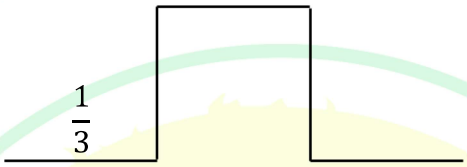
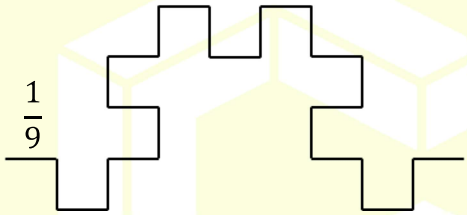
General Aptitude

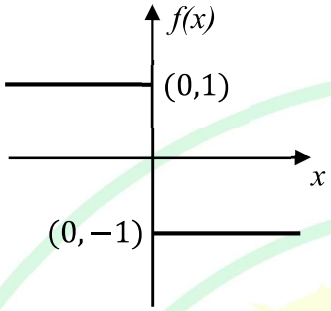
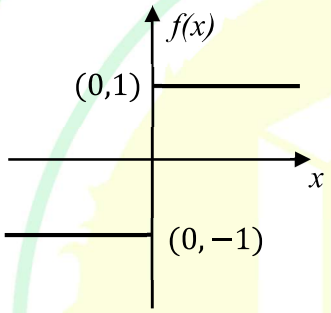
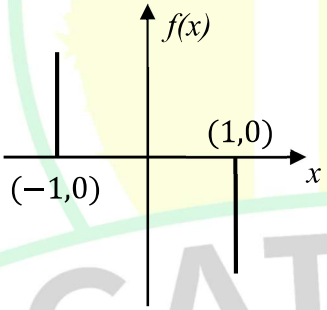
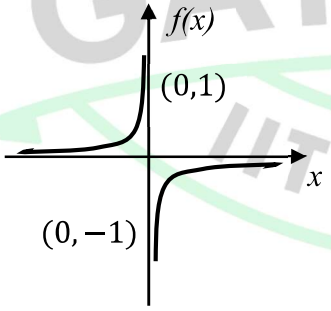
Q.1 – Q.5 Carry ONE mark Each

Q.1	Here are two analogous groups, Group-I and Group-II, that list words in their decreasing order of intensity. Identify the missing word in Group-II. Group-I: Abuse → Insult → Ridicule Group-II: _____ → Praise → Appreciate
(A)	Extol
(B)	Prize
(C)	Appropriate
(D)	Espouse

Q.2	Had I learnt acting as a child, I _____ a famous film star. Select the most appropriate option to complete the above sentence.
(A)	will be
(B)	can be
(C)	am going to be
(D)	could have been

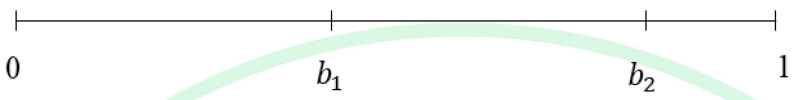
Q.3	The 12 musical notes are given as $C, C^{\#}, D, D^{\#}, E, F, F^{\#}, G, G^{\#}, A, A^{\#}$, and B. Frequency of each note is $\sqrt[12]{2}$ times the frequency of the previous note. If the frequency of the note C is 130.8 Hz, then the ratio of frequencies of notes $F^{\#}$ and C is:
(A)	$\sqrt[6]{2}$
(B)	$\sqrt{2}$
(C)	$\sqrt[4]{2}$
(D)	2

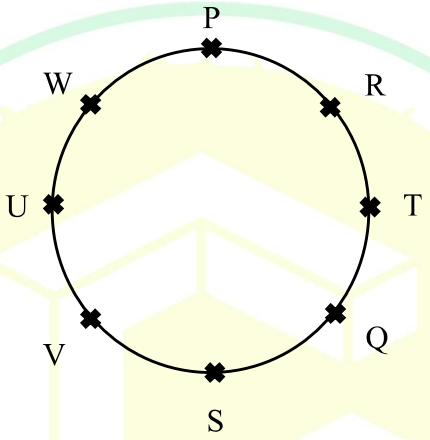
Q.4	The following figures show three curves generated using an iterative algorithm. The total length of the curve generated after 'Iteration n' is: Note: The figures shown are representative.
	Iteration 0:  Iteration 1:  Length of each segment: $\frac{1}{3}$ Iteration 2:  Length of each segment: $\frac{1}{9}$
(A)	$\left(\frac{5}{3}\right)^{\frac{n}{2}}$
(B)	$\left(\frac{5}{3}\right)^{n}$
(C)	$\left(\frac{5}{3}\right)^{2n}$
(D)	$\left(\frac{5}{3}\right)^{n(2n-1)}$

Q.5	Which one of the following plots represents $f(x) = -\frac{\lvert x \rvert}{x}$, where x is a non-zero real number? Note: The figures shown are representative.
(A)	
(B)	
(C)	
(D)	

