How do you see it?

Following this page you will see 10 sketches of 3D objects. Think of the sketches as 2D pictures of 3D wire sculptures; the 2D strokes on paper suggest a network of intersecting 3D curves or wires that lie on the surface of a 3D object. Curves occluded by the suggested 3D object have a faded appearance. Part of a 2D stroke bounded on either side by intersecting strokes is called a stroke-segment and its perceived 3D interpretation, a curve-segment. A number of smoothly connected curve-segments form a 3D curve. Some of the sketches show only half of a vertically symmetric 3D object.

Study each sketch, imagine the 3D object it represents and answer Yes questions about the following 5 properties of your imagined 3D curves. Remember there is no right or wrong answer but the answer depends entirely on how you imagine what you see in 3D:

1. **Is the 3D curve that you imagine a straight line?**

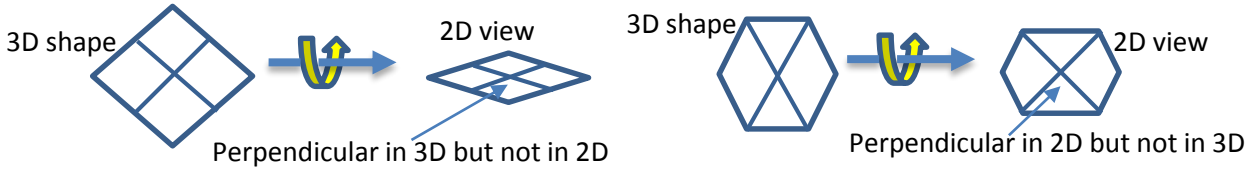
   Remember that a straight 2D stroke could be an imagined 3D curve, that just happens to viewed edge-on as shown below. i.e. it is possible that you imagine the seemingly straight horizontal strokes (left) as curved in 3D, revealed by rotating the view (right).

2. **Is the 3D curve that you imagine planar?**

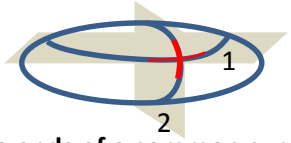
   Is there some 3D plane which completely contains the 3D curve you imagine. If you imagine the closed curve below in 3D as a speed bump on a road (left) it is not planar; if you however imagine it as a bend in a river (right) it is planar. Other examples of planar curves are in the picture for #4.

3. **Do the 3D curves you imagine intersect each other perpendicularly?**

   Remember that lines or curves intersecting each other in 3D at 90^0 as on the square (left) might not appear so in a 2D view like the rotated view on the where it has a diamond shape. Also lines or curves that do not intersect at 90^0 like in the hexagon (right) can seem at 90^0 in a 2D view.

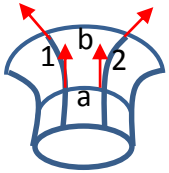


4. **Does the 3D curve you imagine define a local (small region around the intersection) plane of symmetry for its intersecting 3D curve?**



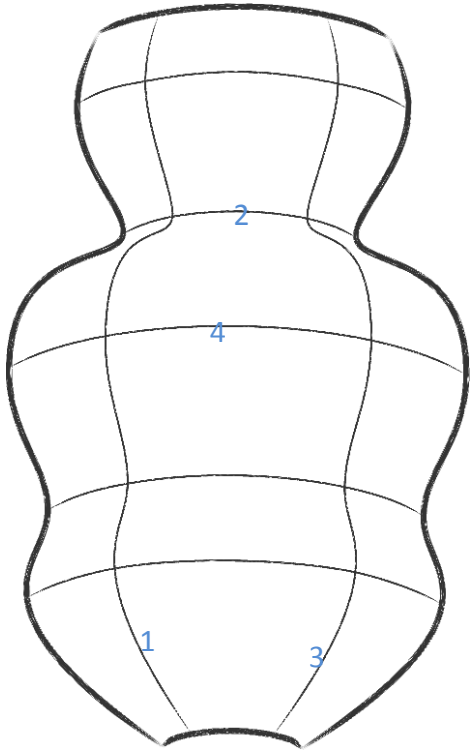
curve 2 defines a plane of symmetry for curve 1 but not vice versa.
(some local part of the curve near the intersection shown in red).

