NG 24 (GROUP B)

PART I — ENGINEERING MATHEMATICS

(Common to all Candidates)

(Answer ALL questions)

1. If A is a 3×3 matrix and determinant of A is 6, then find the value of the determinant of the matrix $(2A)^{-1}$

   a. $\frac{1}{12}$

   b. $\frac{1}{24}$

   c. $\frac{1}{36}$

   d. $\frac{1}{48}$

2. If $3x+2y+z=0$, $x+4y+z=0$, $2x+y+4z=0$, be a system of equations, then

   a. it is inconsistent

   b. it has only the trivial solution $x=0,\ y=0,\ z=0$

   c. it can be reduced to a single equation and so a solution does not exist

   d. the determinant of the matrix of coefficients is zero

3. Let $M=\begin{pmatrix}1&1&1\\0&1&1\\0&0&1\end{pmatrix}$. The maximum number of linearly independent eigen vectors of M is

   a. 0

   b. 1

   c. 2

   d. 3

4. The shortest and longest distance from the point $(1, 2, -1)$ to the sphere $x^2+y^2+z^2=24$ is

   a. $\left(\sqrt{14}, \sqrt{46}\right)$

   b. (14, 46)

   c. $\left(\sqrt{24}, \sqrt{56}\right)$

   d. (24, 56)

5. The solution of the given ordinary differential equation $x\frac{d^2y}{dx^2}+\frac{dy}{dx}=0$ is

   a. $y=A\log x+B$

   b. $y=Ae^{\log x}+Bx+C$

   c. $y=Ae^{x}+B\log x+C$

   d. $y=Ae^{x}+Bx^2+C$

6. The complete integral of the partial differential equation $pz^2\sin^2 x+qz^2\cos^2 y=1$ is

   a. $z=3a\cot x+(1-a)\tan y+b$

   b. $z^2=3a^2\cot x+3(1+a)\tan y+b$

   c. $z^3=-3a\cot x+3(1-a)\tan y+b$

   d. $z^4=2a^2\cot x+(1+a)(1-a)\tan y+b$

7. The area between the parabolas $y^2 = 4 - x$ and $y^2 = x$ is given by

a. $\frac{3\sqrt{2}}{16}$

b. $\frac{16\sqrt{3}}{5}$

c. $\frac{5\sqrt{3}}{16}$

d. $\frac{16\sqrt{2}}{3}$

8. The value of the integral $\int_0^a \int_0^b \int_0^c e^{x+y+z}\, dz\, dy\, dx$ is

a. e^{a+b+c}

b. $e^a + e^b + e^c$

c. $\left(e^a - 1\right)\left(e^b - 1\right)\left(e^c - 1\right)$

d. e^{abc}

9. If $\nabla\phi = 2xyz^3\,\vec{i} + x^2z^3\,\vec{j} + 3x^2yz^2\,\vec{k}$, then $\phi(x, y, z) =$

a. $\phi = xyz^2 + c$

b. $\phi = x^3yz^2 + c$

c. $\phi = x^2yz^3 + c$

d. $\phi = x^3yz + c$

10. The only function from the following that is analytic is

a. $F(z) = \mathrm{Re}(z)$

b. $F(z) = \mathrm{Im}(z)$

c. $F(z) = z$

d. $F(z) = \sin z$

11. The value of m so that $2x - x^2 + my^2$ may be harmonic is

a. 0

b. 1

c. 2

d. 3

12. The value of $\int_C \frac{1}{z} dz$, where C is the circle $z = e^{i\theta}$, $0 \le \theta \le \pi$ is,

a. πi

b. $-\pi i$

c. $2\pi i$

d. 0

13. The Region of convergence of the signal $x(n) = \delta(n - k),\ k > 0$ is

a. $z = \infty$

b. $z = 0$

c. Entire z-plane, except at $z = 0$

d. Entire z-plane, except at $z = \infty$

14. The Laplace transform of a signal $X(t)$ is $\frac{4s+1}{s^2+6s+3}$. The initial value $X(0)$ is

a. 0

b. 4

c. 1/6

d. 4/3

15. Given the inverse Fourier transform of $f(s)=\begin{cases} a-|s|, & |s|\le a \\ 0, & |s|>a \end{cases}$ is $\frac{a^2}{2\pi}\left[\frac{\sin\frac{ax}{2}}{\frac{ax}{2}}\right]^2$. The value of $\int_0^\infty\left[\frac{\sin x}{2}\right]^2 dx$ is