Q.6 – Q.10 Carry TWO marks Each

Q.6	Identify the option that has the most appropriate sequence such that a coherent paragraph is formed: P. Over time, such adaptations lead to significant evolutionary changes with the potential to shape the development of new species. Q. In natural world, organisms constantly adapt to their environments in response to challenges and opportunities. R. This process of adaptation is driven by the principle of natural selection, where favorable traits increase an organism's chances of survival and reproduction. S. As environments change, organisms that can adapt their behavior, structure and physiology to such changes are more likely to survive.
(A)	P → Q → R → S
(B)	Q → S → R → P
(C)	R → S → Q → P
(D)	S → P → R → Q

Q.7	A stick of length one meter is broken at two locations at distances of b_1 and b_2 from the origin (0), as shown in the figure. Note that $0 < b_1 < b_2 < 1$. Which one of the following is NOT a necessary condition for forming a triangle using the three pieces? Note: All lengths are in meter. The figure shown is representative.
	
(A)	$b_1 < 0.5$
(B)	$b_2 > 0.5$
(C)	$b_2 < b_1 + 0.5$
(D)	$b_1 + b_2 < 1$

Q.8	Eight students (P, Q, R, S, T, U, V, and W) are playing musical chairs. The figure indicates their order of position at the start of the game. They play the game by moving forward in a circle in the clockwise direction. After the 1st round, 4th student behind P leaves the game. After 2nd round, 5th student behind Q leaves the game. After 3rd round, 3rd student behind V leaves the game. After 4th round, 4th student behind U leaves the game. Who all are left in the game after the 4th round? Note: The figure shown is representative.
	
(A)	P; T; Q; S
(B)	V; P; T; Q
(C)	W; R; Q; V
(D)	Q; T; V; W

Q.9 The table lists the top 5 nations according to the number of gold medals won in a tournament; also included are the number of silver and the bronze medals won by them. Based only on the data provided in the table, which one of the following statements is INCORRECT?

Nation	Gold	Silver	Bronze
USA	40	44	41
Canada	39	27	24
Japan	20	12	13
Australia	17	19	16
France	16	26	22

(A) France will occupy the third place if the list were made on the basis of the total number of medals won.

(B) The order of the top two nations will not change even if the list is made on the basis of the total number of medals won.

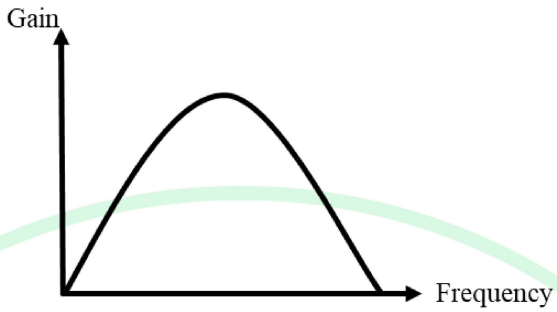
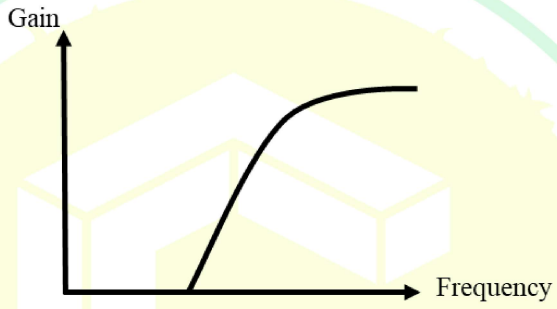
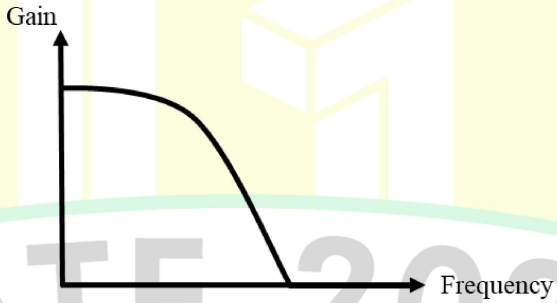
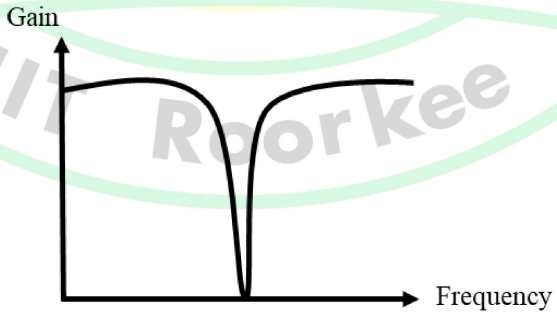
(C) USA and Canada together have less than 50% of the medals awarded to the nations in the above table.

(D) Canada has won twice as many total medals as Japan.

