JEECUP 2026 Group-A (Polytechnic)

Question Paper (Memory-Based) with Solutions PDF

Conducted by Joint Entrance Examination Council, Uttar Pradesh (JEECUP).

General Instructions

(i) The examination is conducted in Computer-Based Test (CBT) mode.

(ii) Each question carries **+4 marks** for a correct answer and **-1 mark** for a wrong answer.

(iii) The total number of questions is **100**.

(iv) The total duration of the exam is **150 minutes** (2 hours and 30 minutes).

1. A body is moving with a constant speed v in a circular path of radius r. The magnitude of average velocity after half a revolution is:

(A) $\frac{2v}{\pi}$

(B) v

(C) $\frac{v}{\pi}$

(D) zero

Correct Answer: (A) $\frac{2v}{\pi}$

Solution:

Step 1: Understanding the Concept:

Speed is a scalar quantity defined as distance per unit time, whereas velocity is a vector quantity defined as displacement per unit time.

Average velocity is calculated as the total displacement divided by the total time taken.

Step 2: Key Formula or Approach:

The formulas required for a body completing half a revolution are:

- Displacement (d) = Straight-line distance between initial and final positions = $2r$
- Distance covered (s) = Half of the circumference = πr
- Time taken (t) = $\frac{\text{Distance}}{\text{Speed}} = \frac{\pi r}{v}$
- Magnitude of average velocity (v_{avg}) = $\frac{\text{Total Displacement}}{\text{Total Time}}$

Step 3: Detailed Explanation:

Let the body start from point A on the circular path and reach the diametrically opposite point B after half a revolution.

The direct straight-line distance from A to B is equal to the diameter of the circle:

$$\text{Displacement} = 2r$$

The path distance traveled along the semi-circle is:

$$\text{Distance} = \pi r$$

Given that the body moves with a constant speed v, the time interval t to cover this distance is:

$$t = \frac{\pi r}{v}$$

Now, substituting the values of displacement and time into the average velocity formula:

$$v_{\text{avg}} = \frac{2r}{t}$$

$$v_{\text{avg}} = \frac{2r}{\left(\frac{\pi r}{v}\right)}$$

Simplifying the expression by cancelling out r:

$$v_{\text{avg}} = \frac{2v}{\pi}$$

Step 4: Final Answer:

The magnitude of the average velocity after half a revolution is $\frac{2v}{\pi}$.

Quick Tip: Always remember the difference between speed and velocity. For half a revolution, the average speed is v, but the average velocity is lower ($\approx 0.637v$) because displacement is shorter than the actual curved path distance traveled.

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2. Which of the following is the most electronegative element?

(A) Fluorine

(B) Chlorine

(C) Oxygen

(D) Nitrogen

Correct Answer: (A) Fluorine

Solution:

Step 1: Understanding the Concept:

Electronegativity is the chemical property that describes the tendency of an atom to attract a shared pair of electrons towards itself within a covalent bond.

Step 2: Key Formula or Approach:

Electronegativity shows periodic trends across the periodic table:

- It increases from left to right across a period due to an increase in nuclear charge and a decrease in atomic size.
- It decreases down a group due to an increase in atomic radius and electron shielding.

Step 3: Detailed Explanation:

Let us look at the positions of the given elements in the periodic table:

- Nitrogen (N), Oxygen (O), and Fluorine (F) belong to Period 2.
- Chlorine (Cl) belongs to Period 3, positioned directly below Fluorine in Group 17.

Moving across Period 2 from left to right: Electronegativity increases in the order N < O < F.

Moving down Group 17: Electronegativity decreases from Fluorine to Chlorine (Cl < F.

On the Pauling scale, Fluorine has the highest assigned value of 4.0, followed by Oxygen at 3.5, Nitrogen at 3.0, and Chlorine at 3.0.

Therefore, Fluorine is the most electronegative element in the entire periodic table.

Step 4: Final Answer:

The most electronegative element is Fluorine.

Quick Tip: Remember the mnemonic "FONCl" (Fluorine > Oxygen > Nitrogen ≈ Chlorine) to instantly recall the order of the most electronegative elements in chemistry.