a. π

b. $\frac{2\pi}{3}$

c. $\frac{\pi}{2}$

d. $\frac{\pi}{4}$

16. If $A=[a_{ij}]$ is the coefficient matrix for a system of algebraic equations, then a sufficient condition for convergence of Gauss-Seidel iteration method is

a. A is strictly diagonally dominant

b. $|a_{ii}|=1$

c. $\det(A)\neq 0$

d. $\det(A)>0$

17. Which of the following formula is used to fit a polynomial for interpolation with equally spaced data?

a. Newton's divided difference interpolation formula

b. Lagrange's interpolation formula

c. Newton's forward interpolation formula

d. Least- square formula

18. For applying Simpson's $\frac{1}{3}$ rule, the given interval must be divided into how many number of sub-intervals?

a. odd

b. two

c. even

d. three

19. A discrete random variable X has the probability mass function given by $p(x)=cx,\ x=1,2,3,4,5$. The value of the constant 'c' is

a. 1/5

b. 1/10

c. 1/15

d. 1/20

20. For a Binomial distribution with mean 4 and variance 2, the value of 'n' is

a. 2

b. 4

c. 6

d. 8

PART II — BASIC ENGINEERING AND SCIENCES

(Common to all candidates)

(Answer ALL questions)

21. Speed of the processor chip is measured in
    a. Mbps
    b. GHz
    c. Bits per second
    d. Bytes per second

22. A program that converts Source Code into machine code is called
    a. Assembler
    b. Loader
    c. Compiler
    d. Converter

23. What is the full form of URL?
    a. Uniform Resource Locator
    b. Unicode Random Locator
    c. Unified Real Locator
    d. Uniform Read Locator

24. Which of the following can adsorb larger volume of hydrogen gas?
    a. Finely divided platinum
    b. Colloidal solution of palladium
    c. Small pieces of palladium
    d. A single metal surface of platinum

25. What are the factors that determine an effective collision?
    a. Collision frequency, threshold energy and proper orientation
    b. Translational collision and energy of activation
    c. Proper orientation and steric bulk of the molecule
    d. Threshold energy and proper orientation

26. Which one of the following flows in the internal circuit of a galvanic cell?
    a. atoms
    b. electrons
    c. electricity
    d. ions

27. Which one of the following is not a primary fuel?
    a. petroleum
    b. natural gas
    c. kerosene
    d. coal

28. Which of the following molecules will not display an infrared spectrum?
    a. CO_2
    b. N_2
    c. Benzene
    d. HCCH

29. Which one of the following behaves like an intrinsic semiconductor, at the absolute zero temperature?
    a. Superconductor
    b. Insulator
    c. n-type semiconductor
    d. p-type semiconductor

30. The energy gap (eV) at 300K of the material *GaAs* is
    a. 0.36
    b. 0.85
    c. 1.20
    d. 1.42

31. Which of the following ceramic materials will be used for spark plug insulator?

a. SnO_2

b. α-Al_2O_3

c. TiN

d. $YBaCuO_7$

32. In unconventional super-conductivity, the pairing interaction is

a. non-phononic

b. phononic

c. photonic

d. non-excitonic

33. What is the magnetic susceptibility of an ideal super conductor?

a. 1

b. –1

c. 0

d. infinite

34. The Rayleigh scattering loss, which varies as _____ in a silica fiber.

a. λ^0

b. λ^{-2}

c. λ^{-4}

d. λ^{-6}

35. What is the near field length *N* that can be calculated from the relation (if D is the diameter of the transducer and λ is the wavelength of sound in the material)?

a. $D^2 / 2\lambda$

b. $D^2 / 4\lambda$

c. $2D^2 / \lambda$

d. $4D^2 / \lambda$

36. Which one of the following represents open thermodynamic system?

a. Manual ice cream freezer

b. Centrifugal pump

c. Pressure cooker

d. Bomb calorimeter

37. In a new temperature scale say $°\rho$, the boiling and freezing points of water at one atmosphere are $100°\ \rho$ and $300°\rho$ respectively. Correlate this scale with the Centigrade scale. The reading of $0°\rho$ on the Centigrade scale is:

a. 0°C

b. 50°C

c. 100°C

d. 150°C

38. Which of the cross-section of the beam subjected to bending moment is more economical?

a. Rectangular cross-section

b. I - cross-section

c. Circular cross-section

d. Triangular cross-section

39. The velocity of a particle is given by $V = 4t^3 - 5t^2$. When does the acceleration of the particle becomes zero?

a. 8.33 s

b. 0.833 s

c. 0.0833 s

d. 1 s

40. What will happen if the frequency of power supply in a pure capacitor is doubled?

a. The current will also be doubled

b. The current will reduce to half

c. The current will remain the same

d. The current will increase to four-fold

PART III

11 - BIO-MEDICAL ENGINEERING

(Answer ALL questions)