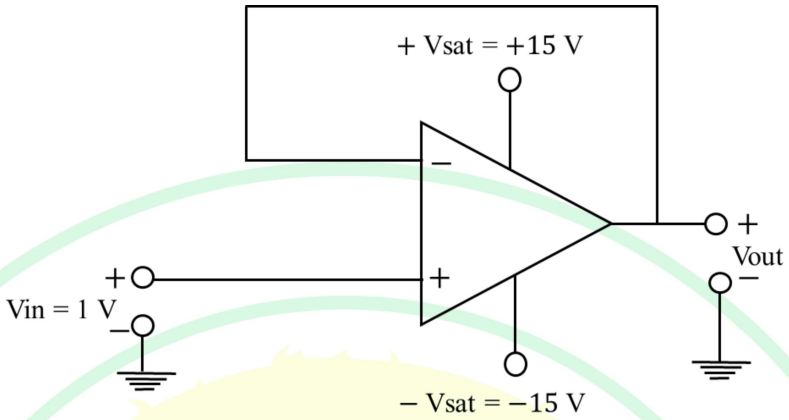
Q.10	An organization allows its employees to work independently on consultancy projects but charges an overhead on the consulting fee. The overhead is 20% of the consulting fee, if the fee is up to ₹ 5,00,000. For higher fees, the overhead is ₹ 1,00,000 plus 10% of the amount by which the fee exceeds ₹ 5,00,000. The government charges a Goods and Services Tax of 18% on the total amount (the consulting fee plus the overhead). An employee of the organization charges this entire amount, i.e., the consulting fee, overhead, and tax, to the client. If the client cannot pay more than ₹ 10,00,000, what is the maximum consulting fee that the employee can charge?
(A)	₹ 7,01,438
(B)	₹ 7,24,961
(C)	₹ 7,51,232
(D)	₹ 7,75,784

Q.11 – Q.35 Carry ONE mark Each

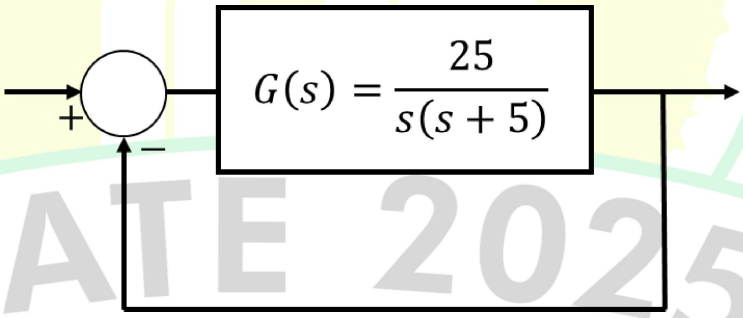
Q.11	Consider two cuboidal blocks of volume 1 cm^3 each, one made of gold and the other of undoped silicon. What will happen to the resistivity of these blocks if the temperature is increased from 300 K to 350 K? Choose one of the following.
(A)	Resistivity of gold increases and undoped silicon decreases
(B)	Resistivity of gold decreases and undoped silicon increases
(C)	Resistivity of gold remains same and undoped silicon increases
(D)	Resistivity of gold decreases and undoped silicon remains same

Q.12	Which one of the following represents the frequency response of a notch filter?
(A)	
(B)	
(C)	
(D)	

Q. 13	Given the following statements, which one of the options is correct? Statement (i): Histology is the study of histones Statement (ii): Cytology is the study of tissues
(A)	Both the statements are correct
(B)	Both the statements are incorrect
(C)	Statement (i) is correct; statement (ii) is incorrect
(D)	Statement (i) is incorrect; statement (ii) is correct
Q. 14	Given the following statements, which one of the options is correct? Statement (i): Structural Magnetic Resonance Imaging (sMRI) has better spatial resolution than Electroencephalogram (EEG) Statement (ii): EEG has better temporal resolution than sMRI
(A)	Both the statements are correct
(B)	Both the statements are incorrect
(C)	Statement (i) is correct; statement (ii) is incorrect
(D)	Statement (i) is incorrect; statement (ii) is correct

Q. 15	In the circuit shown below, assuming an ideal op-amp, for an input voltage Vin = 1V, the output voltage Vout = _____ (in volts).
	
(A)	1.0
(B)	2.0
(C)	0.5
(D)	0.1

Q. 16	Consider the following statements: Assertion: Positron Emission Tomography (PET) uses radionuclides, such as ^{11}C and ^{15}N, to study tissue metabolism. Reason: Positron-emitting nuclides are incorporated in molecules that are essential for metabolism.
(A)	Both Assertion and Reason are true; Reason is not the correct explanation for the Assertion
(B)	Both Assertion and Reason are true; Reason is the correct explanation for the Assertion
(C)	Assertion is true, but Reason is false
(D)	Both Assertion and Reason are false
Q. 17	The determinant of a 3×3 matrix M is 8. If every element of M is multiplied by -2, the determinant of the modified matrix will be
(A)	-64
(B)	-16
(C)	8
(D)	64

Q. 18	For any continuous and differentiable function $f(x)$ with first derivative $f'(x) \neq 0$ for all values of x, which one of the following is ALWAYS TRUE for $a \neq b$? Here, a and b are finite and real.
(A)	$f(a) > f(b)$
(B)	$f(a) = f(b)$
(C)	$f(a) \neq f(b)$
(D)	$f(a) < f(b)$
Q. 19	The closed loop system shown below _____.
	