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3. If α and β are the roots of $x^2 - 5x + 6 = 0$, the value of $\alpha^2 + \beta^2$ is:

(A) 13

(B) 25

(C) 10

(D) 15

Correct Answer: (A) 13

Solution:

Step 1: Understanding the Concept:

For a standard quadratic equation, there are fundamental relationships between the coefficients of the equation and its roots, known as Vieta's relations.

Step 2: Key Formula or Approach:

For a quadratic equation $ax^2 + bx + c = 0$ having roots α and β:

- Sum of roots: $\alpha + \beta = -\frac{b}{a}$
- Product of roots: $\alpha\beta = \frac{c}{a}$

An algebraic identity can be used to find the sum of squares of the roots:

$$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$$

Step 3: Detailed Explanation:

Given the quadratic equation:

$$x^2 - 5x + 6 = 0$$

Comparing this with the general form $ax^2 + bx + c = 0$, we identify:

$$a = 1, \quad b = -5, \quad c = 6$$

Using Vieta's relations, calculate the sum and product of the roots:

$$\alpha + \beta = -\frac{-5}{1} = 5$$

$$\alpha\beta = \frac{6}{1} = 6$$

Now, substitute these expressions into the algebraic identity for $\alpha^2 + \beta^2$:

$$\alpha^2 + \beta^2 = (5)^2 - 2(6)$$

$$\alpha^2 + \beta^2 = 25 - 12$$

$$\alpha^2 + \beta^2 = 13$$

Step 4: Final Answer:

The value of $\alpha^2 + \beta^2$ is 13.

Quick Tip: Alternatively, you can factorize this specific equation easily: $x^2 - 5x + 6 = (x-2)(x-3) = 0$. The roots are clearly $\alpha = 2$ and $\beta = 3$. Thus, $\alpha^2 + \beta^2 = 2^2 + 3^2 = 4 + 9 = 13$.

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4. The focal length of a concave mirror is 20 cm. The distance at which an object should be placed to get a real image of same size is:

(A) 10 cm

(B) 20 cm

(C) 40 cm

(D) 30 cm

Correct Answer: (C) 40 cm

Solution:

Step 1: Understanding the Concept:

For a concave mirror, the nature, size, and position of the image formed depend completely on the position of the object relative to the focus (F) and the center of curvature (C).

To obtain a real, inverted image that is exactly the same size as the object, the object must be positioned precisely at the center of curvature (C).

Step 2: Key Formula or Approach:

The distance of the center of curvature from the pole of the mirror is known as the radius of curvature (R).

The relationship connecting the radius of curvature (R) and the focal length (f) of a spherical mirror is:

$$R = 2f$$

Step 3: Detailed Explanation:

Given parameters from the question:

- Focal length of the concave mirror, $f = 20$ cm

Since a real image of the same size is formed only when the object is at the center of curvature:

$$\text{Object distance } (u) = \text{Radius of curvature } (R)$$

Using the relation between R and f:

$$R = 2 \times 20 \text{ cm}$$

$$R = 40 \text{ cm}$$

Therefore, the object should be placed at a distance of 40 cm in front of the concave mirror.

Step 4: Final Answer:

The distance at which the object should be placed is 40 cm.

Quick Tip: When an object is placed at C ($2f$), the image is also formed at C, is real, inverted, and has a magnification of exactly -1 (same size).

5. What is the common name of CH_3COOH?

(A) Acetic acid

(B) Formic acid

(C) Oxalic acid

(D) Citric acid

Correct Answer: (A) Acetic acid

Solution:

Step 1: Understanding the Concept:

Organic chemical compounds are designated by both their systematic IUPAC names and historical traditional names, known as common names.

Step 2: Key Formula or Approach:

Match the given chemical formula CH_3COOH with its respective common commercial or natural naming convention.

Step 3: Detailed Explanation:

The compound CH_3COOH contains a two-carbon chain with a carboxylic acid functional group, making its systematic IUPAC name ethanoic acid.