41. Which type of collagen represents 90% to 95% of the collagen in ECM and forms fibrils and fibres interwines with proteoglycan aggregates?
    a. Type II
    b. Type I
    c. Type IX and X
    d. Type L

42. Which of the following is the cardiac output?
    a. Stroke volume/heart rate
    b. Stroke volume × heart rate
    c. Stroke volume × resistance
    d. Heart rate/resistance

43. During respiration, the gaseous exchange takes place in
    a. Trachea and larynx
    b. Alveoli and throat
    c. Throat and Lungs
    d. Lungs and Alveoli

44. Centre for Pressure and Touch lies in
    a. Midbrain
    b. Occipital lobe
    c. Frontal lobe
    d. Parietal lobe

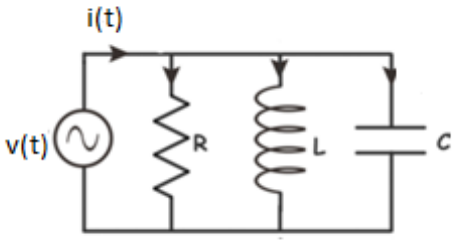
45. Which of the following is the TCA cycle metabolite used in the detoxification of ammonia in brain?
    a. Ornithine
    b. α -ketoglutarate
    c. Oxaloacetate
    d. Glycine

46. Which of the following does not have a negative effect on PFK?
    a. ATP
    b. Citrate
    c. pH
    d. AMP

47. Which of the following inhibits acetyl-coA carboxylase in fatty acid synthesis?
    a. ATP
    b. Malonyl coA
    c. Palmitic acid
    d. Glucose

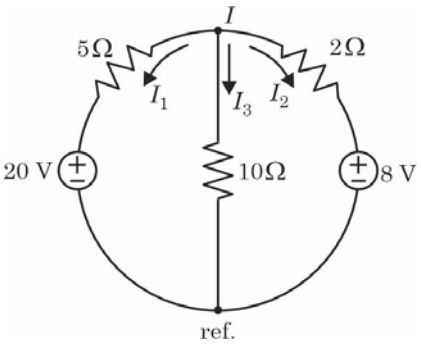
48. Which of the following behaves as a precursor for the synthesis of TGL and PL?
    a. Glycerol-3-phosphate
    b. Pyruvic acid
    c. Acetyl coA
    d. 2-Phospho glycerate

49. Find i(t) in the following circuit, given $R = 1/3\,\Omega$, L = 1/4 H, C = 3F and $v(t) = \sin 2t$



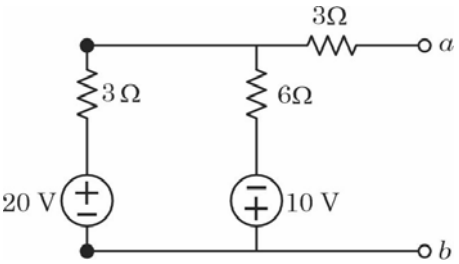
    a. $5 \sin(2t + 53.1°)$
    b. $5 \sin(2t - 53.1°)$
    c. $25 \sin(2t + 53.1°)$
    d. $25 \sin(2t - 53.1°)$

50. Find I_1, I_2 and I_3 for the following circuit



    a. –2A, –1A and 1A respectively
    b. 2A, 1A and 1A respectively
    c. –2A, 1A and 1A respectively
    d. –2A, 2A and 1A respectively

51. Find V_{th} and R_{th} for the following circuit



a. V_{th} = 10V and R_{th} = 5 Ω respectively

b. V_{th} = 20V and R_{th} = 5 Ω respectively

c. V_{th} = 10V and R_{th} = 9 Ω respectively

d. V_{th} = 20V and R_{th} = 9 Ω respectively

52. The voltage v = 12 cos (60t + 45°) is applied to a 0.1-H inductor. Find the steady-state current through the inductor.