5. **Do the pair of curves adjacent to the two ends of a common curve-segment, imagined in 3D, emanate in a direction parallel to each other?**



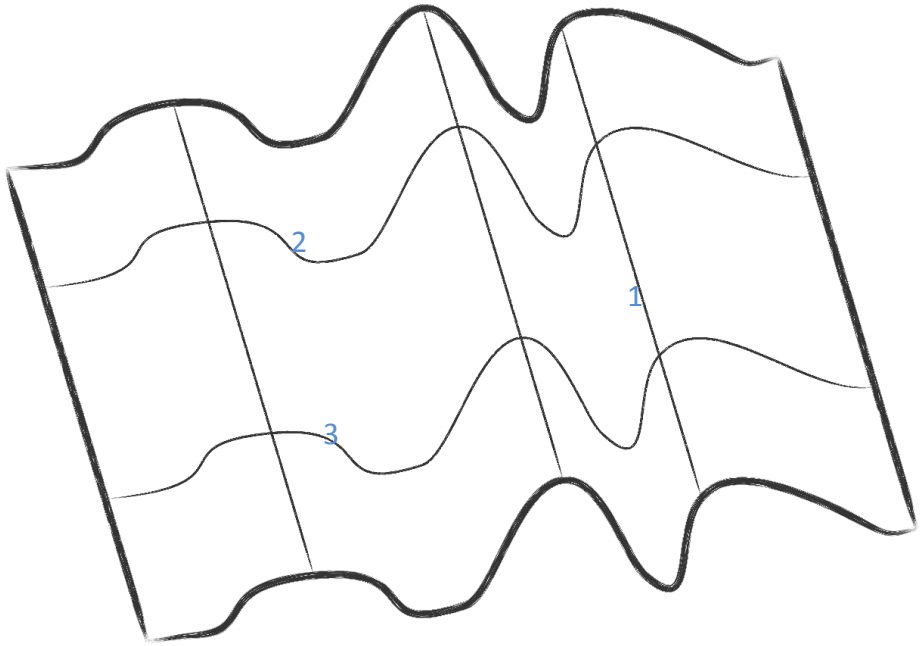
curves 1 and 2 are a pair adjacent to curve-segment a and b.
If you imagine a funnel shape in 3D curves 1 and 2 emanate parallel to each other from segment a, but not from b.

Model #1



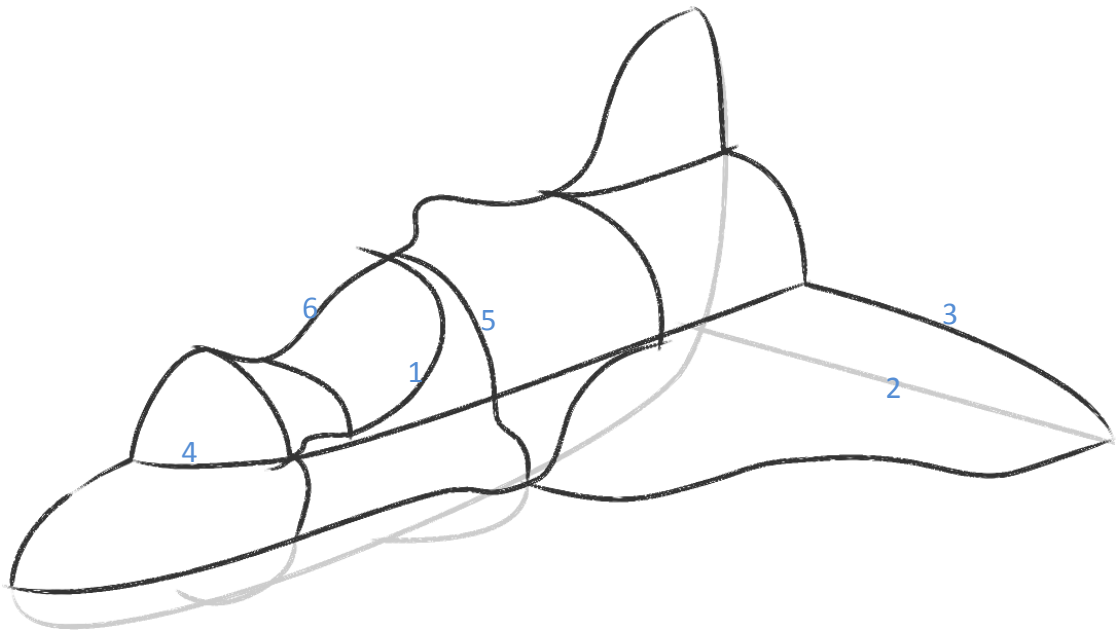
1. curve 2 imagined in 3D is a straight line. (Yes☐)
2. curve 3 imagined in 3D is planar. (Yes ☐)
3. curve 1 and 2 imagined in 3D intersect each other perpendicularly. (Yes☐)
4. curve 1 imagined in 3D defines a plane of local symmetry for curve 4. (Yes☐)
5. curves 2, 4 imagined in 3D emanate parallel from their intersection with curve 3. (Yes ☐)