Historically, this acid was isolated from vinegar.

The Latin word for vinegar is acetum, from which the common name "acetic acid" is derived.

Let us review the names of the other choices for context:

- Formic acid is HCOOH (found in ant stings).
- Oxalic acid is $H_2C_2O_4$.
- Citric acid is $C_6H_8O_7$.

Therefore, the common name for CH_3COOH is acetic acid.

Step 4: Final Answer:

The common name of CH_3COOH is Acetic acid.

Quick Tip: A 5% – 8% aqueous solution of acetic acid is commercially sold and used in households under the common name vinegar.

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6. The value of $\sin^2 30^\circ + \cos^2 30^\circ$ is:

(A) 1

(B) 0

(C) 0.5

(D) $\sqrt{3}$

Correct Answer: (A) 1

Solution:

Step 1: Understanding the Concept:

This problem can be verified by substituting standard trigonometric values or resolved directly by applying basic trigonometric identities.

Step 2: Key Formula or Approach:

According to the fundamental Pythagorean trigonometric identity, for any given angle θ:

$$\sin^2 \theta + \cos^2 \theta = 1$$

Step 3: Detailed Explanation:

Method 1: Using the identity

Let the angle be $\theta = 30^\circ$.

Applying the fundamental identity:

$$\sin^2 30^\circ + \cos^2 30^\circ = 1$$

Method 2: Using standard values

We know the exact values from trigonometric tables:

$$\sin 30^\circ = \frac{1}{2}$$

$$\cos 30^\circ = \frac{\sqrt{3}}{2}$$

Squaring and adding these values together:

$$\sin^2 30^\circ + \cos^2 30^\circ = \left(\frac{1}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2$$

$$\sin^2 30^\circ + \cos^2 30^\circ = \frac{1}{4} + \frac{3}{4}$$

$$\sin^2 30^\circ + \cos^2 30^\circ = \frac{4}{4} = 1$$

Both methods verify that the expression evaluates exactly to 1.

Step 4: Final Answer:

The value of $\sin^2 30^\circ + \cos^2 30^\circ$ is 1.

Quick Tip: The expression $\sin^2 \theta + \cos^2 \theta$ is always equal to 1 for any real angle θ. You do not need to calculate individual squares if the angles match perfectly!

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7. A current of 5 A flows through a wire for 10 minutes. The total charge passed is:

(A) 500 C

(B) 50 C

(C) 300 C

(D) 3000 C

Correct Answer: (D) 3000 C

Solution:

Step 1: Understanding the Concept:

Electric current is defined as the rate of flow of electric charge through a cross-section of a conductor over a specific time interval.

Step 2: Key Formula or Approach:

The fundamental relationship between charge, current, and time is given by the formula:

$$Q = I \times t$$

where:

- Q is the electric charge measured in Coulombs (C)
- I is the electric current measured in Amperes (A)
- t is the time interval measured in seconds (s)

Step 3: Detailed Explanation:

Given parameters from the problem:

- Current, $I = 5$ A
- Time, $t = 10$ minutes

Before substituting these values into our formula, the time must be converted from minutes into its standard SI unit, which is seconds:

$$t = 10 \times 60 \text{ seconds}$$

$$t = 600 \text{ seconds}$$

Now, apply the values to the charge formula:

$$Q = 5 \text{ A} \times 600 \text{ s}$$

$$Q = 3000 \text{ C}$$

Thus, the total electric charge that passed through the wire is 3000 C.

Step 4: Final Answer:

The total charge passed is 3000 C.

Quick Tip: Always double-check your units! In physics calculations, time must almost always be converted to standard seconds (s) rather than minutes or hours to get the correct answer in Coulombs (C).

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8. Which gas is liberated when an acid reacts with a metal?

(A) Hydrogen

(B) Oxygen

(C) Carbon dioxide

(D) Nitrogen

Correct Answer: (A) Hydrogen

Solution:

Step 1: Understanding the Concept:

Metals positioned above hydrogen in the reactivity series react with dilute mineral acids to undergo a single displacement reaction.