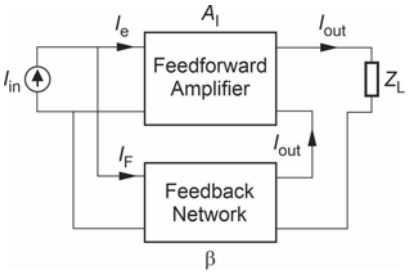
a. i(t) = 2 sin (60t –45°) A

b. i(t) = 2 cos (60t - 45°) A

c. i(t) = 2 cos (60t + 45°) A

d. i(t) = 2 sin (60t + 45°) A

53. Consider the negative feedback system shown in the Fig. with Ro as output resistance of the feedforward amplifier. The overall output resistance of the negative feedback amplifier is



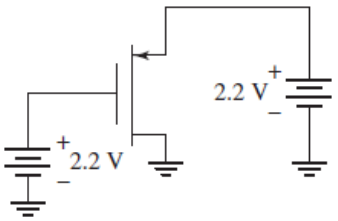
a. $Ro(1 + A_I\beta)$

b. $\dfrac{R_o}{1 + A_i\beta}$

c. $R \circ \beta$

d. $\dfrac{R_o}{\beta}$

54. For the MOSFET transistor shown in the below Figure, operating region of the transistor is



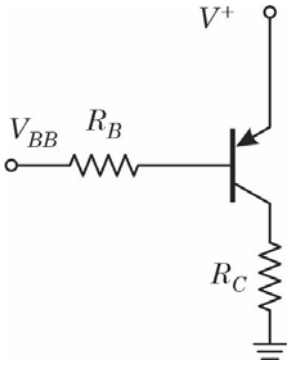
a. Triode

b. Saturation

c. Cutoff

d. Velocity Saturation

55. What is the slope of the output load line characteristic for the circuit shown in the below Figure?



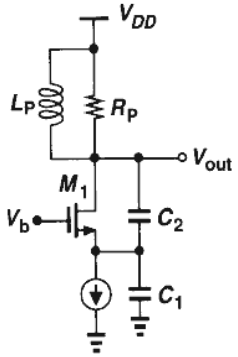
a. $-1/R_C$

b. $-1/(R_C + R_B)$

c. $-1/(R_B)$

d. $-1/(R_C \parallel R_B)$

56. What is the minimum voltage gain required for the Colpitts Oscillator shown in the below Figure for sustained oscillation is?



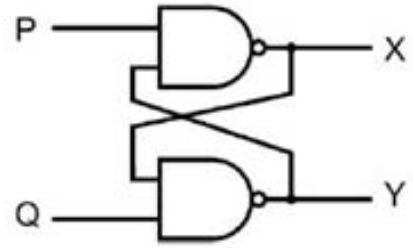
a. 1

b. 3

c. 4

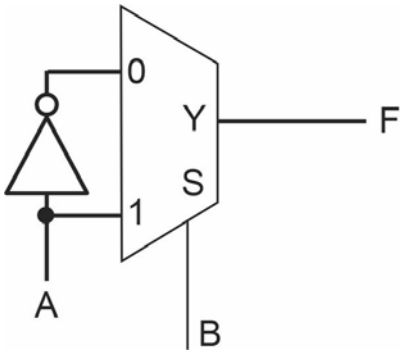
d. 2

57. What are the invalid inputs in the following flip flop?



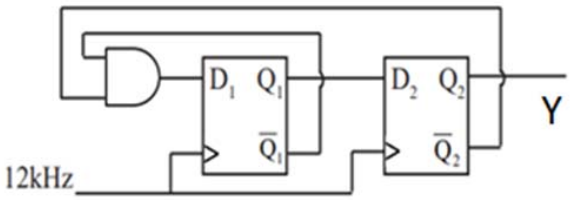
a. P = 0, Q = 0
b. P = 0, Q = 1
c. P = 1, Q = 0
d. P = 1, Q = 1

