PRACTICE EXAM 16: FE ELECTRICAL AND COMPUTER SIMULATION (110 QUESTIONS)

Time allotted: 5 hours 20 minutes

Materials: NCEES-approved calculator + NCEES FE Reference Handbook only

1. What is the derivative of $f(x) = 2x^5$?

A. $2x^4$

B. $5x^4$

C. $2x^6$

D. $10x^4$

2. Evaluate $\int 3\,dx$.

A. 0

B. $3x + C$

C. $3 + C$

D. $x^3 + C$

3. Add the complex numbers $(2 + j3)$ and $(4 - j1)$.

A. $6 + j2$

B. $6 - j2$

C. $2 + j4$

D. $6 + j4$

4. Solve for x: $3(x - 2) = 9$.

A. 1

B. 3

C. 5

D. 11

5. Evaluate $\cos(0°)$.

A. 0

B. 0.5

C. -1

D. 1

6. The derivative of $f(x) = 4x$ is:

A. 4

B. $4x$

C. $2x^2$

D. x

7. Evaluate $\int_0^2 x\,dx$.

A. 4

B. 2

C. 1

D. 0.5

8. The number of degrees in π radians is:

A. 90°

B. 360°

C. 180°

D. 45°

9. The limit $\lim(x \to \infty)\ 1/x$ equals:

A. ∞

B. 1

C. -1

D. 0

10. If $\log_{10}(x) = 2$, then x equals:

A. 100

B. 20

C. 10

D. 200

11. The transpose of a row vector [1, 2, 3] is:

A. [3, 2, 1]

B. [1, 2, 3]

C. A column vector with entries 1, 2, 3

D. The scalar 6

12. The slope of a line perpendicular to a line with slope 2 is:

A. 2

B. −1/2

C. 1/2

D. −2

13. A coin is tossed once. What is the probability of getting tails?

A. 0

B. 1

C. 1/4

D. 1/2

14. The sum of all probabilities in a complete probability distribution must equal:

A. 1

B. 0

C. 100

D. The number of outcomes

15. A box has 6 red and 4 blue balls. What is the probability of drawing a blue ball?

A. 6/10

B. 2/5

C. 1/4

D. 1/6

16. The factorial 4! equals:

A. 4

B. 16

C. 24

D. 12

17. In a data set, the value that appears most frequently is the:

A. Mode

B. Mean

C. Median

D. Range

18. Under the NSPE Code, an engineer who signs a document without having reviewed or prepared it commits:

A. An acceptable time-saving practice

B. A minor administrative oversight

C. A reasonable delegation of duty

D. A serious ethical and professional violation

19. An engineer learns that a design they approved contains an error that could endanger users. The engineer should:

A. Wait for the client to discover it independently

B. Promptly notify the responsible parties to correct it

C. Take no action since the design was already approved

D. Quietly fix it in the next project without disclosure

20. Under the NSPE Code, an engineer may advertise their professional services as long as the advertising is:

A. More impressive than that of competitors

B. Endorsed by a licensing board official

C. Truthful and free from misleading claims

D. Limited to the engineer's home state only

21. The NSPE Code requires that engineers credit the work of others and:

A. Not accept credit for work performed by others

B. Claim joint authorship of all reviewed work

C. Withhold recognition to protect trade secrets

D. Assign all credit to the most senior engineer

22. Simple interest of $150 is earned on a $1,000 principal over 3 years. The annual interest rate is:

A. 5%

B. 15%

C. 1.5%

D. 50%

23. The "minimum attractive rate of return" (MARR) represents the:

A. Average return of all past company projects

B. Highest possible return any project could earn

C. Lowest acceptable return for a proposed investment

D. Rate of inflation expected over the project life

24. A present sum of $1,000 at 8% annual interest will, after one year, be worth:

A. $1,008

B. $1,080

C. $1,800

D. $800

25. In comparing alternatives, the "do nothing" option represents:

A. The baseline of making no new investment

B. The most profitable available alternative

C. A mandatory minimum expenditure