Step 2: Key Formula or Approach:

The general chemical word equation representing this reaction is:

$$\text{Metal} + \text{Dilute Acid} \rightarrow \text{Metal Salt} + \text{Hydrogen Gas} \uparrow$$

Step 3: Detailed Explanation:

When an active metal (such as Zinc, Magnesium, or Iron) comes into contact with a dilute acid (such as Hydrochloric acid or Sulfuric acid), the metal displaces hydrogen ions from the acid solution.

For example, let us look at the reaction between Zinc (Zn) and dilute Hydrochloric acid (HCl):

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g) \uparrow$$

The liberated gas forms bubbles in the solution and escapes as elemental hydrogen gas (H_2). This gas can be confirmed experimentally because it burns with a distinctive, sharp "pop" sound when a burning splinter is brought near it.

Step 4: Final Answer:

The gas liberated when an acid reacts with a metal is Hydrogen.

Quick Tip: To test for the identity of the gas: - Hydrogen gas (H_2) burns with a distinctive "pop" sound. - Carbon dioxide (CO_2) extinguishes a flame and turns lime water milky.

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9. The sum of the first 10 terms of an AP with $a = 2$ and $d = 3$ is:

(A) 155

(B) 145

(C) 165

(D) 150

Correct Answer: (A) 155

Solution:

Step 1: Understanding the Concept:

An Arithmetic Progression (AP) is a numerical sequence where the difference between any two consecutive terms remains constant.

The total value of a specific number of terms added together can be found directly using the standard summation formula for an AP.

Step 2: Key Formula or Approach:

The formula to compute the sum of the first n terms (S_n) of an AP is:

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

where:

- n is the total number of terms to sum
- a is the first term of the progression
- d is the common difference between consecutive terms

Step 3: Detailed Explanation:

Given parameters from the question:

- First term, $a = 2$
- Common difference, $d = 3$
- Number of terms to calculate, $n = 10$

Substitute these values directly into the arithmetic series summation formula:

$$S_{10} = \frac{10}{2}[2(2) + (10-1)3]$$

Simplify the multiplier outside the bracket:

$$S_{10} = 5[4 + (9 \times 3)]$$

Calculate the products inside the brackets:

$$S_{10} = 5[4 + 27]$$

Add the values within the bracket:

$$S_{10} = 5[31]$$

Multiply the final terms together:

$$S_{10} = 155$$

Step 4: Final Answer:

The sum of the first 10 terms of the given AP is 155.

Quick Tip: An alternative formula for the sum is $S_n = \frac{n}{2}(a + l)$, where l is the last term. Here, the 10th term is $a_{10} = a + 9d = 2 + 9(3) = 29$. Using the formula: $S_{10} = \frac{10}{2}(2 + 29) = 5 \times 31 = 155$.

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10. An object of 10 kg at a height of 5 m has potential energy ($g = 9.8$ m/s²):

(A) 49 J

(B) 500 J

(C) 490 J

(D) 980 J

Correct Answer: (C) 490 J

Solution:

Step 1: Understanding the Concept:

Gravitational potential energy is the energy possessed by an object due to its position or height relative to a reference level (usually the ground).

Step 2: Key Formula or Approach:

The mathematical formula to calculate gravitational potential energy (U) is:

$$U = m \cdot g \cdot h$$

where:

- m is the mass of the object in kilograms (kg)
- g is the acceleration due to gravity in meters per second squared (m/s^2)
- h is the height above the reference ground level in meters (m)

Step 3: Detailed Explanation:

Given values from the question:

- Mass, $m = 10$ kg
- Height, $h = 5$ m
- Acceleration due to gravity, $g = 9.8$ m/s^2

Substitute these values directly into the potential energy formula:

$$U = 10 \times 9.8 \times 5$$

Rearranging the multiplication to make it simpler:

$$U = (10 \times 5) \times 9.8$$

$$U = 50 \times 9.8$$

$$U = 490 \text{ Joules (J)}$$

Therefore, the gravitational potential energy of the object is 490 J.

