.0 mA
D. 4.0 mA

73. An ideal half-wave rectifier is driven by a sine wave with a 20-V peak and feeds a resistive load. What is the average output voltage?

A. 12.73 V
B. 6.37 V
C. 14.14 V
D. 10.00 V

74. A bridge rectifier with silicon diodes (0.7 V each) is fed from a 12-V rms transformer secondary. What is the peak output voltage?

A. 16.27 V
B. 16.97 V
C. 10.60 V
D. 15.57 V

75. A full-wave rectifier on a 60-Hz line feeds a 0.5-A load through a 2,200-µF capacitor filter. What is the approximate peak-to-peak ripple?

A. 1.89 V
B. 3.79 V
C. 0.55 V
D. 0.60 V

76. A 47-µF capacitor charges through a 10-kΩ resistor. Using the five-time-constant rule, about how long does it take to charge fully?

A. 0.47 s
B. 2.35 s
C. 4.70 s
D. 0.94 s

77. A 24-V source with 6 Ω internal resistance has a 12-Ω resistor connected across its terminals. What is the maximum power this network can deliver to an external load?

A. 24 W
B. 16 W
C. 64 W
D. 10.7 W

78. A series RLC circuit has L = 10 mH and C = 0.1 µF. What is its resonant frequency?

A. 5,033 Hz
B. 31,623 Hz
C. 1,592 Hz
D. 10,066 Hz

79. A series RLC circuit has R = 20 Ω, L = 10 mH and C = 0.1 µF. What is its half-power bandwidth?

A. 2,000.0 Hz
B. 636.6 Hz
C. 318.3 Hz
D. 159.2 Hz

80. What is the 8-bit two's-complement representation of –45?

A. 11010010
B. 10101101
C. 11010011
D. 00101101

81. Simplify the Boolean expression AB + AB′.

A. B
B. AB
C. A
D. A + B

82. What is the minimum number of flip-flops needed to build a mod-50 counter?

A. 6
B. 5
C. 7
D. 50

83. A 1.6-MHz clock drives a 4-bit binary ripple counter. What is the frequency at the most significant bit output?

A. 400 kHz
B. 100 kHz
C. 200 kHz
D. 50 kHz

84. A 10-bit DAC has a full-scale reference of 5.12 V. What is the output change for one LSB step?

A. 0.5 mV
B. 5.0 mV
C. 10 mV
D. 20 mV

85. Once an SCR has been triggered into conduction, how is it normally turned off?

A. By removing the gate trigger signal
B. By applying a positive pulse to the gate
C. By raising the anode voltage further
D. By reducing anode current below the holding current

86. An ideal buck converter operates from 24 V at a duty cycle of 0.40. What is its output voltage?

A. 14.4 V
B. 40.0 V
C. 9.6 V
D. 60.0 V

87. An ideal boost converter operates from 12 V at a duty cycle of 0.60. What is its output voltage?

A. 7.2 V
B. 20 V
C. 30 V
D. 18 V

88. Silicon doped with a pentavalent impurity such as phosphorus becomes which type of material?

A. P-type, with holes as majority carriers
B. N-type, with electrons as majority carriers
C. N-type, with holes as majority carriers
D. Intrinsic, with equal carrier counts

89. Which semiconductor device shows a negative-resistance region in its forward I-V characteristic because of quantum tunneling?

A. Schottky diode
B. Varactor diode
C. Tunnel diode
D. Zener diode

90. A differential amplifier has a differential gain of 200 and a common-mode gain of 0.02. What is its CMRR in decibels?

A. 40 dB
B. 20 dB
C. 100 dB
D. 80 dB

Electronic Systems and Technologies

91. An AM waveform displayed on an oscilloscope has a maximum envelope of 150 V peak-to-peak and a minimum of 50 V peak-to-peak. What is the modulation index?