D. The salvage value of existing equipment

26. An annuity is best described as a series of:

A. One-time lump-sum payments

B. Randomly varying cash flows

C. Decreasing gradient payments

D. Equal payments made at regular intervals

27. The resistivity of a semiconductor, compared to that of a conductor and an insulator, is:

A. Lower than both

B. Between the two

C. Higher than both

D. Exactly equal to a conductor's

28. Increasing the temperature of an intrinsic semiconductor causes its conductivity to:

A. Decrease toward zero

B. Remain constant

C. Increase

D. Become negative

29. The permittivity of a material determines its ability to:

A. Store electrical energy in an electric field

B. Conduct direct current with low loss

C. Concentrate magnetic flux lines

D. Resist mechanical deformation

30. A permanent magnet is made from a "hard" magnetic material, which is characterized by:

A. High coercivity and high remanence

B. Low coercivity and low remanence

C. Zero magnetic permeability

D. Negative magnetic susceptibility

31. A 6 V source drives a 2 Ω resistor. The power dissipated is:

A. 3 W

B. 18 W

C. 12 W

D. 6 W

32. Two 12 Ω resistors are connected in parallel. The equivalent resistance is:

A. 24 Ω

B. 12 Ω

C. 6 Ω

D. 3 Ω

33. The voltage across a 5 Ω resistor carrying 3 A is:

A. 1.67 V

B. 8 V

C. 0.6 V

D. 15 V

34. Kirchhoff's current law (KCL) is based on the conservation of:

A. Electric charge

B. Energy

C. Magnetic flux

D. Power

35. The reactance of a 0.5 H inductor at 100 rad/s is:

A. 200 Ω

B. 0.005 Ω

C. 50 Ω

D. 100 Ω

36. In a series circuit, if one element opens (breaks), the current in the circuit becomes:

A. Maximum

B. Zero

C. Doubled

D. Unchanged

37. The total capacitance of two 6 µF capacitors in parallel is:

A. 3 µF

B. 6 µF

C. 1.5 µF

D. 12 µF

38. In an AC circuit, the term "impedance" combines:

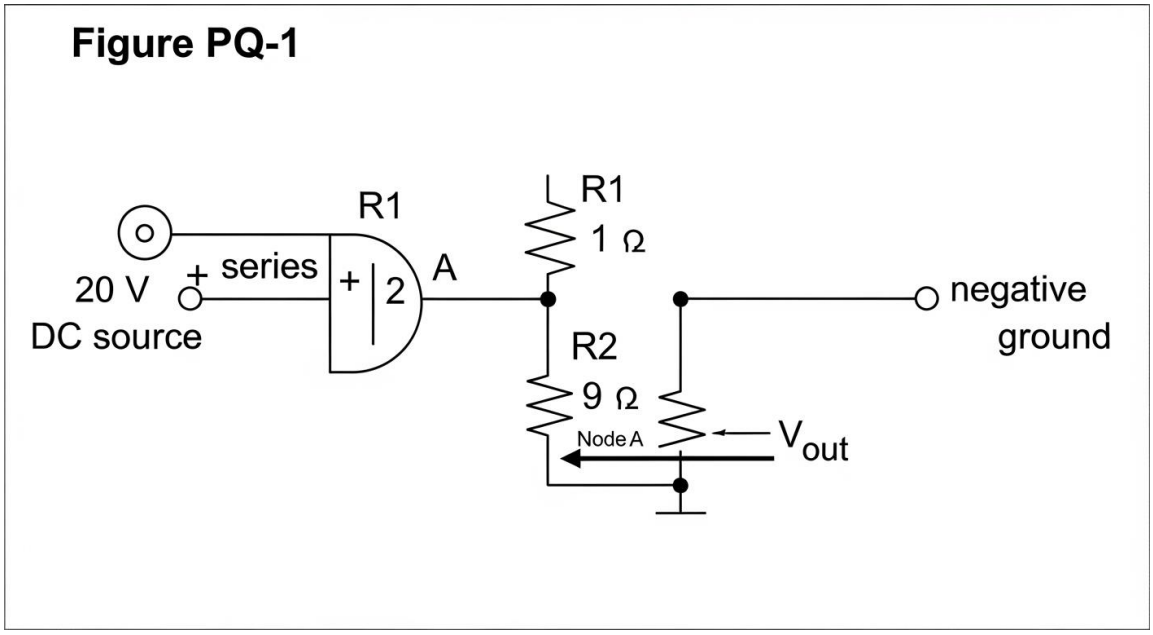
A. Resistance and reactance

B. Voltage and current

C. Power and energy

D. Frequency and phase

39. In the circuit shown, what is the voltage V_out across the 9 Ω resistor?



A. 20 V

B. 18 V

C. 2 V

D. 10 V

40. The phase relationship between voltage and current in an ideal inductor is that the voltage:

A. Lags the current by 90°

B. Leads the current by 90°

C. Is in phase with the current

D. Leads the current by 45°

41. The conductance of a circuit element with resistance 5 Ω is:

A. 5 S

B. 25 S

C. 1 S

D. 0.2 S

42. The maximum power transfer theorem states that maximum power is delivered to a load when the load resistance is:

A. Equal to the Thévenin resistance of the source

B. Much greater than the source resistance

C. Equal to zero (a short circuit)

D. Infinite (an open circuit)

43. The energy delivered by a 60 W bulb operating for 2 hours is:

A. 30 Wh

B. 120 Wh

C. 60 Wh

D. 3600 Wh

44. The Laplace transform of the unit step function u(t) is:

A. 1

B. s

C. 1/s

D. $1/s^2$

45. A system that satisfies both additivity and homogeneity is said to be:

A. Causal

B. Stable

C. Time-invariant

D. Linear

46. The zeros of a transfer function are the values of s that make the:

A. Denominator equal to zero

B. Output equal to the input

C. Gain equal to infinity

D. Numerator equal to zero

47. The frequency of the signal $x(t) = 2\sin(40\pi t)$ is:

A. 40 Hz

B. 80 Hz

C. 20 Hz

D. 10 Hz

48. A discrete-time unit impulse $\delta[n]$ is equal to:

A. 1 for all n

B. 1 at $n = 0$ and 0 elsewhere

C. n for all $n \geq 0$

D. 0 for all n

49. To represent a 3 kHz audio signal digitally without aliasing, the minimum sampling rate is:

