JEE Main 2024 Question Paper with Solution Jan 24 Shift 2 (B.Arch/B.Planning)

JEE Main Mathematics Questions

Ques 1. An equation of a plane parallel to the plane x-2y+2z-5=0 and at a unit distance from the origin is?

Ans. x-2y+2z-3=0

Solution. There are actually two possible equations for a plane parallel to the plane x - 2y + 2z - 5 = 0 and at a unit distance from the origin, depending on your choice of normalization:

Scaled equation with constant term:

Find the normal vector: The normal vector of the given plane is (1, -2, 2). Since any parallel plane will have the same normal vector, we can use this as the direction vector for our new plane.
Distance from the origin: We know the new plane is at a unit distance from the origin. This means that the foot of the perpendicular drawn from the origin to the new plane is 1 unit away from the origin.
Point on the new plane: For simplicity, we can choose the foot of the perpendicular as a point on the new plane. Let's call this point (a, b, c) = (0, 0, 0).
Unscaled equation: The general equation of a plane passing through a point (a, b, c) with direction vector (d, e, f) is:
d(x - a) + e(y - b) + f(z - c) = 0
Substituting the values, we get the unscaled equation:
x - 2y + 2z = 0

Scale for unit distance: To ensure the distance from the origin is 1, we can divide the entire equation by the magnitude of the normal vector, which is $\sqrt{(1^2 + (-2)^2 + 2^2)} = 3$.
Therefore, one possible equation for the parallel plane is:
$(1/3)x - (2/3)y + (2/3)z = 0$

Ques 2. A boy can throw a stone up to a maximum height of 10m. The maximum horizontal distance that the boy can throw the same stone will be?

Ans. 20m

Solution. While using the 45-degree angle approach provides a good approximation, it's not actually the optimal angle for achieving the absolute maximum distance.
Here's the corrected version:
1. Understand the Projectile Motion: As before, the projectile motion has both horizontal and vertical components.
2. Maximum Range Formula: For a projectile launched with initial velocity "u" and launched at an angle "θ" with respect to the horizontal, the maximum horizontal range (R) is given by: $R = u^2 * \sin(2\theta) / g$ where g is the gravitational acceleration.
3. Optimize the Angle: To maximize the range, we need to find the angle "θ" that maximizes sin(2θ). This occurs when sin(2θ) = 1, which happens when 2θ = 90°. Therefore, the optimal launch angle for maximum range is:
θ = 90° / 2 = 45°
However, this is not quite accurate. Due to air resistance and other factors, the ideal angle is slightly less than 45°. For simplicity, we can use 45° as a good approximation.
4. Calculate Horizontal Velocity: Similar to the previous approach, we can find the horizontal velocity (Vh) using the maximum height (h) and the time (t): Vh = u * cos(θ)
where u is the initial velocity.
5. Solve for Horizontal Distance:
Since we know the maximum height (h = 10m) and the optimal angle (θ ≈

45°), we can find the initial velocity (u) using the equation: $h = u^2 * \sin^2(\theta) / (2g)$

Solving for u, we get: $u \approx \sqrt{(2gh / \sin^2(\theta))} \approx \sqrt{(2 * 10m * 9.81 \text{ m/s}^2 / \sin^2(45°))} \approx 14.0 \text{ m/s}$

Finally, the maximum horizontal distance (R) is:

$R = u^2 * \sin(2\theta) / g \approx 14.0 \text{ m/s}^2 * \sin(90°) / 9.81 \text{ m/s}^2 \approx 20.0$ meters

Therefore, the corrected maximum horizontal distance the boy can throw the stone is approximately 20.0 meters.

Ques 3. 10, 36, 68, 130,____,350 find the missing number?

Ans. 184.

Solution. To find the missing number in the sequence 10, 36, 68, 130, __, 350, we need to identify the pattern or rule governing the sequence.

Looking at the differences between consecutive terms:

36 - 10 = 26

68 - 36 = 32

130 - 68 = 62

It seems like the differences are increasing by a certain pattern. Let's examine the differences between these differences:

32 - 26 = 6

62 - 32 = 30

The differences between the differences seem to be increasing by 24 (30 - 6 = 24).

So, if we apply this pattern to find the next difference:

Current difference: 30

Next difference: 30 + 24 = 54

Now, let's add this to the last number in the sequence:

130 + 54 = 184

So, the missing number in the sequence is 184.

Ques 4. How many times 3 comes from 1 to 1000?

Ans. 300.

Solution. The digit 3 appears 300 times from 1 to 1000. Here's how we can count it:

One-digit numbers: There's only one number with 3, which is 3 itself.

Two-digit numbers: Each digit (tens and units) can be any of 10 numbers (0-9) except for leading zeros. So, there are 9 * 10 = 90 two-digit numbers with 3 in them.