A. 0.50
B. 0.67
C. 0.33
D. 2.00

92. An AM transmitter has an unmodulated carrier power of 1,000 W. What is the total power at 80% modulation?

A. 1,640 W
B. 1,320 W
C. 1,160 W
D. 1,800 W

93. A 1,000-W carrier is amplitude modulated to 80%. How much power is carried by each sideband?

A. 320 W
B. 400 W
C. 80 W
D. 160 W

94. An FM signal has a peak deviation of 75 kHz and a highest modulating frequency of 15 kHz. What bandwidth does Carson's rule give?

A. 150 kHz
B. 90 kHz
C. 180 kHz
D. 30 kHz

95. A 3-kHz tone produces a peak frequency deviation of 12 kHz in an FM transmitter. What is the modulation index?

A. 0.25
B. 36
C. 15
D. 4

96. What is the rms thermal noise voltage across a 10-kΩ resistor at 290 K over a 1-MHz bandwidth? Use k = 1.38 × 10■²³ J/K.

A. 12.87 µV
B. 12.65 µV
C. 4.00 µV
D. 6.33 µV

97. What is the thermal noise power available in a 1-MHz bandwidth at 290 K? Use k = 1.38 × 10■²³ J/K.

A. –144.0 dBm
B. –114.0 dBm
C. –84.0 dBm
D. –54.0 dBm

98. A receiver front end has an amplifier (gain 10 dB, noise figure 3 dB) followed by a mixer with a 6 dB noise figure. What is the overall noise figure?

A. 3.60 dB
B. 9.00 dB
C. 6.97 dB
D. 3.00 dB

99. An amplifier has a noise figure of 3 dB. What is its equivalent noise temperature, taking T■ = 290 K?

A. 870.0 K
B. 578.6 K
C. 145.3 K
D. 288.6 K

100. A channel has a bandwidth of 3 kHz and a signal-to-noise ratio of 30 dB. What is its Shannon capacity?

A. 14.86 kbps
B. 90.00 kbps
C. 29.90 kbps
D. 59.80 kbps

101. What is the maximum data rate of a noiseless 4-kHz channel using 8-level signaling, according to Nyquist?

A. 12 kbps
B. 64 kbps
C. 24 kbps
D. 32 kbps

102. A 50-Ω line is terminated in a 100-Ω resistive load. What is the voltage standing wave ratio?

A. 1.5
B. 2.0
C. 3.0
D. 0.5

103. A load produces a reflection coefficient magnitude of 1/3 on a transmission line. What is the return loss?

A. 9.54 dB
B. 4.77 dB
C. 0.51 dB
D. 6.02 dB

104. A lossless line has an inductance of 250 nH/m and a capacitance of 100 pF/m. What is its characteristic impedance?

A. 2,500 Ω
B. 25 Ω
C. 158 Ω
D. 50 Ω

105. A quarter-wave section is used to match a 100-Ω resistive load to a 25-Ω line. What characteristic impedance must the section have?

A. 62.5 Ω
B. 75 Ω
C. 50 Ω
D. 125 Ω

106. What is the free-space wavelength of a 2.4-GHz signal?

A. 1.25 cm
B. 12.5 cm
C. 125 cm
D. 8.0 cm

107. What is the free-space path loss over 10 km at 2 GHz?

A. 118.46 dB
B. 98.46 dB
C. 58.46 dB
D. 138.46 dB

108. A transmitting antenna stands 100 m above flat ground. Using a 4/3 effective earth radius (Earth radius 6,371 km), what is its radio horizon distance?

A. 35.7 km
B. 82.4 km
C. 41.2 km
D. 29.1 km

109. A 2-m parabolic dish with 55% aperture efficiency operates at 6 GHz. What is its gain?

A. 42.0 dBi
B. 39.4 dBi
C. 18.4 dBi
D. 33.4 dBi

110. A 10-W transmitter feeds a 20-dBi antenna through a cable with 2 dB of loss. What is the EIRP?

A. 62 dBm
B. 28 dBm
C. 58 dBm
D. 30 dBm

111. Express a power of 2 W in dBm.

A. 3.01 dBm
B. 66.02 dBm
C. 33.01 dBm
D. 23.01 dBm

112. A step-index fiber has a core index of 1.48 and a cladding index of 1.46. What is its numerical aperture?

A. 0.242
B. 0.020
C. 0.141
D. 0.059

113. For the core-cladding boundary of a fiber with n■ = 1.48 and n■ = 1.46, what is the critical angle measured from the normal?