A. 1.5 kHz

B. 3 kHz

C. 4.5 kHz

D. 6 kHz

50. An ideal high-pass filter blocks:

A. All frequencies above the cutoff

B. A narrow band around the cutoff

C. All frequencies below the cutoff

D. All frequencies entirely

51. Two systems in cascade have a combined transfer function equal to the _____ of their individual transfer functions.

A. Product

B. Sum

C. Difference

D. Quotient

52. The output of a system to a unit step input is called the system's:

A. Impulse response

B. Step response

C. Frequency response

D. Phase response

53. A larger number of bits in an analog-to-digital converter results in:

A. A higher sampling frequency

B. A wider input voltage range

C. More aliasing distortion

D. Finer amplitude resolution

54. The region of convergence of a z-transform determines a system's:

A. Steady-state gain value

B. Resonant frequency

C. Stability and causality

D. Quantization error

55. A signal that exists only for a finite duration and is otherwise zero is best described as:

A. A time-limited signal

B. A periodic signal

C. A power signal

D. A DC signal

56. The gain of a non-inverting op-amp amplifier with feedback resistor R_f and ground resistor R_g is:

A. $-R_f/R_g$

B. $1 + R_f/R_g$

C. R_g/R_f

D. $R_f - R_g$

57. In a p-n junction diode, the region depleted of mobile charge carriers is called the:

A. Conduction band

B. Drift region

C. Depletion region

D. Valence band

58. The base-emitter junction of a BJT in the active region is:

A. Reverse biased

B. At exactly zero bias

C. In breakdown

D. Forward biased

59. A clipping (limiter) circuit using diodes is used to:

A. Restrict a signal's amplitude to a set level

B. Amplify a weak signal substantially

C. Shift the DC level of a signal

D. Multiply the signal frequency

60. The main purpose of a coupling capacitor between two amplifier stages is to:

A. Provide a DC path for bias current

B. Block DC while passing the AC signal

C. Increase the supply voltage to the stage

D. Convert the AC signal to DC

61. A MOSFET conducts between drain and source when the gate-source voltage:

A. Is held at exactly zero

B. Falls below the threshold voltage

C. Exceeds the threshold voltage

D. Equals the drain-source voltage

62. The output of a comparator changes state when the input voltage:

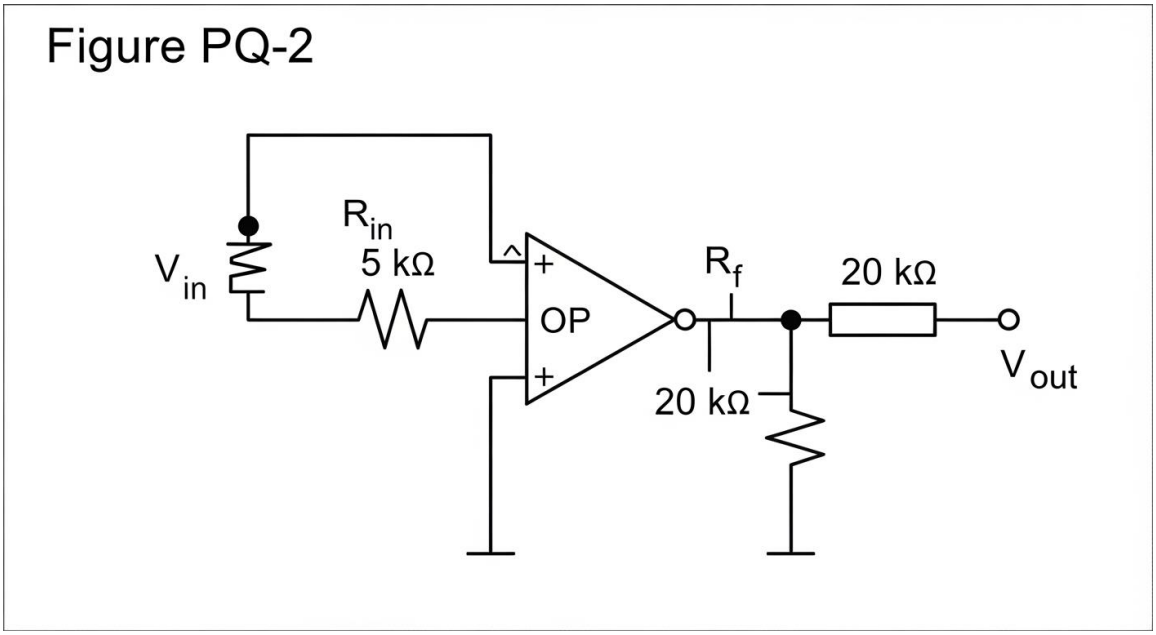
A. Reaches the supply rail value

B. Equals zero volts exactly

C. Doubles its previous value

D. Crosses the reference voltage

63. For the inverting op-amp circuit shown, what is the magnitude of the closed-loop voltage gain?



A. 4

B. 0.25

C. 25

D. 100

64. A 120 V supply delivers 10 A to a resistive load. The power consumed is:

A. 12 W

B. 1200 W

C. 130 W

D. 110 W

65. An ideal 1:5 step-up transformer with 100 V applied to the primary produces a secondary voltage of:

A. 20 V

B. 100 V

C. 500 V

D. 5 V

66. The slip of a three-phase induction motor is the difference between synchronous speed and rotor speed, expressed:

A. In horsepower

B. In amperes

C. As an absolute speed in rpm only

D. As a fraction of synchronous speed

67. The kVA rating of a transformer represents its:

A. Real power output capability

B. Apparent power handling capacity

C. Internal power losses at full load

D. Reactive power consumption

68. A synchronous generator converts mechanical energy into electrical energy through:

A. Electromagnetic induction

B. Electrostatic charging

C. Chemical reaction

D. Thermionic emission