58. Which is the boolean expression at F in the following figure?



a. F = AB
b. F = A + B
c. F = A XOR B
d. F = A XNOR B

59. What is the frequency of the waveform at Y?



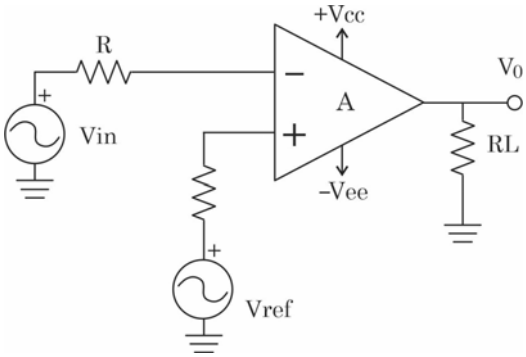
a. 2 kHz
b. 3 kHz
c. 4 kHz
d. 6 kHz

60. Which is the Hexadecimal equivalent of 1100101011101011_2?
a. 6FA3
b. CAEB
c. ED2F
d. 4FAB

61. The basic step of an 8-bit DAC is 12.4 mV. If the binary input 00000000 represents 0V. Determine the output, if the input is 10110111?
a. 1.36 V
b. 2.27 V
c. 5.45 V
d. 3.25 V

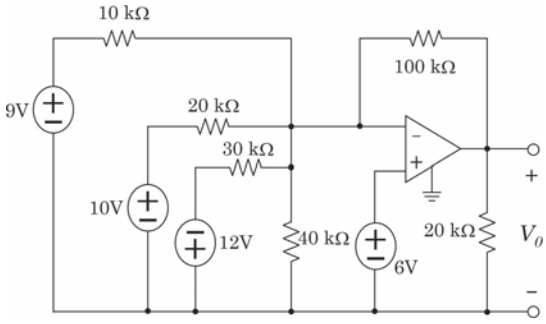
62. Which IC is a fixed positive voltage regulator?
a. LM78XX
b. LM79XX
c. LM2576
d. LM2596

63. Which is the correct option for the circuit shown below to get an output Vo as -Vcc?



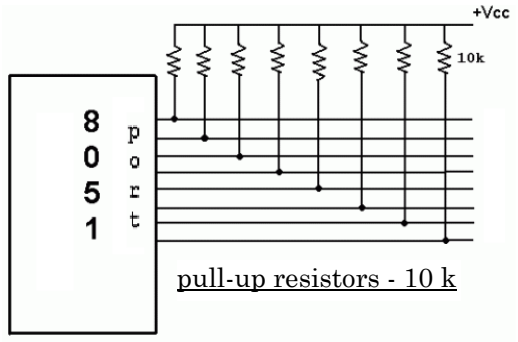
a. $V_{ref} > V_{in}$
b. $V_{ref} < V_{in}$
c. $V_{ref} = V_{in}$
d. None of the above

64. What is the output voltage Vo for the circuit shown below?



a. 31
b. 12
c. 21
d. 11

65. Which port in 8051microcontroller requires external pull up as shown below?



a. Port 0
b. Port 1
c. Port 2
d. Port 3

66. The instruction XLAT in 8086 microprocessor is used to
a. Translate a byte in AL using a table index
b. Transfer data from source to destination
c. Push the contents of specified source on to the stack
d. Exchange the contents of source with destination

67. In 8085 microprocessor, two address lines namely A13 and A6 have become faulty and are stuck at logic 0. Which of the following address locations cannot be accessed in the memory?
a. 0000H
b. 1F1FH
c. 1FFFH
d. 1F0FH

68. For the given 8086 microprocessor instructions below, which of the following is an invalid instruction?
a. MOV BX, [0301 H]
b. MOV CX, 037AH
c. MOV AL,BL
d. MOV DS, 4100H

69. Consider a system output $y(t)$ is related to its input $x(t)$ as, $y(t) = x(t) + \cos(x(t))$. This system is
a. linear and time invariant
b. linear and time variant
c. non-linear and time invariant
d. non-linear and time variant

70. A continuous system is described by $y(t) = x(t)\cos(200\pi t)$. If $x(t)$ is a two tone signal with frequencies 25 Hz & 50 Hz then, the frequency components present in $y(t)$ will be
a. 25 Hz & 50 Hz
b. 100 Hz
c. 50 Hz, 75 Hz, 125 Hz & 150 Hz
d. 25 Hz, 50 Hz, 75 Hz & 150 Hz