A. 9.43°
B. 80.57°
C. 14.03°
D. 44.61°

114. A signal travels from an earth station to a geostationary satellite and back down, with a slant range of 36,000 km each way. What is the propagation delay?

A. 0.24 s
B. 0.12 s
C. 0.48 s
D. 0.024 s

115. A signal with a highest frequency of 5 kHz is sampled at the Nyquist rate and coded with 10 bits per sample. What is the PCM bit rate?

A. 100 kbps
B. 50 kbps
C. 80 kbps
D. 200 kbps

116. What is the theoretical signal-to-quantization-noise ratio of a 12-bit uniform quantizer driven by a full-scale sine wave?

A. 72.24 dB
B. 36.12 dB
C. 98.08 dB
D. 74.00 dB

117. A superheterodyne receiver tuned to 100 MHz uses a 10.7-MHz IF with the local oscillator above the signal. What is the image frequency?

A. 110.7 MHz
B. 89.3 MHz
C. 78.6 MHz
D. 121.4 MHz

118. A 16-QAM link carries 40 Mbps. What is the symbol rate?

A. 20 Mbaud
B. 2.5 Mbaud
C. 10 Mbaud
D. 160 Mbaud

119. A trunk group handles 120 calls per hour with an average holding time of 3 minutes. What is the offered traffic?

A. 360 erlangs
B. 6 erlangs
C. 40 erlangs
D. 2 erlangs

120. A rectangular waveguide has a broad-wall width of 2.286 cm. What is the cutoff frequency of the TE10 mode?

A. 13.12 GHz
B. 3.28 GHz
C. 0.66 GHz
D. 6.56 GHz

Answer key

Electronics Engineering

1. A. 9.25

r + s = 7/2 and rs = 3/2, so r² + s² = (r + s)² – 2rs = 12.25 – 3 = 9.25.

2. B. 36.95

dy/dx = 3x²e^(2x) + 2x³e^(2x); at x = 1 this is 5e² = 36.95.

3. B. 1.5708

Using sin²x = (1 – cos 2x)/2, the integral is [x/2 – sin 2x/4] from 0 to π = π/2 ≈ 1.5708.

4. B. 10.667 square units

The curves meet at x = ±2, so A = ∫(4 – x²)dx from –2 to 2 = 16 – 16/3 = 32/3 ≈ 10.667.

5. B. –1 + j2

Multiply by the conjugate: (3 + j4)(1 + j2)/(1 + 4) = (–5 + j10)/5 = –1 + j2.

6. C. 10∠–45°

For a product, multiply magnitudes and add angles: 5 × 2 = 10 and 30° + (–75°) = –45°.

7. D. 1/9

The favorable outcomes are (3,6), (4,5), (5,4), (6,3), so P = 4/36 = 1/9.

8. D. 210

Choose 2 of 7 engineers and 2 of 5 technicians: C(7,2) × C(5,2) = 21 × 10 = 210.

9. C. 780

d = (45 – 17)/7 = 4 and a■ = 17 – 16 = 1, so S■■ = (20/2)(2 + 19 × 4) = 780.

10. A. 18

The common ratio is 2/3, so S = a/(1 – r) = 6/(1/3) = 18.

11. A. 2/[(s + 3)² + 4]

L{sin 2t} = 2/(s² + 4); multiplying by e^(–3t) shifts s to s + 3, giving 2/[(s + 3)² + 4].

12. A. 40.17

The solution is y = 2e^(3x), so y(1) = 2e³ = 40.17.

13. C. –53

Expanding along the first row: 2(4 + 2) – 1(0 + 5) + 3(0 – 20) = 12 – 5 – 60 = –53.