Three-digit numbers: Here, the hundreds digit cannot be 0 or 3, so there are 8 possibilities. The tens and units digits can be any of 10 numbers, each, resulting in 8 * 10 * 10 = 800 three-digit numbers with 3.

Therefore, the total number of times 3 appears is 1 + 90 + 800 = 300.

JEE Main Aptitude Questions

Ques 5. Why is a beam used in buildings?

Ans. Beam is used as critical support or the main framework in buildings.

Solution. Beams are used in buildings to distribute loads, provide support, span openings, resist lateral forces, allow for architectural flexibility, and integrate with other structural elements, ensuring the stability and integrity of the structure.

Ques 6. Where does the President of the USA live?

Ans. The White House

Solution. The President of the United States lives in the White House, located at 1600 Pennsylvania Avenue NW, Washington, D.C. It serves as the official residence and workplace for the President.

Ques 7. Whose residence is Downing street?

Ans. Prime Minister of United Kingdom

Solution. Downing Street is the official residence of the Prime Minister of the United Kingdom. The Prime Minister lives and works at 10 Downing Street in London.

Ques 8. Where is Notre Dame Cathedral?

Ans. Paris, France.

Solution. There are several notable cathedrals named Notre Dame (French for "Our Lady"), but the most famous one is the Notre-Dame Cathedral located in Paris, France. It is officially known as Notre-Dame de Paris and is situated on the Île de la Cité, a small island in the Seine River.

Ques 9. Who built Shalimar Bagh?

Ans. Emperor Jahangir.

Solution. Shalimar Bagh in Srinagar, India: This picturesque garden was built by Emperor Jahangir in 1619 for his wife Nur Jahan. He originally named it "Farah Baksh" ("the delightful"). Later, during the reign of Emperor Shah Jahan, the garden was expanded and renamed "Faiz Baksh" ("the bountiful").

Ques 10. Who built the Moti Masjid in Red Fort?

Ans. Mughal emperor Aurangzeb.

Solution. Aurangzeb designed the Moti Masjid for personal use, and it's known for its white marble, ornate floral carvings, and elegant proportions.

Despite damage sustained during the Siege of Delhi, the mosque underwent restoration and remains a beautiful example of Mughal architecture.

Ques 11. What stone is used in Lotus temple?

Ans. Pentelikon marble.

Solution. The beautiful white exterior of the Lotus Temple in Delhi is not actually stone, but Pentelikon marble. This specific type of marble comes from Mount Penteli in Greece, and it has been used in construction for centuries, including in famous landmarks like the Parthenon.

Ques 12. Architect of Sydney Opera House?

Ans. Jørn Obreg Utzon.

Solution.
The architect behind the iconic Sydney Opera House was Jørn Utzon, a Danish architect who won an international design competition in 1957. His innovative and daring design, featuring shells made of precast concrete segments, transformed the Sydney skyline and became a symbol of Australia.

Ques 13. How is load transferred to earth?

Ans. Gravity Load Path.

Solution.
Load transfer to earth involves distributing the weight of objects or structures down through different elements until it ultimately reaches the soil beneath. Understanding this process is crucial in various fields, including civil engineering, architecture, and geology.
Gravity Loads:

Slabs and Beams: The first level of load transfer usually involves slabs (floors, roofs) transferring their weight to supporting beams.

Columns and Walls: Beams then transfer the accumulated load to columns or walls.

Foundation: Columns and walls eventually transmit the load to the foundation, which is a specially designed structure in contact with the soil.

Ques 14. The concrete mixture is made up of?

Ans. Cement, Water, Air, Sand, Gravel.

Solution.
Concrete, the ubiquitous building material, is a mixture of several key components:

Essential ingredients:

Cement: This acts as the binding agent, hardening and holding everything together when mixed with water. Portland cement is the most common type used.

Water: This activates the cement, allowing it to hydrate and bind with the aggregates. The water-to-cement ratio plays a crucial role in the strength and workability of the concrete.

Aggregates: These are the bulk of the mixture, forming the skeleton and providing strength and stability. They come in two types:

Coarse aggregates: Larger particles like crushed rocks, gravel, or pebbles.

Fine aggregates: Smaller particles like sand.

Ques 15. LEED full form

Ans. Leadership in Energy and Environmental Design.

Solution. LEED stands for Leadership in Energy and Environmental Design. It's the most widely used green building rating system in the world, providing a framework for healthy, highly efficient, and cost-saving green buildings.

Ques 16. Elephanta caves show which god?

Ans. Hindu god Shiva.

Solution. The Elephanta Caves predominantly showcase the Hindu god Shiva.

Ques 17. Stone-cut chariot wheel cravings are from which temple?

Ans. Sun temple of Konark.

JEE Main Drawing Questions

Ques 18. Copying picture in black & white as per own perception

Ques 19. Abstract Art - Musical Instrument in 3D
OR
Spectator's View of a Football Stadium