(A)	is overdamped
(B)	is underdamped
(C)	is critically damped
(D)	has sustained oscillations

Q. 20	Which one of the following statements is CORRECT for any second order linear system with Proportional Integral Derivative (PID) controller?
(A)	Integral component decreases residual steady state error
(B)	Integral component integrates the output signal only
(C)	Integral component increases residual steady state error
(D)	Integral component integrates the input signal only
Q. 21	The eigenvalues of the matrix $\begin{pmatrix} cos\theta & -sin\theta \\ sin\theta & cos\theta \end{pmatrix}$ are _____.
(A)	$cos\theta$ and $sin\theta$
(B)	$e^{i\theta}$ and $e^{-i\theta}$, where $i = \sqrt{-1}$
(C)	$cos\theta$ and $-sin\theta$
(D)	$cos2\theta$ and $sin2\theta$

Q. 22	Let R_1, R_2 and R_3 be the Reynolds numbers corresponding to the following three cases, respectively Case 1: A 1 μm long bacterium swimming in water Case 2: A 10 cm long fish swimming in water Case 3: A 10 m long whale swimming in water If each of them covers a distance equal to their respective body length in one second, which one of the following is CORRECT?
(A)	$R_1 > R_2 > R_3$
(B)	$R_1 < R_2 < R_3$
(C)	$R_3 < R_1 < R_2$
(D)	$R_2 < R_1 < R_3$

Q. 23	The shape of an elastic rod of length l is represented by the position vector $\vec{r}(s)$ corresponding to the arc length s. If the bending energy of the rod is $$E = K\int_0^l \left(\frac{\partial^2 \vec{r}}{\partial s^2}\right)^2 ds,$$ what is the dimension of K in terms of mass M, length L and time T ?
(A)	MLT^{-2}
(B)	ML^3T^{-2}
(C)	ML^2T^{-2}
(D)	ML^3T^{-1}
Q. 24	The duration of action potential in a ventricular muscle cell of a human heart ranges from _____ milliseconds.
(A)	2 to 3
(B)	200 to 300
(C)	2000 to 3000
(D)	20 to 30

Q. 25	${}^{9}_{6}C$ and ${}^{10}_{6}C$ are _____, whereas ${}^{9}_{6}C$ and ${}^{8}_{5}B$ are _____.
(A)	isotopes; isomers
(B)	isomers; isotopes
(C)	isotopes; isotones
(D)	isotones; isotopes
Q. 26	Cerebrospinal fluid in humans is present in the _____ space.
(A)	subdural
(B)	subarachnoid
(C)	pericardial
(D)	epidural

Q.27	In the context of temperature sensitive polymers, LCST stands for _____.
(A)	Large Critical Solution Temperature
(B)	Local Critical Solute Temperature
(C)	Large Critical Solvent Temperature
(D)	Lower/Lowest Critical Solution Temperature
Q.28	In the electrocardiogram (ECG) of humans, the electrical signature of atrial repolarization is masked by the _____.
(A)	P wave
(B)	QRS complex
(C)	T wave
(D)	ST segment

Q.29	Which one of the following hormones is NOT secreted by the adrenal gland in humans?
(A)	Cortisol
(B)	Epinephrine
(C)	Oxytocin
(D)	Aldosterone
Q.30	Which one of the following does NOT use piezoelectric transducers?
(A)	Ultrasonography
(B)	Phonocardiography
(C)	Echocardiography
(D)	Electroencephalography

Q.31	A low pass filter with cutoff frequency of 250 Hz is NOT suitable for recording _____.
(A)	Electrocardiogram (ECG)
(B)	Electroencephalogram (EEG)
(C)	Electromyogram (EMG)
(D)	Electrooculogram (EOG)
Q.32	If $f(x) = x - \frac{1}{x}$, the value of $\lim_{\Delta x \to 0} \frac{f(1+\Delta x) - f(1)}{\Delta x}$ is _____.
(A)	0
(B)	$\frac{1}{2}$
(C)	1
(D)	2

Q.33	The elements of the dataset $\{-5,1,a,5,b\}$ are in ascending order. If both mean and median of the dataset are equal to 3, what is the value of b?
(A)	7
(B)	11
(C)	9
(D)	12
Q.34	For a tissue with Young's modulus 4 kPa and shear modulus 1.5 kPa, what is the value of the Poisson's ratio?
(A)	$\frac{1}{5}$
(B)	$\frac{1}{3}$
(C)	$\frac{1}{4}$
(D)	$\frac{1}{2}$

