AP PGECET shift 2 Question Paper With Solutions

Time Allowed :2 Hours	**Maximum Marks :**120	**Total questions :**120

General Instructions

Read the following instructions very carefully and strictly follow them:

1. **Mode of Examination:** Online (Computer-based examination)
2. **Medium of Exam:** English
3. **Duration of Exam:** 2 hours
4. **Type of Questions:** Multiple-choice questions
5. **Number of Questions:** 120 Questions
6. **Total Marks:** 120 Marks
7. **Marking Scheme:**
    - 1 mark for each correct answer.
    - No negative markings for incorrect answers.

1. Which of the following processes is primarily used for the removal of suspended solids from water?

(1) Filtration

(2) Coagulation

(3) Sedimentation

(4) Disinfection

Correct Answer: (3) Sedimentation

Solution: To answer this question, let's examine the processes used for removing suspended solids from water:

Step 1: Filtration is used for separating solids from liquids, but it is typically used after other processes like coagulation or sedimentation to remove finer particles.

Step 2: Coagulation is a process where chemicals are added to water to destabilize particles, causing them to aggregate and form larger particles. While this helps remove suspended solids, it is often followed by sedimentation or filtration.

Step 3: Sedimentation is the primary process for the removal of suspended solids. It involves allowing the particles to settle at the bottom of a container due to gravity. Larger particles will settle faster, and this is the first step in water purification before filtration or disinfection. Thus, the correct answer is Sedimentation.

Quick Tip

Sedimentation is one of the simplest and most effective methods for removing suspended solids by allowing them to settle naturally.

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2. Find the eigenvalues of the matrix:

$$A = \begin{bmatrix} 4 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & 5 \end{bmatrix}$$

(1) 1, 5, 6

(2) 3, 4, 7

(3) 2, 3, 8

(4) 1, 2, 9

Correct Answer: (3) 2, 3, 8

Solution:

Given matrix A is:

$$A = \begin{bmatrix} 4 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & 5 \end{bmatrix}$$

The eigenvalues of matrix A are the solutions to the characteristic equation:

$$\det(A - \lambda I) = 0$$

where λ is the eigenvalue and I is the identity matrix. First, subtract λ from the diagonal elements of A:

$$A - \lambda I = \begin{bmatrix} 4-\lambda & 1 & 2 \\ 1 & 3-\lambda & 0 \\ 2 & 0 & 5-\lambda \end{bmatrix}$$

Now, calculate the determinant of the matrix:

$$\det(A - \lambda I) = \begin{vmatrix} 4-\lambda & 1 & 2 \\ 1 & 3-\lambda & 0 \\ 2 & 0 & 5-\lambda \end{vmatrix}$$

Expanding the determinant, we get:

$$(4-\lambda)\begin{vmatrix} 3-\lambda & 0 \\ 0 & 5-\lambda \end{vmatrix} - 1\begin{vmatrix} 1 & 0 \\ 2 & 5-\lambda \end{vmatrix} + 2\begin{vmatrix} 1 & 3-\lambda \\ 2 & 0 \end{vmatrix}$$

Simplifying this expression leads to the characteristic equation:

$$(\lambda - 2)(\lambda - 3)(\lambda - 8) = 0$$

Thus, the eigenvalues are $\lambda = 2, 3, 8$.

Quick Tip

To find eigenvalues, solve the characteristic equation $\det(A - \lambda I) = 0$, where λ represents the eigenvalue. The solutions to this equation give the eigenvalues.

3. The Carnot efficiency of a heat engine depends on the temperature of the:

(1) Hot reservoir only

(2) Cold reservoir only

(3) Difference between the hot and cold reservoirs

(4) Volume of the engine

Correct Answer: (3) Difference between the hot and cold reservoirs

Solution: The Carnot efficiency of a heat engine is a theoretical measure of the maximum efficiency that any heat engine can achieve when operating between two reservoirs. The formula for the Carnot efficiency is:

$$\eta = 1 - \frac{T_c}{T_h}$$

where:

η is the efficiency,

T_c is the temperature of the cold reservoir,

T_h is the temperature of the hot reservoir.

Step 1: The efficiency depends on the temperatures of both the hot and cold reservoirs. However, it's important to note that the Carnot efficiency is determined by the difference between the temperatures of these two reservoirs, not just the temperature of one reservoir.

Step 2: The greater the difference between the hot and cold reservoirs, the higher the efficiency. If the temperature of the cold reservoir is very low and the temperature of the hot reservoir is very high, the efficiency will be closer to 100%. However, in practice, this ideal efficiency cannot be achieved due to practical limitations.

Thus, the correct answer is Difference between the hot and cold reservoirs.

Step 3: The volume of the engine is not a factor in the Carnot efficiency, as the efficiency is a function of temperature, not volume or size of the engine.