14. A. 4.0

d = |Ax■ + By■ + C|/√(A² + B²) = |12 + 6 + 2|/5 = 4.0.

15. A. 0.80

Dividing by 225 gives a = 5 and b = 3, so c = √(25 – 9) = 4 and e = c/a = 0.80.

16. A. 8

Since 1 – cos u ≈ u²/2 for small u, (1 – cos 4x) ≈ 8x², so the limit is 8.

17. A. 225 m²

With sides x and 30 – x, A = x(30 – x) is maximum at x = 15 m, giving 15 × 15 = 225 m².

18. B. 73.40°

The largest angle is opposite the 9 cm side: cos C = (49 + 64 – 81)/(2 × 7 × 8) = 0.2857, so C = 73.40°.

19. B. x = 4

x(x – 2) = 2³ gives x² – 2x – 8 = 0, so x = 4 or –2; x = –2 is rejected because the logarithm of a negative number is undefined.

20. D. 2.828

The mean is 8 and the squared deviations sum to 40, so σ = √(40/5) = √8 = 2.828.

21. B. Sine terms only

An odd function integrates to zero against every cosine and against the constant, so only the b■ sine coefficients remain.

22. A. 108.36°

A·B = 2 – 3 – 4 = –5, |A| = √14 and |B| = √18, so cos θ = –5/√252 and θ = 108.36°.

23. C. A circle of radius 1 centered at (0, 1)

Multiplying by r gives x² + y² = 2y, or x² + (y – 1)² = 1, a unit circle centered at (0, 1).

24. C. z/(z – a), for |z| > |a|

Summing a■z■■ from n = 0 gives the geometric series 1/(1 – az■¹) = z/(z – a), which converges for |z| > |a|.

25. A. 2.250

x■ = x■ – f(x■)/f′(x■) = 2 – (–1)/4 = 2.250.

26. A. 25.13 cubic units

Disk method: V = π∫(√x)²dx from 0 to 4 = π[x²/2] = 8π ≈ 25.13.

27. B. 3.6 hours

Combined rate = 1/6 + 1/9 = 5/18 tank per hour, so time = 18/5 = 3.6 hours.

28. C. 38

∂f/∂x = 2xy + 3y³ and then ∂/∂y gives 2x + 9y²; at (1, 2) this is 2 + 36 = 38.

29. D. 8 L

(6 + x)/(20 + x) = 0.50 gives 6 + x = 10 + 0.5x, so x = 8 L.

30. D. 0.3151

Binomial: P = C(10,1)(0.05)(0.95)■ = 0.3151.

31. A. 59.87 m

R = v²sin 2θ/g = (25²)(sin 70°)/9.81 = 59.87 m.

32. B. 3.03 s

h = ½gt², so t = √(2h/g) = √(90/9.81) = 3.03 s.

33. D. PHP 74,297.37

F = P(1 + i)■ with i = 0.08/4 = 0.02 and n = 20: F = 50,000(1.02)²■ = PHP 74,297.37.

34. B. 12.68%

i_eff = (1 + 0.12/12)¹² – 1 = 12.68%.

35. B. PHP 62,097.94

P = A[1 – (1 + i)■■]/i = 10,000[1 – 1.06■■]/0.06 = PHP 62,097.94.

36. D. PHP 150,000.00

Annual depreciation = (250,000 – 25,000)/9 = PHP 25,000, so book value = 250,000 – 4(25,000) = PHP 150,000.

37. B. 99.8 kPa

p = nRT/V = (2)(8.314)(300)/0.05 = 99,768 Pa ≈ 99.8 kPa.

38. D. 62.5%

Carnot efficiency = 1 – Tc/Th with absolute temperatures: 1 – 300/800 = 0.625 = 62.5%.

39. D. 753.5 kJ

Q = mcΔT = (3)(4,186)(60) = 753,480 J ≈ 753.5 kJ.

40. D. 3.18 Hz

f = (1/2π)√(k/m) = (1/2π)√400 = 20/2π = 3.18 Hz.