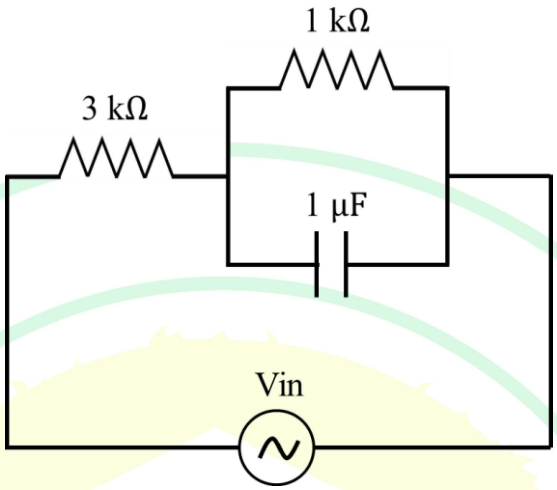
Q.35	The Electroencephalogram (EEG) voltage measured by a test device is 2.4 μV, while the reference device measured it to be 3.0 μV. What is the percentage error of the test device?
(A)	25%
(B)	20%
(C)	10%
(D)	0.6%

Q.36 – Q.65 Carry TWO marks Each

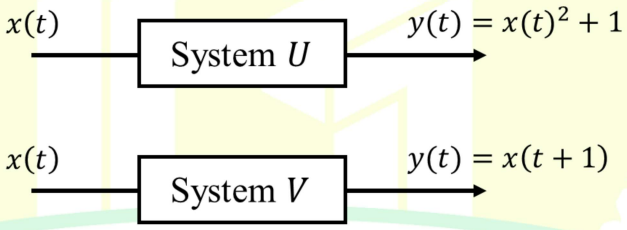
Q.36	A time domain signal is given by $$x(t) = 20\sin(100\pi t) + 36\sin(150\pi t) - 2\sin(300\pi t),$$ where time t is in seconds. Among the following options, what is the frequency (in Hz) at which $x(t)$ should be sampled for accurate signal reconstruction?
(A)	500
(B)	150
(C)	200
(D)	250

Q.37	A voltage source $Vs = 5\sin\left(100t + \frac{\pi}{2}\right)$ volts is driving a current $I = 10\sin\left(100t + \frac{\pi}{6}\right)$ mA through a circuit. The average power dissipated in the circuit is _____ mW.
(A)	0.0
(B)	12.5
(C)	25.0
(D)	50.0
Q.38	N independent trials of a binomial random variable yield an expectation value of 16 and variance of 12. What is the value of N?
(A)	80
(B)	60
(C)	45
(D)	64

Q.39	Given a function $y(x)$ satisfying the differential equation $$y'' - 0.25y = 0,$$ with initial conditions $y(0) = 1;\ y'(0) = 1$, what is the value of $y(\log_e 100)$? Here, y' and y'' are the first and second derivatives of y, respectively.
(A)	14.05
(B)	14.25
(C)	14.95
(D)	14.65

Q.40	In the circuit shown below, Vin =$10\cos(1000t)$ volts. The magnitude of the input impedance of the circuit is _____ kΩ. (rounded off to one decimal place)
	
(A)	5.0
(B)	3.5
(C)	6.0
(D)	4.5

Q.41	Gelatin solutions P and Q of concentrations 3.5% and 0.5%, respectively, need to be mixed to obtain a 3% solution R. How much volume (in ml) of P needs to be mixed with 100 ml of Q to obtain R? (Choose the correct option) All concentrations are in units of weight/volume.
(A)	100
(B)	250
(C)	500
(D)	1000
Q.42	Which of the following is/are CORRECT about the value of $y = \log_e(-e^x)$, where x is a real number.
(A)	y is real valued
(B)	y is complex valued
(C)	$y = x \pm in\pi$, where n is an odd integer and $i = \sqrt{-1}$
(D)	$y = x \pm in\pi$, where n is an even integer and $i = \sqrt{-1}$

Q.43	Which of the following statement(s) about ultrasound waves is/are true?
(A)	Acoustic impedance of biological tissues is directly proportional to its density
(B)	The reflection coefficient depends on the impedance mismatch at the interface of two biological tissues
(C)	The transmission coefficient is independent of the impedance of biological tissues
(D)	Biological tissues do not reflect ultrasound waves
Q.44	Two systems U and V are defined as shown below. Which of the following statement(s) is/are CORRECT?
	