Model #2



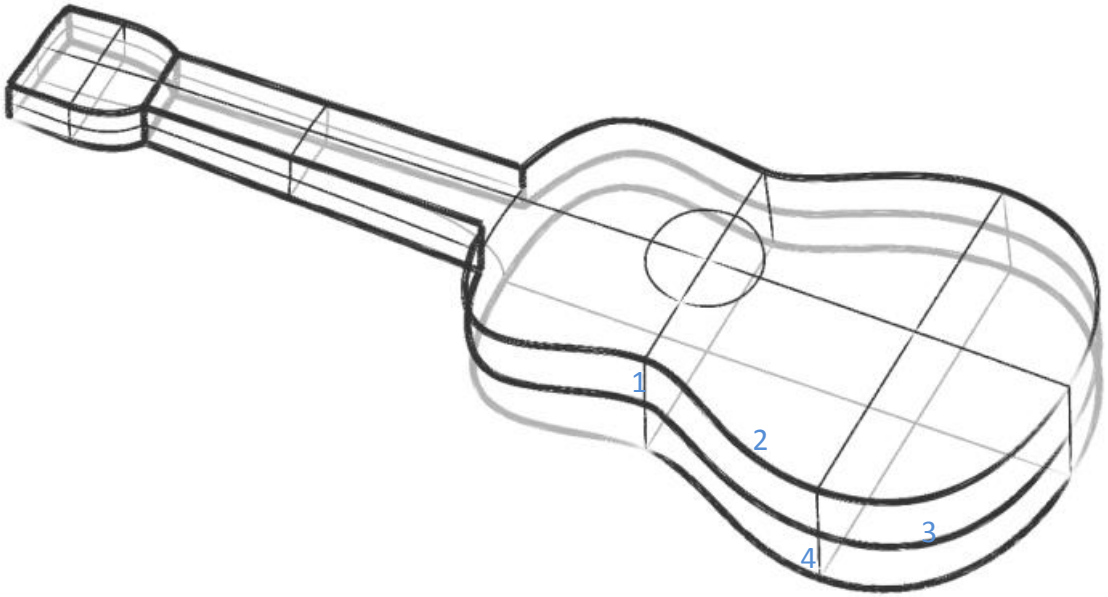
1. curve 1 imagined in 3D is a straight line. (Yes ☐)
2. curve 2 imagined in 3D is a straight line. (Yes ☐)
3. curve 2 imagined in 3D is planar. (Yes ☐)
4. curve 1 and 2 imagined in 3D intersect each other perpendicularly. (Yes ☐)
5. curves 2, 3 imagined in 3D emanate parallel from their intersection with curve 1. (Yes ☐)