41. C. 3.21 m/s²

a = g(sin θ – μ cos θ) = 9.81(0.500 – 0.173) = 3.21 m/s².

42. D. 24 J

Common velocity = (2 × 6)/6 = 2 m/s; KE before = 36 J and after = ½(6)(2²) = 12 J, so 24 J is lost.

43. C. 0.40 M

Moles = 11.7/58.44 = 0.200 mol; M = 0.200 mol/0.500 L = 0.40 M.

44. B. 3

HCl dissociates completely, so [H■] = 10■³ M and pH = –log(10■³) = 3.

45. A. 176.8 MPa

A = π(12²)/4 = 113.1 mm², so σ = P/A = 20,000/113.1 = 176.8 MPa.

46. D. 1.0 mm

δ = PL/(AE) = (10,000)(2)/(100 × 10■■ × 200 × 10■) = 0.001 m = 1.0 mm.

47. A. 147.15 kPa

p = γh = 9.81 kN/m³ × 15 m = 147.15 kPa; adding 101.33 kPa atmospheric would give the absolute value instead.

48. D. 0.60

At equilibrium the weight equals the buoyant force, so the submerged fraction is ρ_block/ρ_water = 600/1,000 = 0.60.

49. B. 25.4°

Snell's law: sin r = sin 40°/1.50 = 0.4285, so r = 25.4°.

50. B. 340 m/s

v = fλ = 500 × 0.68 = 340 m/s.

51. D. 14.4 mm

ΔL = αLΔT = (12 × 10■■)(30 m)(40) = 0.0144 m = 14.4 mm.

52. C. Activities with zero total float

Any delay in a zero-float activity delays the whole project, and the chain of such activities is the critical path.

53. D. The number of subordinates one manager directly supervises

Span of control is the count of people reporting directly to a manager; a narrow span produces taller hierarchies.

54. D. 5,000 units

Break-even = fixed cost/(price – variable cost) = 600,000/120 = 5,000 units.

55. A. Face-centered cubic

FCC is a close-packed structure with 12 nearest neighbors and APF 0.74; BCC has 8 neighbors and APF 0.68.

56. C. The internal energy does not change

The internal energy of an ideal gas depends only on temperature, so $\Delta U = 0$ and the heat absorbed equals the work done.

57. D. 2,943 W

P = mgh/t = (500)(9.81)(12)/20 = 2,943 W.

58. C. 6,000 N

F = mv^2/r = (1,200)(400)/80 = 6,000 N.

59. C. Disclose the relationship and step aside from the evaluation

A conflict of interest must be disclosed to the client or employer, and the engineer should not judge a bid where impartiality is compromised.

60. C. 1.6 L

Boyle's law: p■V■ = p■V■, so V■ = (100)(4.0)/250 = 1.6 L.

61. A. 25.85 mV

V_T = kT/q = (1.381 × 10■^{23})(300)/(1.602 × 10■^{1}■) = 25.85 mV.

62. A. 500 Ω

R = (V_s – V_F)/I = (12 – 2.0)/0.020 = 500 Ω.

63. A. 33.8 mA

I_R = (15 – 6.2)/220 = 40.0 mA and I_L = 6.2/1,000 = 6.2 mA, so I_Z = 40.0 – 6.2 = 33.8 mA.

64. C. 3.025 mA

I_C = βI_B = 3.000 mA, and I_E = I_C + I_B = 3.000 + 0.025 = 3.025 mA.

65. B. 1.41 mA

V_B = 12(10/57) = 2.11 V, V_E = V_B – 0.7 = 1.41 V, so I_E = V_E/R_E = 1.41 mA.

66. C. 300

r′e = 26 mV/2 mA = 13 Ω, so |A_v| = R_C/r′e = 3,900/13 = 300.

67. D. –3.0 V

V_o = –(R_f/R_in)V_in = –(47/4.7)(0.3) = –3.0 V; –3.3 V would be the non-inverting gain of 11 with a sign error.