71. Let a discrete time signal $x(n)$ has Z-transform $X(z) = 1/(1+2\,z^{-1})$, $|z| > 2$. If its Fourier transform is denoted as $X(e^{j\omega})$ then,
a. $X(e^{j\omega}) = 1/(1+2e^{j\omega})$
b. $X(e^{j\omega}) = 1/(j\omega+2)$
c. $X(e^{j\omega}) = 1/(1+2\,e^{-j\omega})$
d. $X(e^{j\omega})$ does not exist

72. A single tone real signal $x[n]$ has its 8 point DFT denoted by $X(k)$ which has $X(2) = 2$. Then, the signal $x[n]$ will be equal to
a. $2e^{j\pi n/4}$
b. $2\cos(\pi n/2)$
c. $2\sin(\pi n/2)$
d. $4\cos(\pi n/2)$

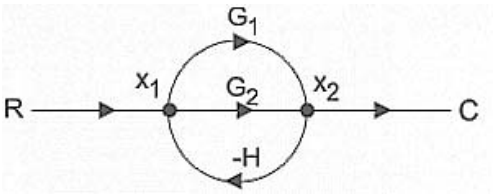
73. The number of stages in radix-2 DIT FFT for N = 8 is
a. 5
b. 3
c. 4
d. 1

74. The minimum number of delay elements and multipliers required to implement linear phase filter with impulse response $h(n)$ defined for $n > 0$ and $n < 8$ are
a. 7, 8
b. 7, 4
c. 6, 6
d. 7, 5

75. In 1024 point DFT of a signal sampled at 8192 Hz, k = 8 corresponds to a frequency of
a. 64 Hz
b. 32 Hz
c. 16 Hz
d. 8 Hz

76. The width of the transition band of a linear phase band pass FIR filter is given as 0.1π. The order of the filter designed using Blackman window is
a. 12
b. 25
c. 54
d. 110

77. Use mason's gain formula to find the transfer function of the given figure

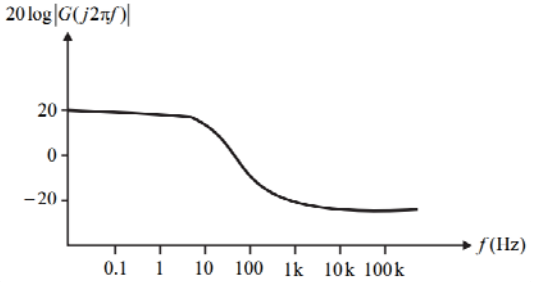


a. G_1+G_2
b. $G_1+G_1/1-G_1H+G_2H$
c. $G_1+G_2/1+G_1H+G_2H$
d. G_1-G_2

78. The transfer function of the system is $G(s) = 100/(s+1)(s+100)$. For a unit step input to the system the approximate settling time for 2% criterion is:
a. 100 sec
b. 4 sec
c. 1 sec
d. 0.01 sec

79. The range of K for the stability of system is $0 < K < 100$. For $K = 10$, The gain Margin of the system
a. 10
b. 5
c. 0.1
d. 0.5

80. A Bode magnitude plot for the transfer function $G(s)$ of a plant is shown below. Which one of the following transfer functions best describes the plant?



a. $\frac{1000(s+10)}{s+100}$
b. $\frac{10(s+10)}{s(s+1000)}$
c. $\frac{s+1000}{10s(s+10)}$
d. $\frac{s+1000}{10(s+10)}$

81. Which of following techniques requires timing synchronization between transmitter and receiver?
a. AM
b. FM
c. FDMA
d. TDMA

82. If a uniform quantizer with sinusoidal input signal produces the output SNR of 43.76 dB, determine the number of quantization levels used
a. 256
b. 128
c. 32
d. 64

83. An AM modulator develops an unmodulated power of 400 W and power of 450 W when modulated with modulation index of μ across the resistive load. Then the value of μ is
a. 0.5
b. 0.6
c. 0.7
d. 0.8