(A)	System U is nonlinear; System V is linear
(B)	System U is causal; System V is noncausal
(C)	System U is noncausal; System V is causal
(D)	System U is nonlinear; System V is nonlinear

Q.45	Which of the following statement(s) about pulse oximetry is/are TRUE?
(A)	Oxygenated hemoglobin absorbs less infrared light (900 nm) compared to deoxygenated hemoglobin
(B)	Oxygenated hemoglobin absorbs less visible light (600 nm) compared to deoxygenated hemoglobin
(C)	Oxygenated hemoglobin absorbs more visible light (600 nm) compared to deoxygenated hemoglobin
(D)	Oxygenated hemoglobin absorbs more infrared light (900 nm) compared to deoxygenated hemoglobin
Q.46	Which of the following statement(s) is/are CORRECT about neuronal membrane and neuronal action potential?
(A)	Application of an outward current depolarizes the neuronal membrane
(B)	Application of an inward current depolarizes the neuronal membrane
(C)	Increasing the stimulus strength increases the amplitude of neuronal action potential
(D)	Increasing the stimulus strength decreases the latency of neuronal action potential

Q.47	A discrete linear time invariant system has an impulse response function given by $h[n] = \delta[n] + \frac{1}{2}\delta[n-1] + \frac{1}{3}\delta[n-2]$. For input signal $x[n] = \delta[n] + \delta[n-1]$, which of the following option(s) is/are CORRECT for the output signal $y[n]$?
(A)	$y[2] = 11/6$
(B)	$y[2] = 5/6$
(C)	$y[k] = 0$ for all $k \geq 3$
(D)	$y[k] = 0$ for all $k \geq 4$
Q.48	Which of the following statement(s) is/are CORRECT about isotonic and isometric tests?
(A)	In an isotonic test, muscle is subjected to a constant tension and its length is recorded.
(B)	In an isotonic test, muscle is held at constant length, and the contractile force generated by the muscle is recorded.
(C)	In an isometric test, muscle is held at constant length, and the contractile force generated by the muscle is recorded.
(D)	In an isometric test, muscle is subjected to a constant tension and its length is recorded.

Q.49	A Newtonian fluid of viscosity μ is undergoing laminar flow in a tube of radius R. For a constant pressure drop per unit length along the tube, which of the following statement(s) is/are CORRECT? Note: r represents the radial position; assume no slip condition at the boundaries.
(A)	The radial profile of the flow velocity is proportional to $(1 - \frac{r^2}{R^2})$
(B)	The radial profile of the flow velocity is proportional to $(1 - \frac{r^3}{R^3})$
(C)	Shear stress is zero at $r = R$
(D)	Shear stress is zero at $r = 0$

Q.50 At a given frequency, the storage modulus (G') and loss modulus (G'') of four biomaterials are shown in the table below. Which of the following option(s) is/are CORRECT?