Step 4: Final Answer:

The potential energy of the object is 490 J.

Quick Tip: To multiply 50×9.8 quickly without a calculator, think of it as 5×98. Since $5 \times 100 = 500$, subtracting $5 \times 2 = 10$ instantly gives you 490.

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11. Which of these is a saturated hydrocarbon?

(A) Ethane

(B) Ethene

(C) Ethyne

(D) Benzene

Correct Answer: (A) Ethane

Solution:

Step 1: Understanding the Concept:

Hydrocarbons are organic chemical compounds composed entirely of carbon and hydrogen

atoms.
They are classified as saturated if all carbon-carbon bonds are single covalent bonds, allowing the maximum possible number of hydrogen atoms to bind to the carbon backbone.

Step 2: Key Formula or Approach:
Saturated hydrocarbons are known as alkanes and follow the general molecular formula:

$$C_nH_{2n+2}$$

Unsaturated hydrocarbons contain at least one double carbon bond (C = C, alkenes), a triple bond (C ≡ C, alkynes), or an aromatic ring system (arenes).

Step 3: Detailed Explanation:
Let us analyze each of the choices given:
- Ethane (C_2H_6): This fits the C_nH_{2n+2} formula perfectly for $n = 2$. It contains only a single covalent bond between the two carbon atoms (CH_3-CH_3), making it a saturated hydrocarbon.
- Ethene (C_2H_4): An alkene containing a double covalent bond ($CH_2 = CH_2$), hence it is unsaturated.
- Ethyne (C_2H_2): An alkyne containing a triple covalent bond (CH ≡ CH), hence it is unsaturated.
- Benzene (C_6H_6): An aromatic cyclic hydrocarbon with delocalized pi electrons, hence it is unsaturated.

Step 4: Final Answer:
The saturated hydrocarbon among the options is Ethane.

Quick Tip: Look closely at the suffixes of the names: - -ane (Alkane) → Saturated single bonds. - -ene (Alkene) → Unsaturated double bond. - -yne (Alkyne) → Unsaturated triple bond.

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12. If the radius of a circle is doubled, its area becomes:

(A) Four times

(B) Double

(C) Eight times

(D) Remains same

Correct Answer: (A) Four times

Solution:

Step 1: Understanding the Concept:

The area of a circle depends non-linearly on its radius. Because the radius term is squared in the mathematical relationship, any scalar modification to the radius results in a squared scaling effect on the total area.

Step 2: Key Formula or Approach:

The classic geometric formula for computing the area (A) of a circle with radius r is:

$$A = \pi r^2$$

Step 3: Detailed Explanation:

Let the initial radius of the circle be r_1.

The initial area of this circle is:

$$A_1 = \pi r_1^2$$

According to the question, the radius is doubled. Therefore, the new radius r_2 is:

$$r_2 = 2r_1$$

Now, substitute this new radius value into the area formula to find the new area A_2:

$$A_2 = \pi(r_2)^2$$

$$A_2 = \pi(2r_1)^2$$

Evaluating the square of the term inside the parenthesis:

$$A_2 = \pi(4r_1^2)$$

$$A_2 = 4(\pi r_1^2)$$

Substituting A_1 back into the expression:

$$A_2 = 4A_1$$

This explicitly demonstrates that the final area becomes exactly four times the original area.

Step 4: Final Answer:

If the radius of a circle is doubled, its area becomes Four times.

Quick Tip: Since area scales with the square of the linear dimensions (Scale factor^2), scaling the radius by a factor of k scales the area by k^2. Here, $k = 2$, so the area increases by $2^2 = 4$ times.

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13. The SI unit of power is:

(A) Watt

(B) Joule

(C) Newton

(D) Pascal

Correct Answer: (A) Watt

Solution:

Step 1: Understanding the Concept:

Power is a physical quantity defined as the rate at which work is done or energy is transferred per unit time.