Quick Tip

For a heat engine to be most efficient, the difference in temperature between the hot and cold reservoirs should be maximized.

4. The Carnot efficiency of a heat engine depends on the temperature of the:

(1) Hot reservoir only

(2) Cold reservoir only

(3) Difference between the hot and cold reservoirs

(4) Volume of the engine

Correct Answer: (3) Difference between the hot and cold reservoirs

Solution: The Carnot efficiency of a heat engine is given by the formula:

$$\eta = 1 - \frac{T_c}{T_h}$$

where:

η is the efficiency of the engine,

T_h is the temperature of the hot reservoir,

T_c is the temperature of the cold reservoir.

Step 1: The Carnot efficiency depends on the difference between the temperatures of the hot and cold reservoirs, not just the temperature of one of them.

Step 2: As the difference between T_h and T_c increases, the efficiency of the engine increases. This means that the larger the temperature difference between the two reservoirs, the higher the efficiency of the engine.

Thus, the correct answer is Difference between the hot and cold reservoirs.

Step 3: The volume of the engine and the temperature of each reservoir alone do not directly determine the Carnot efficiency without considering the temperature difference.

Quick Tip

In the Carnot cycle, maximizing the difference between the hot and cold reservoir temperatures leads to higher efficiency.

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5. A convex lens has a focal length of 10 cm. An object is placed at a distance of 15 cm from the lens. The image formed will be:

(1) Real and inverted

(2) Virtual and upright

(3) Real and upright

(4) Virtual and inverted

Correct Answer: (1) Real and inverted

Solution: We are given that:

Focal length of the lens $f = 10\,\text{cm}$,

Object distance $u = 15\,\text{cm}$.

To determine the image characteristics, we use the lens formula:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

where:

v is the image distance,

u is the object distance,

f is the focal length.

Step 1: Substitute the known values into the lens formula:

$$\frac{1}{10} = \frac{1}{v} - \frac{1}{15}$$

Step 2: Solve for v:

$$\frac{1}{v} = \frac{1}{10} + \frac{1}{15} = \frac{3+2}{30} = \frac{5}{30} = \frac{1}{6}$$

$$v = 6\,\text{cm}$$

Step 3: Since the image distance v is positive, the image is real. The magnification produced by the lens is also negative, which means the image is inverted.

Thus, the correct answer is Real and inverted.

Step 4: The object is placed outside the focal length, which results in the formation of a real, inverted image.

Quick Tip

For a convex lens, when the object is placed outside the focal point, a real and inverted image is formed.

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6. The flow of an incompressible fluid is described by the Bernoulli equation. Which of the following quantities is not conserved along a streamline in steady flow?

(1) Pressure

(2) Kinetic energy

(3) Potential energy

(4) Volume flow rate

Correct Answer: (4) Volume flow rate

Solution: The Bernoulli equation describes the behavior of an incompressible fluid flow along a streamline. The equation states that the sum of pressure energy, kinetic energy, and potential energy per unit volume remains constant along a streamline in steady flow.

Step 1: The Bernoulli equation is:

$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant}$$

where:

P is the pressure,

v is the velocity of the fluid,

ρ is the fluid density,

g is the acceleration due to gravity,

h is the height (potential energy).

Step 2: The equation shows that pressure, kinetic energy, and potential energy are all conserved along a streamline in steady flow. The volume flow rate (which involves the total flow through a pipe or duct) is not directly conserved along a streamline in this equation. Thus, the correct answer is Volume flow rate.

Quick Tip

Bernoulli's equation is useful for analyzing fluid dynamics but does not account for volume flow rate conservation along a streamline.

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7. In a TCP/IP model, which of the following is the layer responsible for routing packets between different networks?

(1) Application layer

(2) Transport layer

(3) Network layer

(4) Data Link layer

Correct Answer: (3) Network layer

Solution: The TCP/IP model is a conceptual framework that standardizes the functions of a communication system. The model consists of four layers: Application, Transport, Network, and Data Link.

Step 1: The Network layer is responsible for routing packets between different networks. It determines how data is sent to the receiver from the source by using logical addressing (e.g., IP addresses).

Step 2: The Transport layer is responsible for the end-to-end communication and data flow control, not for routing packets between networks.

Step 3: The Data Link layer is responsible for the physical transmission of data over a link and does not handle routing between networks.

Thus, the correct answer is Network layer.

Step 4: The Application layer deals with high-level protocols such as HTTP, FTP, etc., and is not concerned with routing.

Quick Tip

The Network layer is key to routing and forwarding packets across different networks.

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8. A fair coin is flipped three times. What is the probability of getting exactly two heads?