Biomaterial	G' (Pa)	G'' (Pa)
P	1000	50
Q	1000	80
R	1000	100
S	1000	0

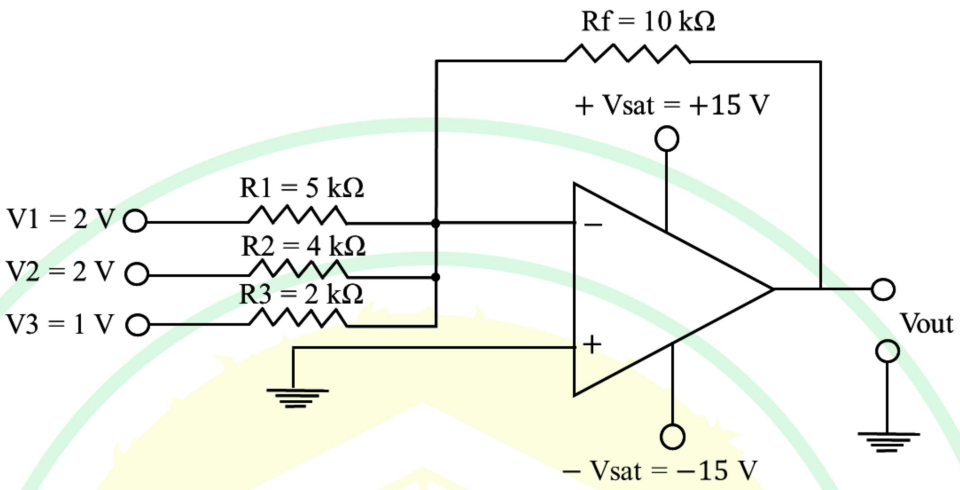
(A) P, Q and R are viscoelastic solids

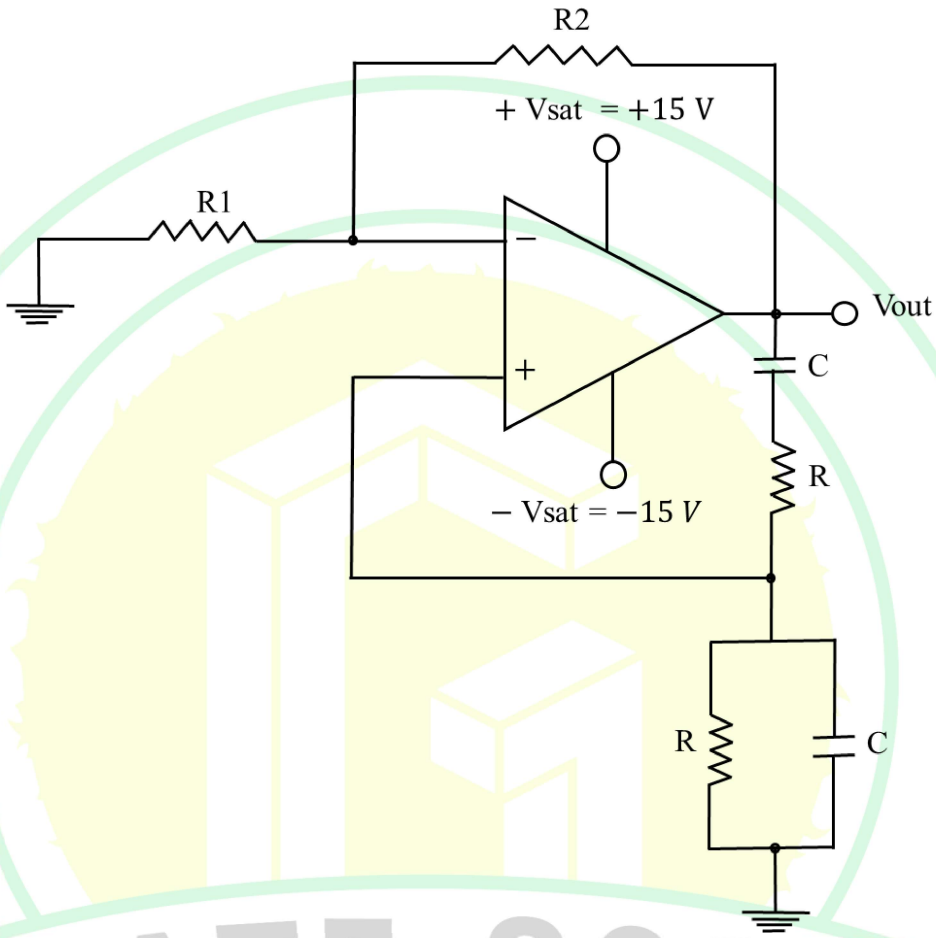
(B) P, Q and R are viscoelastic fluids

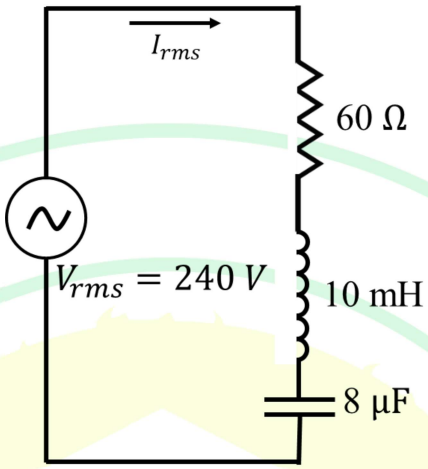
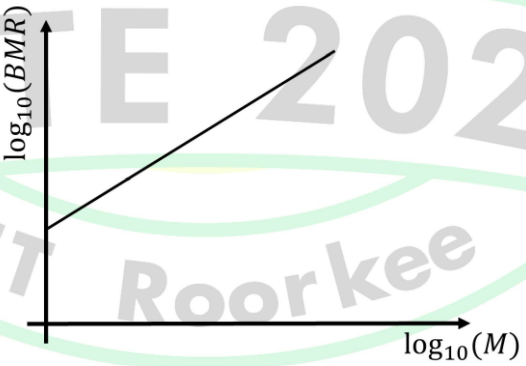
(C) R and S are viscoelastic solids

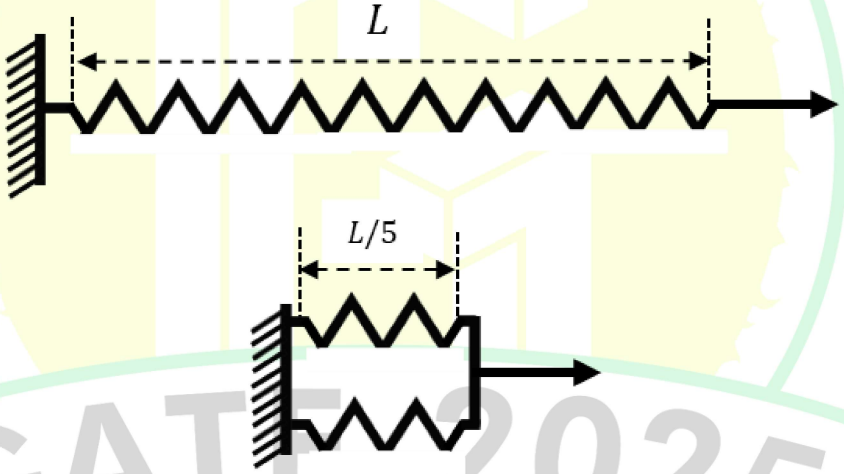
(D) S is an elastic solid

Q.51 For an 8-bit Digital to Analog Converter (DAC), the binary input 0000 0000 results in 0 V, and 1111 1111 results in 5 V. The output of the DAC for an input of 1011 0111 is _____ (in volts, rounded off to two decimal places).