69. A 6-pole, 50 Hz induction motor has a synchronous speed of:

A. 3000 rpm

B. 1500 rpm

C. 750 rpm

D. 1000 rpm

70. In a balanced three-phase delta connection, the line voltage equals the:

A. Line voltage divided by √3

B. Phase voltage times √3

C. Phase voltage

D. Phase voltage times 3

71. A load consumes 6 kW with a reactive power of 8 kVAR. The apparent power is:

A. 14 kVA

B. 10 kVA

C. 2 kVA

D. 48 kVA

72. The direction of rotation of a single-phase capacitor-start induction motor is determined by the:

A. Connection of the start (auxiliary) winding

B. Frequency of the supply voltage

C. Magnitude of the supply voltage

D. Number of poles in the rotor

73. The magnetic field produced by a solenoid is strongest:

A. Outside the coil near the ends

B. Far away from the coil entirely

C. Inside the coil along its axis

D. Perpendicular to the coil's axis

74. Two parallel wires carrying current in the same direction will:

A. Repel each other

B. Experience no force

C. Rotate about each other

D. Attract each other

75. The inductance of a coil is increased by:

A. Removing the magnetic core entirely

B. Increasing the number of turns

C. Decreasing the cross-sectional area

D. Lowering the core's permeability

76. An electromagnetic wave with a wavelength of 1 m in free space has a frequency of approximately:

A. 300 MHz

B. 30 MHz

C. 3 GHz

D. 3 MHz

77. The output of an integral controller is proportional to the:

A. Present value of the error

B. Rate of change of the error

C. Square of the error signal

D. Accumulated error over time

78. A feedback control system is unstable if any of its closed-loop poles lie in the:

A. Left half of the s-plane

B. Origin of the s-plane only

C. Right half of the s-plane

D. Negative real axis only

79. An undamped second-order system ($\zeta = 0$) produces a step response that is:

A. Slow and non-oscillatory

B. A sustained, undamped oscillation

C. Critically damped

D. Exponentially decaying to zero

80. The primary benefit of derivative control action is that it:

A. Eliminates the steady-state error

B. Increases the system's DC gain

C. Slows the system's response

D. Adds damping and improves transient response

81. A type 0 control system has _____ pure integrators in its open-loop transfer function.

A. Zero

B. One

C. Two

D. Three

82. The natural frequency ω_n of a second-order system describes:

A. The frequency at which the gain is maximum

B. The frequency where phase equals zero

C. The oscillation frequency if there were no damping

D. The sampling rate of the controller

83. A proportional controller alone applied to a system typically leaves a:

A. Zero steady-state error to all inputs

B. Nonzero steady-state offset

C. Sustained oscillation at the output

D. Negative steady-state error always

84. In digital modulation, increasing the number of constellation points generally:

A. Reduces the data rate per symbol

B. Eliminates the need for a carrier

C. Lowers the required signal-to-noise ratio

D. Increases the data rate but lowers noise margin

85. The bandwidth required for an FM signal is generally _____ that required for an AM signal carrying the same message.

A. Greater than

B. Less than

C. Equal to

D. Exactly half

86. The process of combining several signals onto a single transmission channel is called:

A. Demodulation

B. Rectification

C. Multiplexing

D. Quantization

87. A digital signal carrying 3 bits per symbol uses how many distinct symbol states?

A. 3

B. 6

C. 4

D. 8

88. The signal-to-noise ratio of a channel directly affects the:

