Karnataka PGECET 2025 Question Paper With Solutions

Time Allowed :2 Hours	**Maximum Marks :**100	**Total questions :**75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. **Mode of exam**: Offline (Pen and Paper Based Test)
2. **Duration**: 2 hours
3. **Question type**: MCQs
4. **Total marks**: 100
5. **Total questions**: 75
6. **Marking scheme**:
   - 50 questions × 1 mark
   - 25 questions × 2 marks
7. **Negative marking**: No

1. Solve the following differential equation:

$$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = 0$$

(a) $y = (C_1 + C_2x)e^{-2x}$

(b) $y = C_1e^{-2x} + C_2xe^{-2x}$

(c) $y = C_1e^{2x} + C_2xe^{2x}$

(d) $y = (C_1 + C_2x)e^xe^x$

Correct Answer: (b) $y = C_1e^{-2x} + C_2xe^{-2x}$

Solution:

We are given the following differential equation:

$$\frac{d^2y}{dx^2} - 4y = 0$$

This is a linear second-order homogeneous differential equation with constant coefficients.

Step 1: Write the characteristic equation

The characteristic equation for this differential equation is:

$$r^2 - 4 = 0$$

$$r^2 = 4 \quad \Rightarrow \quad r = \pm 2$$

Step 2: General solution

For the roots $r_1 = 2$ and $r_2 = -2$, the general solution is:

$$y = C_1e^{2x} + C_2e^{-2x}$$

Now, we need to apply the method of undetermined coefficients. Since the term e^{-2x} already appears in the solution, we multiply it by x to avoid duplication, which gives:

$$y = C_1e^{-2x} + C_2xe^{-2x}$$

Thus, the solution is:

$$y = C_1 e^{-2x} + C_2 x e^{-2x}$$

Quick Tip

When solving second-order linear differential equations with constant coefficients, if one of the roots is repeated, multiply the corresponding term by x to avoid duplication in the general solution.

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2. Which of the following is not a valid data type in C?

(a) int

(b) float

(c) real

(d) char

Correct Answer: (c) real

Solution:

In C, there are several primitive data types. The following are the common ones:

‘int‘ is used to store integers.

‘float‘ is used for storing single-precision floating-point numbers.

‘char‘ is used for storing single characters.

However, ‘real‘ is not a valid data type in C. In C, for real numbers, the types ‘float‘ or ‘double‘ are used. The term ‘real‘ is commonly used in other languages (like Pascal), but not in C.

Thus, the correct answer is (c) real.

Quick Tip

Always use ‘float‘ or ‘double‘ to represent real numbers in C. ‘real‘ is not a valid data type.

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3. The efficiency of a Carnot engine depends on:

(a) The temperature of the hot reservoir only

(b) The temperature of the cold reservoir only

(c) Both the temperatures of the hot and cold reservoirs

(d) The working substance used

Correct Answer: (c) Both the temperatures of the hot and cold reservoirs

Solution:

The efficiency of a Carnot engine is determined by the temperatures of the hot and cold reservoirs. The formula for the efficiency η of a Carnot engine is:

$$\eta = 1 - \frac{T_C}{T_H}$$

where:

T_H is the temperature of the hot reservoir,

T_C is the temperature of the cold reservoir,

Both T_H and T_C are in Kelvin.

The efficiency depends on both temperatures. If either temperature is increased or decreased, the efficiency will change accordingly. The temperature of the working substance does not directly affect the efficiency.

Thus, the correct answer is (c) Both the temperatures of the hot and cold reservoirs.

Quick Tip

Remember, the efficiency of a Carnot engine is solely dependent on the temperatures of the hot and cold reservoirs, not the working substance.

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4. In a series RLC circuit, if the frequency of the applied voltage is increased, the impedance of the circuit:

(a) Increases

(b) Decreases

(c) Remains constant

(d) First increases then decreases

Correct Answer: (b) Decreases

Solution:

In a **series RLC circuit**, the total impedance Z is given by:

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

where:

R is the resistance,

$X_L = 2\pi f L$ is the inductive reactance,

$X_C = \frac{1}{2\pi f C}$ is the capacitive reactance,

f is the frequency of the applied voltage,

L is the inductance, and

C is the capacitance.

Step 1: At very low frequencies, when f is small, the capacitive reactance X_C dominates because it is inversely proportional to the frequency ($X_C = \frac{1}{2\pi f C}$). So, the impedance is high.