68. D. 5.5 V

Gain = 1 + R_f/R1 = 1 + 10 = 11, so V_o = 11 × 0.5 = 5.5 V.

69. D. 7.96 kHz

f_max = SR/(2πV_p) = (0.5 × 10■)/(2π × 10) = 7,958 Hz ≈ 7.96 kHz.

70. A. 20 kHz

For a single-pole op amp, BW = GBW/A_CL = 1 MHz/50 = 20 kHz.

71. C. 2.5 mA

Shockley's equation: $I_D = I_{DSS}(1 - V_{GS}/V_P)^2 = 10(1 - 0.5)^2 = 2.5$ mA.

72. A. 2.0 mA

$I_D = 0.5(3 - 1)^2 = 0.5 \times 4 = 2.0$ mA.

73. B. 6.37 V

$V_{dc} = V_m/\pi = 20/\pi = 6.37$ V; $2V_m/\pi$ would apply to a full-wave rectifier.

74. D. 15.57 V

$V_m = 12\sqrt{2} - 2(0.7) = 16.97 - 1.4 = 15.57$ V, since two diodes conduct in series each half cycle.

75. A. 1.89 V

$V_{r(pp)} \approx I/(2fC) = 0.5/(2 \times 60 \times 2{,}200 \times 10$■■$) = 1.89$ V.

76. B. 2.35 s

$\tau = RC = (10{,}000)(47 \times 10$■■$) = 0.47$ s, and $5\tau = 2.35$ s (over 99% charged).

77. B. 16 W

Thevenin: $V_{th} = 24(12/18) = 16$ V and $R_{th} = 6$ ■ $12 = 4\ \Omega$, so $P_{max} = V_{th}^2/(4R_{th}) = 256/16 = 16$ W.

78. A. 5,033 Hz

f■ $= 1/(2\pi\sqrt{(LC)}) = 1/(2\pi\sqrt{(10$■$^3 \times 10$■■$)}) = 5{,}033$ Hz.

79. C. 318.3 Hz

$BW = R/(2\pi L) = 20/(2\pi \times 0.01) = 318.3$ Hz, equivalently f■$/Q$ with $Q = 15.81$.

80. C. 11010011

+45 = 00101101; inverting gives 11010010 and adding 1 gives 11010011.

81. C. A

$AB + AB' = A(B + B') = A \cdot 1 = A$.

82. A. 6

n flip-flops give 2■ states; 2■ = 32 is too few and 2■ = 64 ≥ 50, so 6 are needed.

83. B. 100 kHz

Each flip-flop divides by 2, so the MSB is at 1.6 MHz/2■ = 100 kHz.

84. B. 5.0 mV

Step size = $V_{ref}/2^{10}$■ $= 5.12/1{,}024 = 5.0$ mV.

85. D. By reducing anode current below the holding current

The gate loses control after latching; the SCR stays on until its anode current falls below the holding current, as at a natural ac zero crossing.

86. C. 9.6 V

For a buck converter $V_o = DV_{in} = 0.40 \times 24 = 9.6$ V.

87. C. 30 V

For a boost converter $V_o = V_{in}/(1 - D) = 12/0.40 = 30$ V.

88. B. N-type, with electrons as majority carriers

A pentavalent donor contributes a fifth valence electron that is free to conduct, making electrons the majority carriers.

89. C. Tunnel diode

The heavily doped tunnel diode has a region where current falls as forward voltage rises, which is useful in oscillators.

90. D. 80 dB

CMRR = A_d/A_cm = 200/0.02 = 10■, and 20 log(10■) = 80 dB.

91. A. 0.50

m = (V_max – V_min)/(V_max + V_min) = (150 – 50)/(150 + 50) = 0.50.

92. B. 1,320 W

P_t = P_c(1 + m²/2) = 1,000(1 + 0.64/2) = 1,320 W.

93. D. 160 W

Each sideband carries P_c m²/4 = 1,000(0.64)/4 = 160 W.

94. C. 180 kHz

BW ≈ 2(Δf + f_m) = 2(75 + 15) = 180 kHz.

