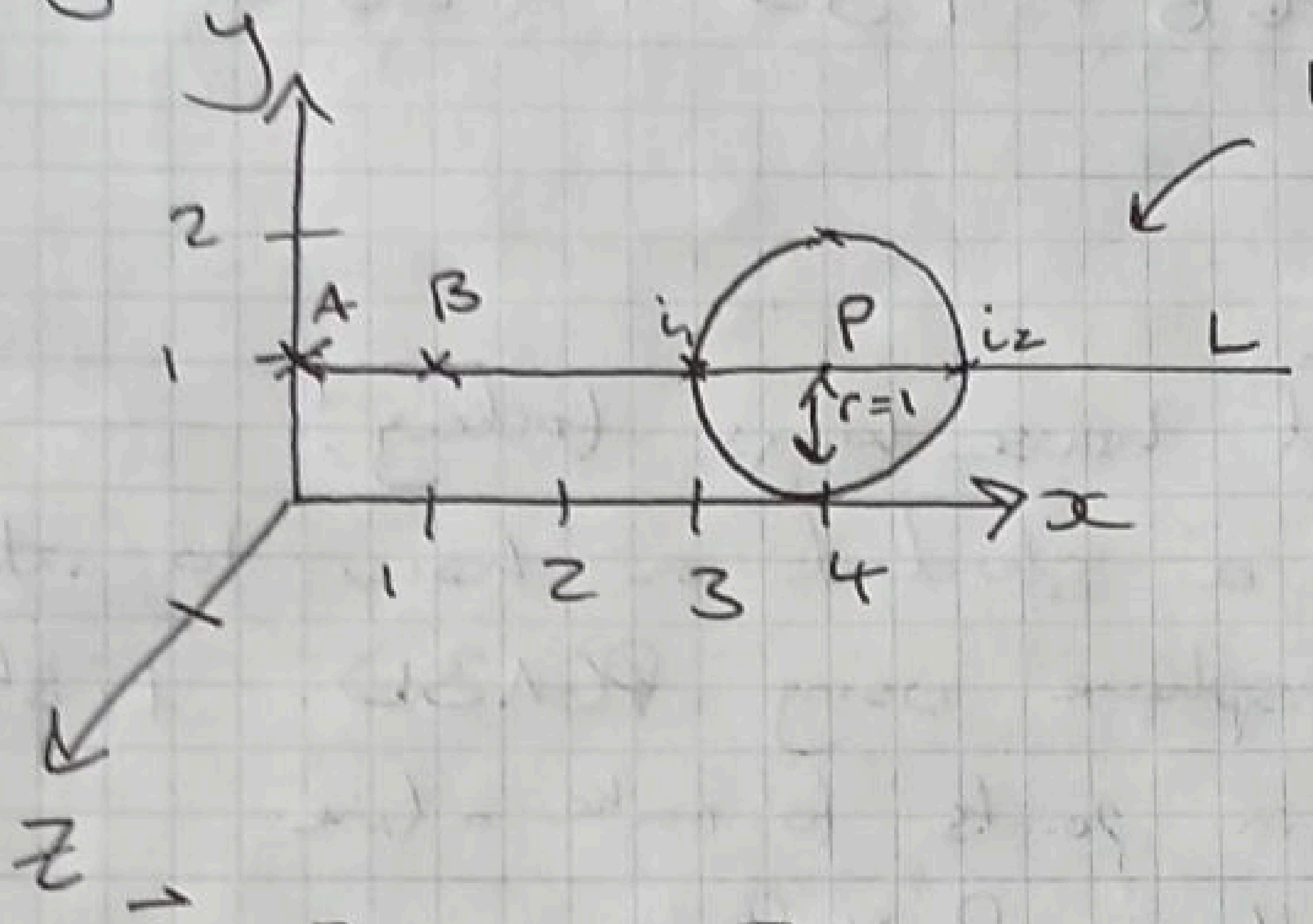
Oct 1 2024

Alright howabout this set up:



Intersecting line L w/ a sphere centred at position P and radius r

$$\vec{P} = [4, 1, 0]$$
$$= 4e_{032} + e_{013} + e_{123}$$

Line $L = A \vee B = (e_{013} + e_{123}) \vee (e_{032} + e_{013} + e_{123})$

$$= \star(A^\star \wedge B^\star)$$
$$= \star((e_2 + e_0) \wedge (e_1 + e_2 + e_0))$$
$$= \star(e_{21} + \cancel{e_{20}} + e_{01} + \cancel{e_{02}})$$
$$= \star(-e_{12} + e_{01})$$
$$L = -e_{03} + e_{23}$$

Lets check this line is good. Where wld it intersect with plane $x = 1$

$$x - 1 = 0$$
$$e_1 - e_0$$

$$\text{Point} = L \wedge (e_1 - e_0)$$
$$= (-e_{03} + e_{23}) \wedge (e_1 - e_0)$$
$$= -e_{031} + e_{231} + - e_{230}$$
$$= e_{013} + e_{123} - e_{302}$$
$$= e_{013} + e_{123} + e_{032}$$
$$= [1, 1, 0]$$

Looks good

OK, so the author, Hamish Todd, says do this

$$M = (\text{Line})(\text{Sphere centre point})$$

where line & point are normalized

$$M = (-e_{03} + e_{23})(4e_{032} + e_{013} + e_{123})$$

$$= --e_{021} + 4e_0 - e_{021} - e_1$$

$$\boxed{M = 4e_0 - e_1}$$

extract grade 3 elements from M

Then $d^2 = r^2 - (\star\langle M\rangle_3)^2$

$$d^2 = 1^2 - 0^2$$

$$d = 1$$

Then two points of intersection are

extract grade 1 elements from M

$$i_1 = L \wedge (\langle M\rangle_1 + e_0\sqrt{d^2})$$

$$i_2 = L \wedge (\langle M\rangle_1 - e_0\sqrt{d^2})$$

$$i_2 = (-e_{03} + e_{23}) \wedge (4e_0 - e_1 \mp e_0)$$

$$= (-e_{03} + e_{23}) \wedge (3e_0 - e_1)$$

$$= e_{031} + 3e_{230} - e_{231}$$

$$= -3e_{032} - e_{013} - e_{123}$$ ← w/ $w=1$

Which is the vector $[3, 1, 0]$

$$i_{12} = (-e_{03} + e_{23}) \wedge (4e_0 - e_1 + e_0)$$

$$= (-e_{03} + e_{23}) \wedge (5e_0 - e_1)$$

$$= e_{031} + 5e_{230} - e_{231}$$

$$= -5e_{032} - e_{013} - e_{123}$$

$$\boxed{i_1 = [5, 1, 0]}$$ ← w/ $w=1$