Step 2: As the frequency increases, the inductive reactance X_L increases (since $X_L = 2\pi f L$) and the capacitive reactance X_C decreases.

Step 3: At the resonant frequency (f_0), the inductive reactance and capacitive reactance are equal, $X_L = X_C$, so the impedance reaches its minimum value, which is just the resistance $Z = R$.

Step 4: If the frequency is increased further past the resonance point, the inductive reactance X_L becomes dominant, and the impedance increases again. But in the range before resonance, the impedance **decreases** as the frequency increases.

Thus, **before resonance** (as the frequency increases from a low value to the resonant frequency), the impedance of the series RLC circuit **decreases**.

Therefore, the correct answer is **(b) Decreases**.

Quick Tip

The impedance in a series RLC circuit decreases as the frequency increases towards resonance. At resonance, the impedance is at its minimum and is equal to the resistance R. After resonance, the impedance starts to increase again.

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5. The modulus of elasticity of concrete is approximately:

(a) 10,000 MPa

(b) 20,000 MPa

(c) 30,000 MPa

(d) 40,000 MPa

Correct Answer: (b) 20,000 MPa

Solution:

The modulus of elasticity, also known as Young's Modulus, is a material property that describes the relationship between stress and strain. In concrete, the modulus of elasticity is influenced by factors such as the type of cement, aggregates, and the mix ratio.

Step 1: Concrete's Modulus of Elasticity Range.

Concrete generally has a modulus of elasticity in the range of 20,000 MPa to 40,000 MPa. The exact value depends on the material composition, but the typical value used for general purposes is approximately 20,000 MPa.

Step 2: Consideration of Option Values.

(a) $10,000$ MPa: Too low for typical concrete.

(b) $20,000$ MPa: This is a common value used for concrete's modulus of elasticity.

(c) $30,000$ MPa: This is also a reasonable value but higher than the typical value.

(d) $40,000$ MPa: This is on the higher side but still within the possible range for concrete with high strength.

Step 3: Conclusion.

Considering the average and typical values used in the construction industry, the most appropriate answer is $20,000$ MPa.

Thus, the correct answer is (b) 20,000 MPa.

Quick Tip

The modulus of elasticity for normal concrete is typically around 20,000 MPa. It can vary depending on concrete strength and material composition.

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6. Which of the following is the main component of natural gas?

(a) Methane

(b) Ethane

(c) Propane

(d) Butane

Correct Answer: (a) Methane

Solution:

Natural gas is primarily composed of hydrocarbons. The composition can vary, but the primary component is methane (CH_4).

Step 1: Understanding Natural Gas Composition.

Natural gas is made up of various hydrocarbons, with methane being the predominant one. Methane typically constitutes about 70–90% of natural gas by volume. Other gases such as ethane, propane, butane, and trace amounts of heavier hydrocarbons and gases like carbon dioxide and nitrogen are also present.

Step 2: Examining the Options.

(a) Methane: This is the main component of natural gas, typically the highest in concentration.

(b) Ethane: While ethane is present in natural gas, it is not the primary component.

(c) Propane: This is another component of natural gas but is present in smaller quantities.

(d) Butane: Like propane, butane is present in trace amounts.

Step 3: Conclusion.

Methane is by far the most abundant component in natural gas, making option (a) the correct choice.

Thus, the correct answer is (a) Methane.

Quick Tip

Methane (CH_4) is the primary component of natural gas, typically comprising around 70–90% of the total gas.

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7. In a transistor, the current gain is defined as:

(a) $\beta = \frac{I_C}{I_B}$

(b) $\beta = \frac{I_E}{I_B}$

(c) $\beta = \frac{I_C}{I_E}$

(d) $\beta = \frac{I_B}{I_E}$

Correct Answer: (a) $\beta = \frac{I_C}{I_B}$

Solution:

Step 1: Understanding current gain in a transistor.

In a transistor, the current gain β is a measure of how much the base current I_B is amplified to produce the collector current I_C.

Step 2: Definition of current gain β.

The current gain β is mathematically defined as the ratio of the collector current I_C to the base current I_B. Therefore:

$$\beta = \frac{I_C}{I_B}$$

Step 3: Explanation of the answer.

The collector current I_C flows through the collector, which is the output of the transistor, and is determined by the base current I_B.

The ratio $\frac{I_C}{I_B}$ indicates how effectively the transistor amplifies the base current into the output collector current.

Step 4: Rejection of other options.