Model #3



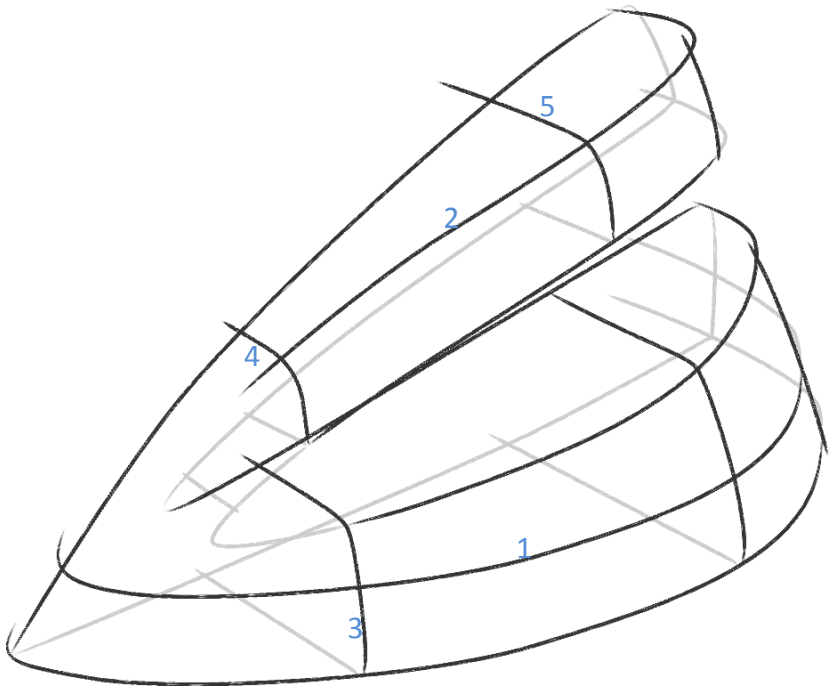
1. curve 1 imagined in 3D is planar. (Yes ☐)
2. curve 2 imagined in 3D is a straight line. (Yes ☐)
3. curve 3 imagined in 3D is a straight line. (Yes ☐)
4. curve 1 and 4 imagined in 3D intersect each other perpendicularly. (Yes ☐)
5. curves 1, 5 imagined in 3D emanate parallel from their intersection with curve 6. (Yes ☐)

Model #4



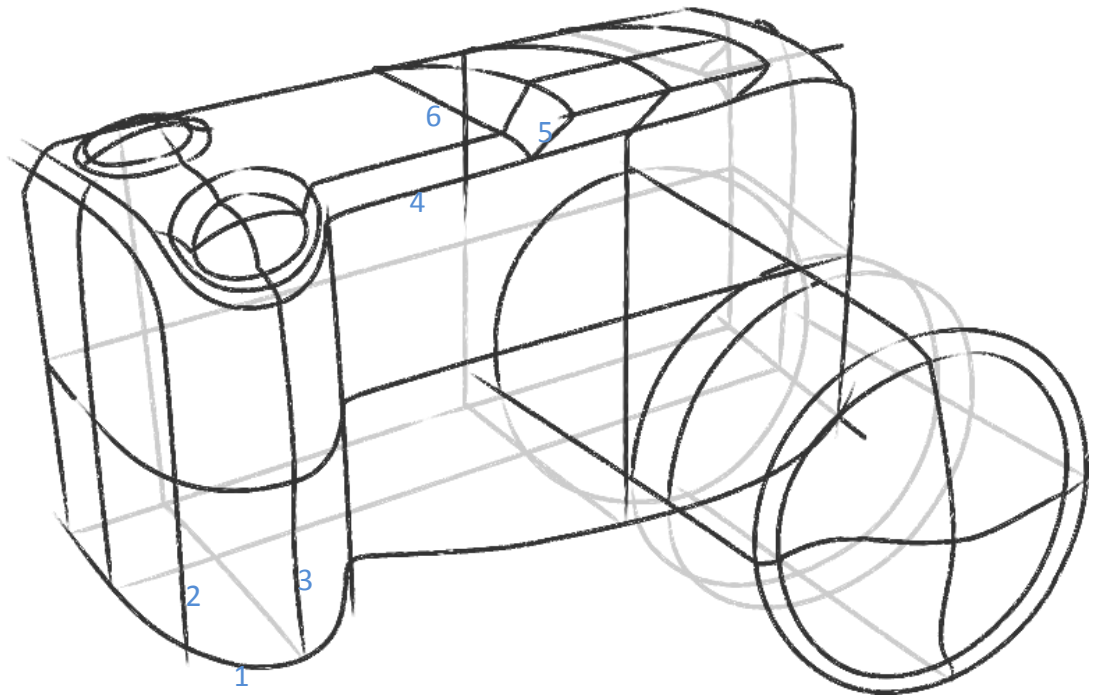
1. curve 1 imagined in 3D is a straight line. (Yes ☐)
2. curve 1 and 2 imagined in 3D intersect each other perpendicularly. (Yes ☐)
3. curve 3 and 4 imagined in 3D intersect each other perpendicularly. (Yes ☐)
4. curve 3 imagined in 3D defines a plane of local symmetry for curve 4. (Yes ☐)
5. curve 1 imagined in 3D defines a plane of local symmetry for curve 3. (Yes ☐)