A. Carrier frequency of the transmission

B. Maximum achievable data rate

C. Physical length of the antenna

D. Number of conductors in the cable

89. The protocol that provides connectionless, unreliable datagram delivery is:

A. UDP

B. TCP

C. HTTP

D. FTP

90. The device that connects multiple network segments and forwards frames based on MAC addresses is a:

A. Repeater

B. Modem

C. Switch

D. Router

91. The maximum number of unique addresses in an 8-bit address space is:

A. 8

B. 16

C. 128

D. 256

92. In the OSI model, error detection and reliable framing over a single link are handled by the:

A. Network layer

B. Data link layer

C. Transport layer

D. Application layer

93. Convert the decimal number 3 to binary.

A. 11

B. 10

C. 100

D. 110

94. The Boolean expression A · A (A AND A) simplifies to:

A. 0

B. 1

C. A

D. A'

95. The output of a NOT gate (inverter) with input 1 is:

A. 1

B. Undefined

C. High impedance

D. 0

96. The number of inputs to a standard half adder is:

A. 1

B. 2

C. 3

D. 4

97. Convert the binary number 1000 to decimal.

A. 4

B. 16

C. 8

D. 10

98. A logic circuit whose output depends only on the current inputs is classified as:

A. Combinational

B. Sequential

C. Synchronous

D. Asynchronous

99. The hexadecimal digit F represents the decimal value:

A. 10

B. 12

C. 14

D. 15

100. A register that can store 8 bits of data is referred to as an:

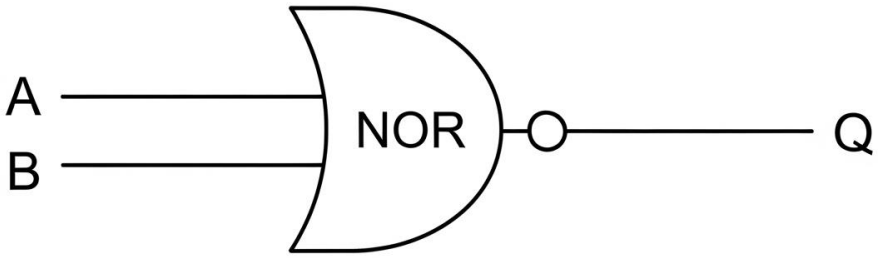
A. 4-bit register

B. 8-bit register

C. Analog register

D. Single-bit latch

101. For the logic circuit shown, what is the output Q when both inputs A and B are 0?



A. Undefined

B. High impedance

C. 1

D. 0

102. The set of all instructions that a particular processor can execute is called its:

A. Instruction set architecture

B. Operating system kernel

C. Memory address space

D. Cache replacement policy

103. Secondary storage (such as a hard disk) differs from main memory (RAM) in that it is:

A. Faster to access than RAM

B. Located inside the CPU core

C. Erased each time it is read

D. Non-volatile and larger in capacity

104. A 4 GB memory module contains approximately how many bytes?

A. 4 thousand

B. 4 billion

C. 4 million

D. 400

105. The component that temporarily holds the single piece of data being operated on by the ALU is a(n):

A. Hard disk sector

B. Cache line buffer

C. CPU register

D. Optical disc track

106. In a computer, an "interrupt" allows a device to:

A. Gain the processor's attention to be serviced

B. Permanently shut down the processor

C. Increase the system clock frequency

D. Erase the contents of main memory

107. In Big-O notation, an algorithm that examines every element of an n-element list exactly once has complexity:

A. O(1)

B. O(n)

C. $O(n^2)$

D. O(log n)

108. A "Boolean" data type can hold which of the following values?

A. Any integer number

B. A single text character

C. A decimal fraction

D. True or false

109. In programming, the operator used to test equality between two values is typically:

A. A single equals sign (=)

B. A plus sign (+)

C. A double equals sign (==)

D. An exclamation mark (!)

110. The first step in the typical software development life cycle is:

A. Writing the source code

B. Testing the finished product

C. Deploying to end users

D. Gathering and analyzing requirements

PRACTICE EXAM 16 — ANSWER KEY AND FULL ANSWER EXPLANATIONS

1. D — Applying the power rule, $d/dx[2x^5] = 2 \cdot 5 \cdot x^4 = 10x^4$. The exponent multiplies the coefficient and drops by one.