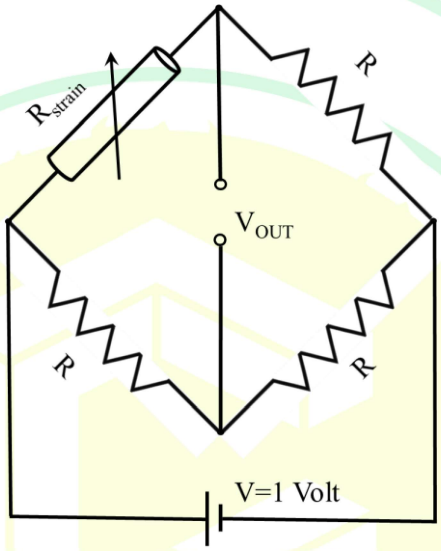
Q.52	What is the output voltage Vout for the circuit shown below? _____ (in volts, rounded off to the nearest integer).
	
Q.53	Resistance R of a thermistor varies as a function of temperature T such that $$R(T) = R_0 \exp\left[\beta\left(\frac{1}{T} - \frac{1}{T_0}\right)\right],$$ where $\beta = 3100$ K and, R_0 and T_0 are positive constants. If the relative error in measuring R is 10%, what is the relative error (in percentage) in measuring 310 K temperature? _____ (rounded off to the nearest integer)

Q.54	The frequency of the oscillator circuit shown in the figure below is _____ kHz. (rounded off to two decimal places) Given: R = 1 kΩ; R1 = 2 kΩ; R2 = 6 kΩ; C = 0.1 μF
	

Q.55	For the RLC circuit shown below, the root mean square current (I_{rms}) at the resonance frequency is _____ amperes. (rounded off to the nearest integer)
	
Q.56	The plot of $\log_{10}(BMR)$ as a function of $\log_{10}(M)$ is a straight line with slope 0.75, where M is the mass of the person and BMR is the Basal Metabolic Rate. If a child with $M = 10$ kg has a $BMR = 600$ kcal/day, the BMR for an adult with $M = 100$ kg is _____ kcal/day. (rounded off to the nearest integer)
	
Q.57	Newton Raphson method is used to solve the equation $x^3 - 2x - 5 = 0$ with an initial guess $x_0 = 3$. What is x_1, the value after ONE iteration? _____ (rounded off to two decimal places)

Q.58	For pulsatile blood flow through an artery of internal diameter 20 mm, wall thickness 1 mm and Young's Modulus 1 MPa, what is the wave speed in metres per second? _____ (rounded off to one decimal place). Assume the density of blood to be 1050 kg/m^3.
Q.59	An ideal, massless spring with spring constant 1 N/m (upper panel of the given figure) is cut into 5 equal parts. If two of these parts are connected in parallel (lower panel of the given figure), what is the resultant spring constant in N/m? _____ (rounded off to the nearest integer) Assume linear behavior of the springs.
	
Q.60	Polylactic-co-glycolic acid (PLGA) is combined with an equal amount (by weight) of hydroxyapatite (HA) to make a bone scaffold. If the porosity of the scaffold is 80%, what is the scaffold density in g/cm^3? _____ (rounded off to two decimal places) Assume densities of PLGA and HA to be 1 g/cm^3 and 3 g/cm^3, respectively.

Q.61	Strength (σ) of an implanted suture is given by the equation $$\sigma = \sigma_0 - 2\ \log_e(t) \text{ for } t \geq 1,$$ where σ_0 represents the original strength and time t is measured in weeks. If the strength of the suture is 2 MPa at 4 weeks, what will be its strength (in MPa) at 8 weeks? _____ (rounded off to two decimal places)
Q.62	If the gyromagnetic ratio of proton is 42.58 MHz per Tesla, the resonance frequency for protons in a magnetic field of 1.5 Tesla is _____ MHz. (rounded off to two decimal places)

Q.63	A Wheatstone bridge is used to measure strain as shown in the figure below. Initially the bridge was balanced. When a strain is applied to the resistor R_{strain}, along its length, the output voltage V_{OUT} is 10 mV. If R_{strain} is a cylindrical resistor of length l and cross-sectional area A, the magnitude of the applied strain is _____. (rounded off to two decimal places)
	
Q.64	The storage modulus (G') of a collagen gel scales as $G' \sim [C]^3$, where $[C]$ represents the collagen concentration in mg/ml. If the storage modulus of a 1 mg/ml collagen gel is 100 Pa, then the storage modulus of a 3 mg/ml collagen gel is _____ Pa. (rounded off to the nearest integer)
Q.65	The cardiac output of a person at rest is 5 litres per minute and the mean aortic pressure is 100 mmHg. During exercise, if the cardiac output doubles and mean aortic pressure rises to 110 mmHg, then the peripheral resistance in the systemic circulation will decrease by _____%. (rounded off to the nearest integer) Assume venous pressure in systemic circulation to be negligible.