Model #5



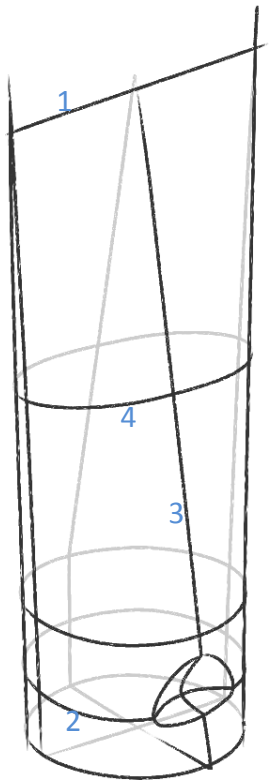
1. curve 2 imagined in 3D is planar. (Yes ☐)
2. curve-segment marked 2 imagined in 3D is a straight line. (Yes ☐)
3. curve 1 imagined in 3D defines a plane of local symmetry for curve 3. (Yes ☐)
4. curve 3 imagined in 3D defines a plane of local symmetry for curve 1. (Yes ☐)
5. curves 4, 5 imagined in 3D emanate parallel from their intersection with curve 2. (Yes ☐)

Model #6



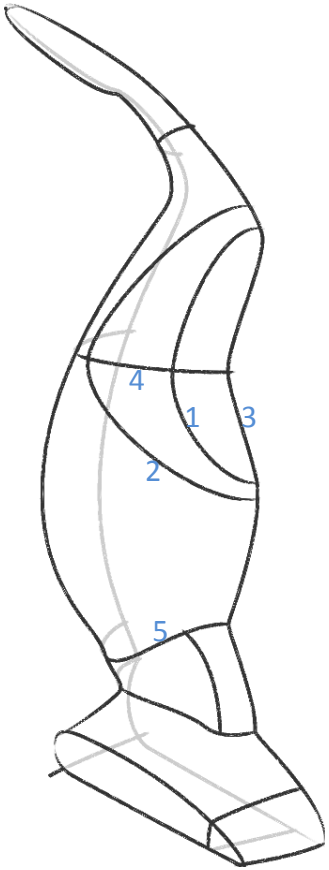
1. curve-segment marked 3 imagined in 3D is a straight line. (Yes☐)
2. curves 2, 3 imagined in 3D emanate parallel from their intersection with curve 1. (Yes☐)
3. curve 4 and 5 imagined in 3D intersect each other perpendicularly. (Yes☐)
4. curve 4 and 6 imagined in 3D intersect each other perpendicularly. (Yes☐)
5. curve 5 and 6 imagined in 3D intersect each other perpendicularly. (Yes☐)

Model #7



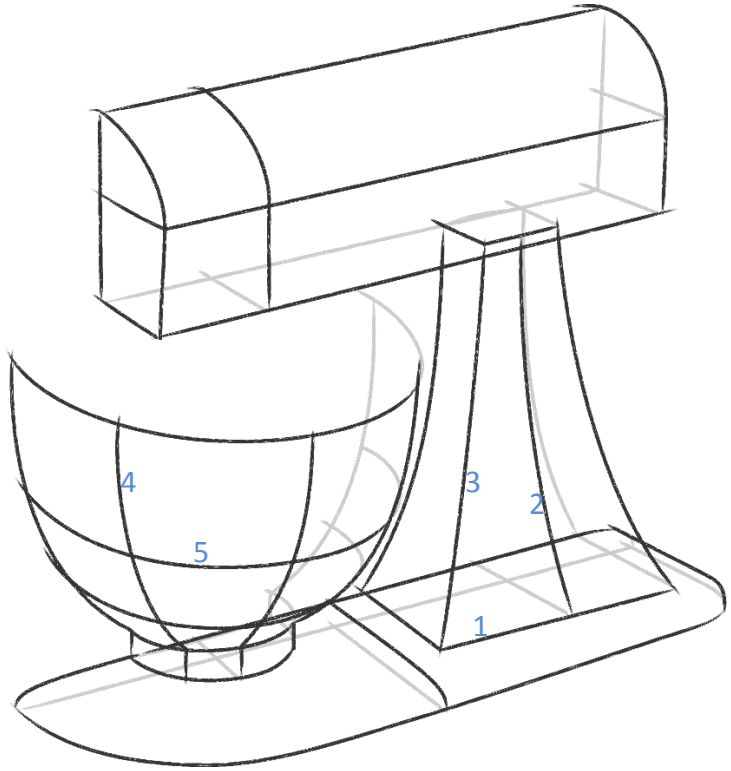
1. curve 1 imagined in 3D is a straight line. (Yes☐)
2. curve-segment marked 4 imagined in 3D is planar. (Yes☐)
3. curve 4 imagined in 3D is planar. (Yes☐)
4. curve 2 and 3 imagined in 3D intersect each other perpendicularly. (Yes☐)
5. curves 1, 4 imagined in 3D emanate parallel from their intersection with curve 3. (Yes☐)