95. D. 4

β = Δf/f_m = 12/3 = 4.

96. B. 12.65 µV

V_n = √(4kTRB) = √(4 × 1.38 × 10■²³ × 290 × 10■ × 10■) = 12.65 µV.

97. B. –114.0 dBm

N = kTB = (1.38 × 10■²³)(290)(10■) = 4.0 × 10■¹■ W, which is –114.0 dBm.

98. A. 3.60 dB

Friis: F = F■ + (F■ – 1)/G■ = 1.995 + (3.981 – 1)/10 = 2.293, which is 3.60 dB.

99. D. 288.6 K

T_e = (F – 1)T■ = (1.995 – 1)(290) = 288.6 K.

100. C. 29.90 kbps

C = B log■(1 + S/N) = 3,000 log■(1,001) = 29,902 bps ≈ 29.90 kbps.

101. C. 24 kbps

C = 2B log■M = 2(4,000)(3) = 24,000 bps.

102. B. 2.0

Γ = (100 – 50)/(100 + 50) = 1/3, so VSWR = (1 + Γ)/(1 – Γ) = (4/3)/(2/3) = 2.0.

103. A. 9.54 dB

Return loss = –20 log|Γ| = –20 log(1/3) = 9.54 dB.

104. D. 50 Ω

Z■ = √(L/C) = √(250 × 10■■/100 × 10■¹²) = √2,500 = 50 Ω.

105. C. 50 Ω

Z_q = √(Z■Z_L) = √(25 × 100) = 50 Ω.

106. B. 12.5 cm

λ = c/f = (3 × 10■)/(2.4 × 10■) = 0.125 m = 12.5 cm.

107. A. 118.46 dB

FSPL = 20 log d(km) + 20 log f(MHz) + 32.44 = 20 + 66.02 + 32.44 = 118.46 dB.

108. C. 41.2 km

d = √(2kRh) = √(2 × 4/3 × 6.371 × 10■ × 100) = 41.2 km.

109. B. 39.4 dBi

λ = 0.05 m, so G = η(πD/λ)² = 0.55(125.66)² = 8,685, which is 39.4 dBi.

110. C. 58 dBm

10 W = 40 dBm, so EIRP = 40 – 2 + 20 = 58 dBm.

111. C. 33.01 dBm

P(dBm) = 10 log(2,000 mW/1 mW) = 33.01 dBm.

112. A. 0.242

NA = √(n■² – n■²) = √(2.1904 – 2.1316) = 0.242.

113. B. 80.57°

θ_c = sin■¹(n■/n■) = sin■¹(1.46/1.48) = 80.57°.

114. A. 0.24 s

t = 2d/c = (2 × 36 × 10■)/(3 × 10■) = 0.24 s.

115. A. 100 kbps

f_s = 2 × 5 kHz = 10 kHz, so bit rate = 10 bits × 10,000 samples/s = 100 kbps.

116. D. 74.00 dB

SQNR = 6.02N + 1.76 = 6.02(12) + 1.76 = 74.00 dB.

117. D. 121.4 MHz

f_LO = 110.7 MHz and the image = f_s + 2f_IF = 100 + 21.4 = 121.4 MHz.

118. C. 10 Mbaud

16-QAM carries log■16 = 4 bits per symbol, so symbol rate = 40/4 = 10 Mbaud.

119. B. 6 erlangs

A = (calls/hour)(holding time in hours) = 120 × 3/60 = 6 erlangs.

120. D. 6.56 GHz

f_c = c/(2a) = (3 × 10■)/(2 × 0.02286) = 6.56 GHz.

Topics to review

• Analog circuits and semiconductor devices

• Digital logic and instrumentation

• Communications, signals and transmission lines

• Troubleshooting, standards and professional practice

Online question banks and study resources

Electronics engineer - Pass Harbor (Question bank)

Electronics technician - Pass Harbor (Question bank)

Official PRC board information

Current PRC exam programs

Independent study material prepared by Board Exam Desk.