84. If a discrete memory less source emits symbols with probabilities 0.2, 0.2, 0.2, 0.2 and 0.2, determine the entropy of the source

a. 2

b. 3

c. 2.32

d. 3.23

85. Respiration rate is measured using _____.

a. RTD

b. Strain gauge

c. Ultrasonics

d. Thermocouple

86. The impedance of Biopotential electrode is _____ at high frequency.

a. Low

b. High

c. Moderate

d. Zero

87. Muscle artifacts in ECG signal are eliminated using

a. Highpass filter with cutoff frequency 0.05 Hz

b. Highpass filter with cutoff frequency 100 Hz

c. Lowpass filter with cutoff frequency 0.05 Hz

d. Lowpass filter with cutoff frequency 100 Hz

88. The greatest volume of gas that can be inspired by voluntary effort after maximum expiration is a

a. Inspiratory capacity

b. Total lung capacity

c. Vital capacity

d. Tidal Volume

89. In surgical diathermy when the needle point electrode are stuck into the tissue and kept steady. This refers to

a. Electrotomy

b. Fulguration

c. Coagulation

d. Desiccation

90. Which of the following are the requirements for a single channel ECG telemetry system?

a. Muscle potential interference alone should be kept maximum

b. Motion artifacts and muscle potential interference to be kept maximum

c. Motion artifacts and muscle potential interference to be kept medium

d. Motion artifacts and muscle potential interference to be kept minimum

91. The equipment used for extra corporeal circulation of blood during cardiac surgery is called

a. Ventilator

b. Dialyser

c. Heart lung machine

d. Pacemaker

92. The membrane used for dialysis is made of

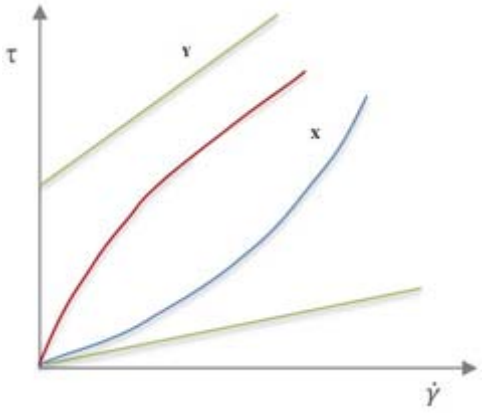
a. Polyethylene

b. Cellulose

c. Polyvinyl Chloride

d. Chitin

93. From the given graph of shear stress Vs strain rate the *X* and *Y* depicts _____ fluid property.



a. X-Pseudo plastic, Y-Newtonian

b. X-Dilatant, Y-Bingham plastic

c. X-Newtonian, Y-Thixotropic

d. X-Thixotropic, Y-Dilatant

94. A high strength steel rod E = 200 GPa and poisons ratio is 0.31 with a diameter of 5 cm is being subjected to a compressive load of 10 KN and experiencing a stress of 5 MPa. Compute the axial strain and the lateral strain.

a. Axial strain-25 μ strain, Lateral strain-8 μ strain

b. Axial strain-25 μ strain, Lateral strain-78 μ strain

c. Axial strain-78 μ strain, Lateral strain-25 μ strain

d. Axial strain-8 μ strain, Lateral strain-25 μ strain

95. A small artery has a length of 1.1 mm and a radius of 25 μ m. If the pressure drop across the artery is 1.3 KPa, calculate the flow rate. The viscosity of the blood is 3 Pa.second.

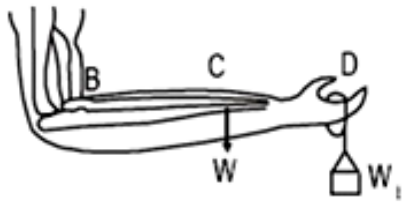
a. 16×10^{-16} m^3/sec

b. 25×10^{-17} m^3/sec

c. 6×10^{-14} m^3/sec

d. 32×10^{-15} m^3/sec

96. For the given figure BC = 15 cm, BD = 35 cm, W = 20 N, W1 = 80 N compute the net moment at the joint B



a. 19 Nm

b. 31 Nm

c. 28 Nm

d. 300 Nm

97. Which one of the following is not a characteristic of PET?

a. Positron emitters

b. Lead collimators

c. 511 keV photons

d. Absolute attenuation correction

98. The visibility of anatomical detail in a CT image will increase when:

a. The field of view is increased.

b. The matrix size is decreased.

c. The smoothing filter algorithm is used.

d. The slice thickness is decreased

99. S1: Ultrasound velocity in bone is greater than in the brain

S2: Ultrasound acoustic impedance is not related to the density of matter

a. S1 is True & S2 True

b. S1 is True & S2 False

c. S1 is False & S2 False

d. S1 is False & S2 True

100. What is T1 Relaxation time?

a. Spin-Lattice relaxation

b. Spin-Spin relaxation

c. Spin-recovery relaxation

d. Spin-echo relaxation