Model #8



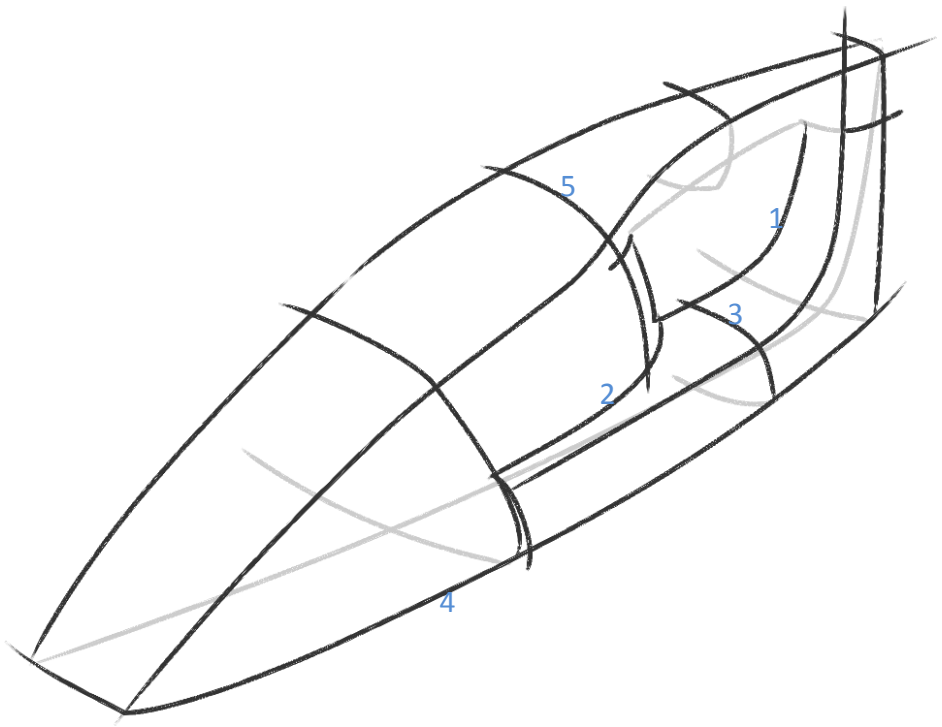
1. curve-segment marked 3 imagined in 3D is a straight line. (Yes☐)
2. curve 2 imagined in 3D is planar. (Yes☐)
3. curve 5 imagined in 3D is planar. (Yes☐)
4. curve 2 and 4 imagined in 3D intersect each other perpendicularly. (Yes☐)
5. curve-segments marked 1, 2 imagined in 3D emanate parallel from their intersection with curve 3. (Yes☐)

Model #9



1. curve-segment marked 1 imagined in 3D is a straight line. (Yes ☐)
2. curve-segment marked 3 imagined in 3D is a straight line. (Yes ☐)
3. curve-segments marked 1 and 3 imagined in 3D intersect each other perpendicularly. (Yes ☐)
4. curves 4 and 5 imagined in 3D intersect each other perpendicularly. (Yes ☐)
5. curves 2, 3 imagined in 3D emanate parallel from their intersection with curve 1. (Yes ☐)

Model #10



1. curve 2 imagined in 3D is planar. (Yes ☐)
2. curve 4 imagined in 3D is planar. (Yes ☐)
3. curve 2 and 5 imagined in 3D intersect each other perpendicularly. (Yes ☐)
4. curve 3 and 4 imagined in 3D intersect each other perpendicularly. (Yes ☐)
5. curves 2, 3 imagined in 3D emanate parallel from their intersection with curve 1. (Yes ☐)