Sketching a Mechanical Gear Train: Tooth Profiles and Shaft Alignment

Original tasks 1, 2, 3 / complete keys

Task 1

A two-gear train has N1 = 12 and N2 = 18 teeth with p = 4 mm. Compute both pitch diameters and the center distance, then describe where the mesh point lies.

Answer: D1 ≈ 15.3 mm, D2 ≈ 22.9 mm, C ≈ 19.1 mm. The mesh point is where the two pitch circles touch, halfway between the shaft centers on the common centerline.

Reason: Use D = N × p / π and C = (D1 + D2) / 2. Rounding to one decimal place keeps the sketch checkable.

Check: Recompute C from the rounded diameters: (15.3 + 22.9) / 2 = 19.1 mm. Confirm the pitch circles touch at one point.

Task 2

For a gear with 20 teeth, state the angular pitch and the angle between every second tooth. Explain how this controls tooth spacing.

Answer: Angular pitch = 360° / 20 = 18°. Every second tooth is 36° apart. Teeth are drawn at 18° intervals around the pitch circle.

Reason: Even spacing means dividing the full circle by the tooth count; multiples of that angle locate later teeth.

Check: Multiply 18° by 20 to get 360°. Check that the last tooth returns to the starting radial line.

Task 3

A three-gear train has pitch diameters 20 mm, 30 mm, and 40 mm in order. Compute the two center distances and describe the shaft centerline.

Answer: First center distance = (20 + 30) / 2 = 25 mm; second = (30 + 40) / 2 = 35 mm. All three shaft centers lie on one horizontal centerline, with mesh points between adjacent pitch circles.

Reason: Each adjacent pair uses the same center-distance formula; parallel shafts share one straight centerline.

Check: Add the two center distances to get the outer-center span: 25 + 35 = 60 mm. Confirm this equals half the sum of the outer diameters plus the middle diameter: (20 + 40) / 2 + 30 = 60 mm.

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Original tasks 4 / complete keys

Task 4

A gear has pitch radius 12 mm, p = 4 mm, addendum multiplier 0.8, and dedendum multiplier 1.0. Compute the addendum and dedendum radii and state the tooth-height range.

Answer: Addendum radius = 12 + 0.8 × 4 = 15.2 mm; dedendum radius = 12 − 1.0 × 4 = 8 mm. Tooth height runs from 8 mm to 15.2 mm radially, a total of 7.2 mm.

Reason: Apply the stated multipliers to the pitch spacing and add or subtract from the pitch radius.

Check: Subtract the dedendum radius from the addendum radius: 15.2 − 8 = 7.2 mm. Confirm both circles are concentric with the pitch circle.

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Source rubric / reflection

- [ ] Pitch circles are drawn and tangent at each mesh point.
- [ ] Center distance equals half the sum of the two pitch diameters, in consistent units.
- [ ] Tooth profiles stay within the stated addendum and dedendum circles.
- [ ] Teeth are spaced at 360° divided by the tooth count.
- [ ] At each mesh, tooth patterns are offset by half an angular pitch.
- [ ] All parallel shaft centers lie on one straight centerline.
- [ ] Labels use consistent units and legible lettering with x-height from baseline to midline.
- [ ] A tooth-profile close-up labels pitch, addendum, and dedendum lines.

Reflection: What did you check, what did you change, and what will you try next?