2. B — The integral of a constant is that constant times x: $\int 3\,dx = 3x + C$. This gives the area of a rectangle of height 3.

3. A — Adding complex numbers combines real with real and imaginary with imaginary: $(2 + 4) + (3 - 1)j = 6 + j2$. The components add independently.

4. C — Distributing gives $3x - 6 = 9$, so $3x = 15$ and $x = 5$. Isolating x solves the linear equation.

5. D — $\cos(0°) = 1$, its maximum value, where the cosine curve begins. This is a standard reference value.

6. A — The derivative of $4x$ is the constant 4, the slope of the line. A linear term differentiates to its coefficient.

7. B — $\int_0^2 x\,dx = x^2/2$ evaluated from 0 to 2 = 4/2 = 2. This is the area of the triangle under $y = x$.

8. C — π radians equals 180°, since a full circle of 2π radians is 360°. Half the circle corresponds to π radians.

9. D — As x grows without bound, $1/x$ approaches 0. The reciprocal of an ever-larger number shrinks toward zero.

10. A — $\log_{10}(x) = 2$ means $x = 10^2 = 100$. Converting the logarithm to exponential form isolates x.

11. C — The transpose of a row vector is the corresponding column vector with the same entries. Transposing interchanges rows and columns.

12. B — The slope of a perpendicular line is the negative reciprocal: $-1/2$ for a slope of 2. Perpendicular slopes multiply to -1.

13. D — A fair coin has two equally likely outcomes, so tails has probability 1/2. Each side is equally probable.

14. A — The probabilities of all possible outcomes in a distribution must sum to 1, representing certainty that some outcome occurs. This normalization defines a valid distribution.

15. B — There are 4 blue balls out of 10 total, giving 4/10 = 2/5. Each ball is equally likely to be drawn.

16. C — $4! = 4 \times 3 \times 2 \times 1 = 24$. The factorial multiplies all positive integers up to 4.

17. A — The mode is the value that occurs most frequently in a data set. It identifies the most common observation.

18. D — Signing a document one did not prepare or review is a serious ethical violation, since the seal certifies responsible charge. It misrepresents who is professionally accountable for the work.

19. B — On discovering a dangerous error, the engineer must promptly notify the responsible parties so it can be corrected. Protecting users from harm takes priority over avoiding embarrassment or cost.

20. C — Advertising of engineering services is permitted as long as it is truthful and not misleading. Honesty in representations protects clients and the public.

21. A — Engineers must give credit to others' work and must not accept credit for work they did not perform. This upholds honesty in professional attribution.

22. A — From $I = Prt$, $150 = 1{,}000 \times r \times 3$, so $r = 0.05 = 5\%$. Simple interest accrues only on the original principal.

23. C — The MARR is the lowest rate of return a company will accept on an investment. Projects must exceed it to be economically justified.

24. B — Future value is $1{,}000 \times (1 + 0.08) = \$1{,}080$ after one year. The 8% interest is added to the principal.

25. A — The "do nothing" alternative is the baseline of making no new investment. It serves as the reference against which other options are judged.

26. D — An annuity is a series of equal payments made at regular intervals. Loan repayments and pensions are common examples.

27. B — A semiconductor's resistivity lies between that of a conductor and an insulator. This intermediate value is the basis of its controllable conduction.

28. C — Heating an intrinsic semiconductor frees more carriers across the band gap, so its conductivity increases. This is opposite to the behavior of metals.

29. A — Permittivity measures a material's ability to store electrical energy by polarizing in an electric field. A higher permittivity yields greater capacitance.

30. A — A hard magnetic material has high coercivity and high remanence, retaining strong magnetization that resists removal. These traits make it suitable for permanent magnets.

31. B — Power is $V^2/R = 6^2/2 = 36/2 = 18$ W. This form uses the known voltage and resistance directly.

32. C — Two equal resistors in parallel give R/2 = 12/2 = 6 Ω. Parallel paths reduce the equivalent resistance.

33. D — By Ohm's law, V = IR = 3 × 5 = 15 V. Voltage is the product of current and resistance.

34. A — Kirchhoff's current law follows from conservation of electric charge; current into a node equals current out. Charge is neither created nor destroyed at a junction.

35. C — Inductive reactance is $X_L = \omega L = 100 \times 0.5 = 50\ \Omega$. It rises with both frequency and inductance.

36. B — Opening any element in a series circuit breaks the single current path, so the current drops to zero. There is no alternate route for the current.