(1) 1/8

(2) 1/4

(3) 3/8

(4) 1/2

Correct Answer: (3) 3/8

Solution: When flipping a fair coin three times, there are $2^3 = 8$ possible outcomes. These outcomes are:

HHH, HHT, HTH, HTT, THH, THT, TTH, TTT

Step 1: We need to find the number of outcomes where exactly two heads occur. These outcomes are:

HHT, HTH, THH

Step 2: There are 3 outcomes where exactly two heads occur.

Step 3: The probability is the number of favorable outcomes divided by the total number of outcomes:

$$\text{Probability} = \frac{3}{8}$$

Thus, the correct answer is 3/8.

Quick Tip

In probability, to find the chance of a specific event, divide the number of favorable outcomes by the total number of possible outcomes.

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9. An object is thrown vertically upwards with an initial velocity of 10 m/s. How long will it take for the object to return to its starting point?

(1) 2 seconds

(2) 1 second

(3) 3 seconds

(4) 5 seconds

Correct Answer: (1) 2 seconds

Solution: When an object is thrown vertically upwards, it decelerates due to gravity until it reaches the highest point, and then accelerates downwards with the same magnitude of acceleration.

Step 1: The initial velocity of the object is $u = 10\,\text{m/s}$, and the acceleration due to gravity is $g = 9.8\,\text{m/s}^2$.

Step 2: The time taken to reach the highest point can be calculated using the formula:

$$v = u - gt$$

At the highest point, the final velocity $v = 0$, so:

$$0 = 10 - 9.8t$$

$$t = \frac{10}{9.8} \approx 1.02 \, \text{seconds}$$

Step 3: The total time for the object to return to its starting point is twice the time taken to reach the highest point:

$$\text{Total time} = 2 \times 1.02 = 2.04 \, \text{seconds}$$

Thus, the correct answer is 2 seconds (approximately).

Quick Tip

For vertical motion under gravity, the time taken to return to the starting point is twice the time taken to reach the highest point.

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10. The most commonly used material in modern construction for making beams and columns is:

(1) Steel

(2) Aluminum

(3) Concrete

(4) Wood

Correct Answer: (3) Concrete

Solution:

Step 1: Material selection in construction

In modern construction, the choice of materials for beams and columns is crucial for the stability, strength, and longevity of structures. Concrete is the most commonly used material because of its versatility, cost-effectiveness, and ability to withstand compression.

Step 2: Benefits of concrete

Concrete has high compressive strength and can be easily molded into various shapes. It is also durable and resistant to fire, making it the preferred material for large-scale constructions, including beams and columns in buildings, bridges, and other infrastructure.

Step 3: Comparison with other materials

Although steel and aluminum are used in some specialized applications, concrete is more commonly used for the structural elements in construction due to its availability, strength, and ease of construction.

Quick Tip

Concrete is the most commonly used material in modern construction due to its cost-effectiveness, compressive strength, and adaptability in molding shapes.

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11. Which of the following processes is used for shaping metal by pressing it into a mold under high pressure?

(1) Casting

(2) Forging

(3) Extrusion

(4) Injection molding

Correct Answer: (4) Injection molding

Solution:

Step 1: Understanding the shaping process

Injection molding is a manufacturing process used for shaping metal or plastic by pressing the material into a mold under high pressure. This method is commonly used for producing precise and complex parts in high volumes.

Step 2: Difference from other processes

- Casting involves pouring molten metal into a mold and allowing it to cool and solidify, but it does not necessarily involve high pressure. - Forging is a process where metal is shaped by compressive forces, usually applied at high temperatures, but it does not typically use molds. - Extrusion involves forcing material through a die to create a long, continuous shape, which differs from molding.

Step 3: Importance of injection molding

Injection molding is widely used in manufacturing industries for its efficiency in producing high-precision, repeatable metal and plastic parts.

Quick Tip

Injection molding is commonly used to create complex shapes by injecting material into a mold under high pressure, offering high precision and repeatability.

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12. In a simply supported beam with a uniform load, the shear force is maximum at:

(1) The midpoint of the beam

(2) The support

(3) The center of the span

(4) At the end of the beam

Correct Answer: (2) The support

Solution:

Step 1: Understanding shear force distribution

In a simply supported beam with a uniform load, the shear force is the force exerted internally to resist the external load. The distribution of shear force is not uniform and varies along the length of the beam.

Step 2: Maximum shear force location

For a simply supported beam with a uniform load, the shear force is maximum at the supports (where the beam is supported). At the support, the shear force is at its highest because the external load is directly transmitted to the supports.

Step 3: Shear force at other locations

The shear force decreases as we move from the support towards the midpoint of the beam. At the midpoint, the shear force is zero, and beyond the midpoint, it begins to increase in the opposite direction.

Quick Tip

In a simply supported beam with a uniform load, the shear force is maximum at the supports and decreases towards the midpoint of the beam.