Step 2: Key Formula or Approach:

The basic formula for power (P) is:

$$P = \frac{W}{t}$$

where:

- W is work done measured in Joules (J)
- t is time taken measured in seconds (s)

Step 3: Detailed Explanation:

From the definition formula, the unit of power can be expressed as:

$$\text{Unit of Power} = \frac{\text{Joule}}{\text{Second}} = \text{J/s}$$

In honor of the Scottish inventor James Watt, this combined unit J/s is named the Watt (W) in the International System of Units (SI).

Let us review the other options for clarity:

- Joule (J) is the SI unit of work and energy.
- Newton (N) is the SI unit of force.
- Pascal (Pa) is the SI unit of pressure.

Step 4: Final Answer:

The SI unit of power is Watt.

Quick Tip: Remember that 1 Watt = 1 Joule per second. Larger commercial and industrial units include kilowatts (1 kW = 10^3 W) and horsepower (1 hp = 746 W).

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14. Which non-metal is liquid at room temperature?

(A) Mercury

(B) Bromine

(C) Iodine

(D) Carbon

Correct Answer: (B) Bromine

Solution:

Step 1: Understanding the Concept:

Most elements on the periodic table exist as solids or gases at standard room temperature and pressure (25°C and 1 atm). Only a couple of elements exist naturally in the liquid state under these typical conditions.

Step 2: Key Formula or Approach:

Distinguish clearly between the physical states of elements at room temperature and categorize them correctly as metals or non-metals.

Step 3: Detailed Explanation:

Let us examine the elements given in the choices:

- Mercury (Hg): This is a element that exists as a liquid at room temperature, but it is chemically classified as a metal.

- Bromine (Br): This is a halogen belonging to Group 17. It exists as a dark reddish-brown liquid at room temperature and is chemically classified as a non-metal.
- Iodine (I): This is a non-metal that exists as a shiny, dark grey/purple crystalline solid at room temperature.
- Carbon (C): This is a non-metal that exists as a solid at room temperature (in forms like graphite or diamond).
Since the question specifically demands a non-metal that is liquid at room temperature, Bromine is the correct choice.

Step 4: Final Answer:
The non-metal that is liquid at room temperature is Bromine.

Quick Tip: Be very careful with the wording of this common question! - Liquid metal at room temperature → Mercury (Hg) - Liquid non-metal at room temperature → Bromine (Br)

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15. Probability of getting a number > 4 on a fair die is:

(A) $\frac{1}{2}$
(B) $\frac{1}{3}$
(C) $\frac{1}{6}$
(D) $\frac{2}{3}$

Correct Answer: (B) $\frac{1}{3}$

Solution:
Step 1: Understanding the Concept:
The theoretical probability of a particular event occurring is calculated as the ratio of the number of favorable outcomes to the total number of equally likely outcomes in the sample space.

Step 2: Key Formula or Approach:

The formula for the probability of an event E is given by:

$$P(E) = \frac{n(E)}{n(S)}$$

where:

- $n(E)$ is the number of favorable outcomes.
- $n(S)$ is the total number of outcomes in the sample space.

Step 3: Detailed Explanation:

When a single fair six-sided die is rolled, the complete sample space S containing all possible numerical outcomes is:

$$S = \{1, 2, 3, 4, 5, 6\}$$

Therefore, the total count of possible outcomes is:

$$n(S) = 6$$

The event E is defined as rolling a number strictly greater than 4 (> 4).

Looking closely at the sample space, the numbers that satisfy this strict condition are 5 and 6 (note that 4 itself is not included since the condition is strictly greater than).

$$E = \{5, 6\}$$

Therefore, the number of favorable outcomes is:

$$n(E) = 2$$

Now, substitute these counts into our basic probability formula:

$$P(E) = \frac{2}{6}$$

Reducing the fraction down to its simplest form by dividing both the numerator and denominator by 2:

$$P(E) = \frac{1}{3}$$

Step 4: Final Answer:

The probability of getting a number > 4 on a fair die is $\frac{1}{3}$.

Quick Tip: Always read the inequality symbol carefully. "Greater than 4" (>4) means 5 and 6 (2 outcomes), while "greater than or equal to 4" (≥ 4) would mean 4, 5, and 6 (3 outcomes).