37. D — Capacitors in parallel add: 6 + 6 = 12 μF. Parallel connection effectively combines their plate areas.

38. A — Impedance combines resistance and reactance into a single complex quantity for AC analysis. Its magnitude and angle describe the opposition to alternating current.

39. B — By voltage division, $V_{out} = 20 \times 9/(1 + 9) = 18$ V. The larger series resistor receives the larger share of the source voltage.

40. B — In an ideal inductor the voltage leads the current by 90°, since voltage depends on the rate of change of current. The current cannot change instantaneously.

41. D — Conductance is the reciprocal of resistance: G = 1/5 = 0.2 S. It measures how readily current flows.

42. A — Maximum power transfer occurs when the load resistance equals the source's Thévenin resistance. At this match, half the source power reaches the load.

43. B — Energy is power times time: 60 W × 2 h = 120 Wh. The watt-hour expresses energy consumed over time.

44. C — The Laplace transform of the unit step u(t) is 1/s. The pole at the origin reflects the step's persistent value.

45. D — A system that obeys both additivity and homogeneity (scaling) is linear. Together these properties constitute superposition.

46. D — The zeros are the values of s that make the numerator of the transfer function zero. They are frequencies the system blocks from the output.

47. C — With $\omega = 40\pi$, the frequency is $f = \omega/(2\pi) = 40\pi/(2\pi) = 20$ Hz. Dividing the angular frequency by 2π gives the cyclic frequency.

48. B — The discrete unit impulse $\delta[n]$ equals 1 at $n = 0$ and 0 for all other n. It is the fundamental building block of discrete signals.

49. D — The Nyquist rate is twice the highest frequency: 2×3 kHz = 6 kHz. Sampling at least this fast prevents aliasing.

50. C — An ideal high-pass filter blocks all frequencies below its cutoff and passes those above. It is the complement of a low-pass filter.

51. A — Cascaded systems multiply their transfer functions, since time-domain convolution becomes multiplication in the s-domain. The overall response is their product.

52. B — The output of a system to a unit step input is called its step response. It characterizes the transient and steady-state behavior to a sudden change.

53. D — Adding bits to an ADC increases the number of quantization levels, giving finer amplitude resolution. Each extra bit halves the step size.

54. C — The region of convergence of a z-transform determines whether a system is stable and causal. Its location relative to the unit circle is decisive.

55. A — A signal that is nonzero only over a finite interval is a time-limited signal. Outside that interval its value is zero.

56. B — The non-inverting amplifier gain is $1 + R_f/R_g$, always greater than or equal to one. The resistor ratio sets the amount above unity.

57. C — The region near a p-n junction that is swept free of mobile carriers is the depletion region. Its width changes with the applied bias.

58. D — In the active region, a BJT's base-emitter junction is forward biased while the collector-base junction is reverse biased. This biasing enables linear amplification.

59. A — A diode clipping or limiter circuit restricts a signal's amplitude to a preset level. It removes peaks that exceed the clipping threshold.

60. B — A coupling capacitor blocks the DC bias while passing the AC signal between stages. This isolates the bias points of adjacent stages.

61. C — A MOSFET conducts when its gate-source voltage exceeds the threshold voltage, forming a channel. Below threshold the device is off.

62. D — A comparator switches its output state when the input crosses the reference voltage. It compares the two voltages and reports which is larger.

63. A — The inverting amplifier gain magnitude is $R_f/R_{in} = 20\ k\Omega/5\ k\Omega = 4$. The resistor ratio sets the closed-loop gain.

64. B — Power for a resistive load is $P = V \times I = 120 \times 10 = 1{,}200$ W. Voltage times current gives the real power.

65. C — A 1:5 step-up transformer multiplies the primary voltage by 5: $100 \times 5 = 500$ V. The secondary has five times the turns of the primary.

66. D — Slip is the difference between synchronous and rotor speed expressed as a fraction of synchronous speed. It is a dimensionless ratio, often given as a percentage.

67. B — A transformer's kVA rating gives its apparent power handling capacity, independent of the load power factor. The kVA, not the kW, limits the loading.

68. A — A synchronous generator converts mechanical to electrical energy by electromagnetic induction as the rotor field sweeps the stator windings. The changing flux induces the output voltage.

69. D — Synchronous speed is $120f/P = 120 \times 50/6 = 1{,}000$ rpm. More poles yield a lower speed for a given frequency.

70. C — In a delta connection the line voltage equals the phase voltage, since each line connects across one phase winding. The line and phase currents differ by $\sqrt{3}$.

71. B — Apparent power is $S = \sqrt{(P^2 + Q^2)} = \sqrt{(6^2 + 8^2)} = \sqrt{100} = 10$ kVA. Real and reactive power combine as perpendicular components.

72. A — The rotation direction of a capacitor-start single-phase motor depends on the connection of the auxiliary (start) winding. Reversing it reverses the direction.