Option (B) $\beta = \frac{I_E}{I_B}$ is incorrect because the current gain β is not defined with the emitter current.

Option (C) $\beta = \frac{I_C}{I_E}$ is incorrect because the ratio of collector current to emitter current is not the definition of current gain.
Option (D) $\beta = \frac{I_B}{I_E}$ is incorrect because the base current to emitter current ratio is not relevant for β.

Quick Tip

The current gain β in a transistor is always defined as $\beta = \frac{I_C}{I_B}$, where I_C is the collector current and I_B is the base current.

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8. The primary function of a Wheatstone bridge is to measure:

(a) Voltage
(b) Current
(c) Resistance
(d) Inductance

Correct Answer: (c) Resistance

Solution:
The Wheatstone bridge is a fundamental electrical circuit used to measure an unknown resistance by balancing two legs of a bridge circuit.
Step 1: Understanding the Wheatstone Bridge.
The Wheatstone bridge consists of four resistors arranged in a diamond shape with a voltage source applied across the bridge. The bridge is ”balanced” when the ratio of resistances in one leg equals the ratio in the other leg, making the potential difference between the middle points (across a galvanometer) equal to zero.
Step 2: Measuring Resistance.
The primary use of the Wheatstone bridge is to precisely measure unknown resistances by adjusting the known resistors until the bridge is balanced.
Step 3: Examining the Options.
(a) Voltage: The Wheatstone bridge does not measure voltage directly.
(b) Current: The Wheatstone bridge is not used to measure current.

(c) Resistance: The Wheatstone bridge is specifically designed to measure resistance.

(d) Inductance: The Wheatstone bridge does not measure inductance.

Step 4: Conclusion. The Wheatstone bridge is primarily used for measuring resistance. Thus, the correct answer is (c) Resistance.

Quick Tip

The Wheatstone bridge is a highly accurate method for measuring an unknown resistance by comparing it with known resistances.

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9. In a communication system, the bandwidth of a signal is:

(a) The difference between the highest and lowest frequencies

(b) The highest frequency only

(c) The lowest frequency only

(d) The sum of the highest and lowest frequencies

Correct Answer: (a) The difference between the highest and lowest frequencies

Solution:

In a communication system, the bandwidth refers to the range of frequencies that a signal occupies. It is defined as the difference between the highest and the lowest frequencies present in the signal.

Step 1: Understanding Bandwidth.

Bandwidth represents the range of frequencies a signal occupies and is essential in determining the data transmission rate of the communication system.

Step 2: Examining the Options.

(a) The difference between the highest and lowest frequencies: This is the correct definition of bandwidth.

(b) The highest frequency only: Bandwidth considers the range, not just the highest frequency.

(c) The lowest frequency only: Bandwidth involves both the highest and the lowest frequencies.

(d) The sum of the highest and lowest frequencies: Bandwidth is the difference, not the sum of frequencies.

Step 3: Conclusion.

The correct definition of bandwidth is the difference between the highest and lowest frequencies.

Thus, the correct answer is (a) The difference between the highest and lowest frequencies.

Quick Tip

Bandwidth is critical in communication systems as it determines how much information can be transmitted within a specific frequency range.

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10. Which of the following is a non-invasive method to measure blood pressure?

(a) Sphygmomanometer

(b) Electrocardiogram

(c) Pulse oximeter

(d) Stethoscope

Correct Answer: (a) Sphygmomanometer

Solution:

A sphygmomanometer is a non-invasive medical device used to measure blood pressure. It measures the pressure in the arteries when the heart pumps blood and when it rests between beats.

Step 1: Understanding Non-Invasive Methods.

Non-invasive methods do not require insertion into the body. They simply involve external devices that measure bodily functions or conditions.

Step 2: Examining the Options.

(a) Sphygmomanometer: This is the correct answer. It measures blood pressure externally without breaking the skin.

(b) Electrocardiogram: This measures the electrical activity of the heart, not blood pressure.

(c) Pulse oximeter: This measures the oxygen saturation of the blood, not blood pressure.

(d) Stethoscope: While a stethoscope is used to listen to heart sounds and blood flow, it does not directly measure blood pressure.

Step 3: Conclusion.

A sphygmomanometer is the correct tool for non-invasive blood pressure measurement.

Thus, the correct answer is (a) Sphygmomanometer.

Quick Tip

A sphygmomanometer is typically used in conjunction with a stethoscope to measure blood pressure manually.