73. C — A solenoid's magnetic field is strongest and most uniform inside the coil along its axis. The contributions of the turns reinforce there.

74. D — Two parallel wires carrying current in the same direction attract each other. Their magnetic fields combine to produce a mutual attractive force.

75. B — Inductance increases with the square of the number of turns, so adding turns raises it. A higher-permeability core also increases inductance.

76. A — Frequency is $f = c/\lambda = (3 \times 10^8)/1 = 3 \times 10^8$ Hz $= 300$ MHz. A 1 m wavelength corresponds to the UHF range.

77. D — An integral controller's output is proportional to the accumulated error over time. This accumulation drives the steady-state error to zero.

78. C — A feedback system is unstable if any closed-loop pole lies in the right half of the s-plane, producing a growing response. Stability requires all poles to have negative real parts.

79. B — With zero damping ($\zeta = 0$), a second-order system oscillates indefinitely at its natural frequency. The response neither grows nor decays.

80. D — Derivative action responds to the rate of change of error, adding damping and improving the transient response. It anticipates error trends to reduce overshoot.

81. A — A type 0 system has no pure integrators (no poles at the origin) in its open-loop transfer function. It therefore leaves a finite error to a step input.

82. C — The natural frequency ω_n is the frequency at which the system would oscillate with no damping present. Damping lowers the actual oscillation frequency below ω_n.

83. B — A proportional-only controller leaves a nonzero steady-state offset, the familiar proportional error. An integral term is needed to remove it.

84. D — More constellation points pack more bits into each symbol, raising the data rate, but the closer spacing lowers the noise margin. This is the rate-versus-robustness trade-off.

85. A — FM requires a greater bandwidth than AM for the same message, because frequency deviation generates many significant sidebands. The wider bandwidth buys improved noise immunity.

86. C — Multiplexing combines several signals onto a single transmission channel. Time, frequency, and code division are common multiplexing methods.

87. D — Three bits per symbol require $2^3 = 8$ distinct symbol states. Each additional bit doubles the number of states.

88. B — A channel's signal-to-noise ratio sets the maximum achievable data rate, per the Shannon-Hartley theorem. A higher SNR supports more bits per second.

89. A — UDP provides connectionless, unreliable datagram delivery with no retransmission. It trades reliability for low overhead and speed.

90. C — A switch connects network segments and forwards frames based on destination MAC addresses. It learns which port reaches each device.

91. D — An 8-bit address space provides $2^8 = 256$ unique addresses. Each added bit doubles the count.

92. B — The data link layer handles error detection and reliable framing over a single physical link. It packages bits into frames with addressing and checks.

93. A — Decimal $3 = 2 + 1 = 11$ in binary. The two low-order bits are set.

94. C — The Boolean product $A \cdot A$ simplifies to A, since ANDing a value with itself leaves it unchanged. This is the idempotent law.

95. D — A NOT gate inverts its input, so an input of 1 produces an output of 0. The inverter always outputs the opposite logic level.

96. B — A half adder has two inputs, the two single bits to be added. It lacks a carry-in, distinguishing it from a full adder.

97. C — Binary 1000 = 8 in decimal, since only the 8s place is set. The leading bit carries a weight of 2^3.

98. A — A combinational circuit's output depends only on the current inputs, with no stored state. This contrasts with sequential logic, which has memory.

99. D — The hexadecimal digit F represents the decimal value 15, the largest single hex digit. Hex digits A through F denote 10 through 15.

100. B — A register storing 8 bits is an 8-bit register. Its width equals the number of bits it can hold.

101. C — A NOR gate outputs 1 only when all inputs are 0, so with A = B = 0 the output Q is 1. Any HIGH input would force the output LOW.

102. A — The complete set of instructions a processor can execute is its instruction set architecture (ISA). It defines the machine-level interface to the hardware.

103. D — Secondary storage is non-volatile and offers much larger capacity than RAM, though it is slower to access. It retains data after power is removed.

104. B — A 4 GB module holds about 4×10^9 bytes, since giga denotes roughly a billion. The prefix sets the scale of the capacity.

105. C — A CPU register temporarily holds the operand the ALU is currently processing. Its location inside the processor makes it the fastest storage.

106. A — An interrupt lets a device signal the processor to pause and service its request. This enables responsive, event-driven handling without constant polling.

107. B — Examining each of n elements exactly once gives O(n), or linear, time complexity. The work scales directly with the input size.

108. D — A Boolean data type holds one of two values, true or false. It represents logical conditions in a program.

109. C — The double equals sign (==) tests equality between two values, distinct from the single = used for assignment. Confusing the two is a common programming error.

110. D — The software development life cycle begins with gathering and analyzing requirements. Understanding what the system must do precedes design and coding.