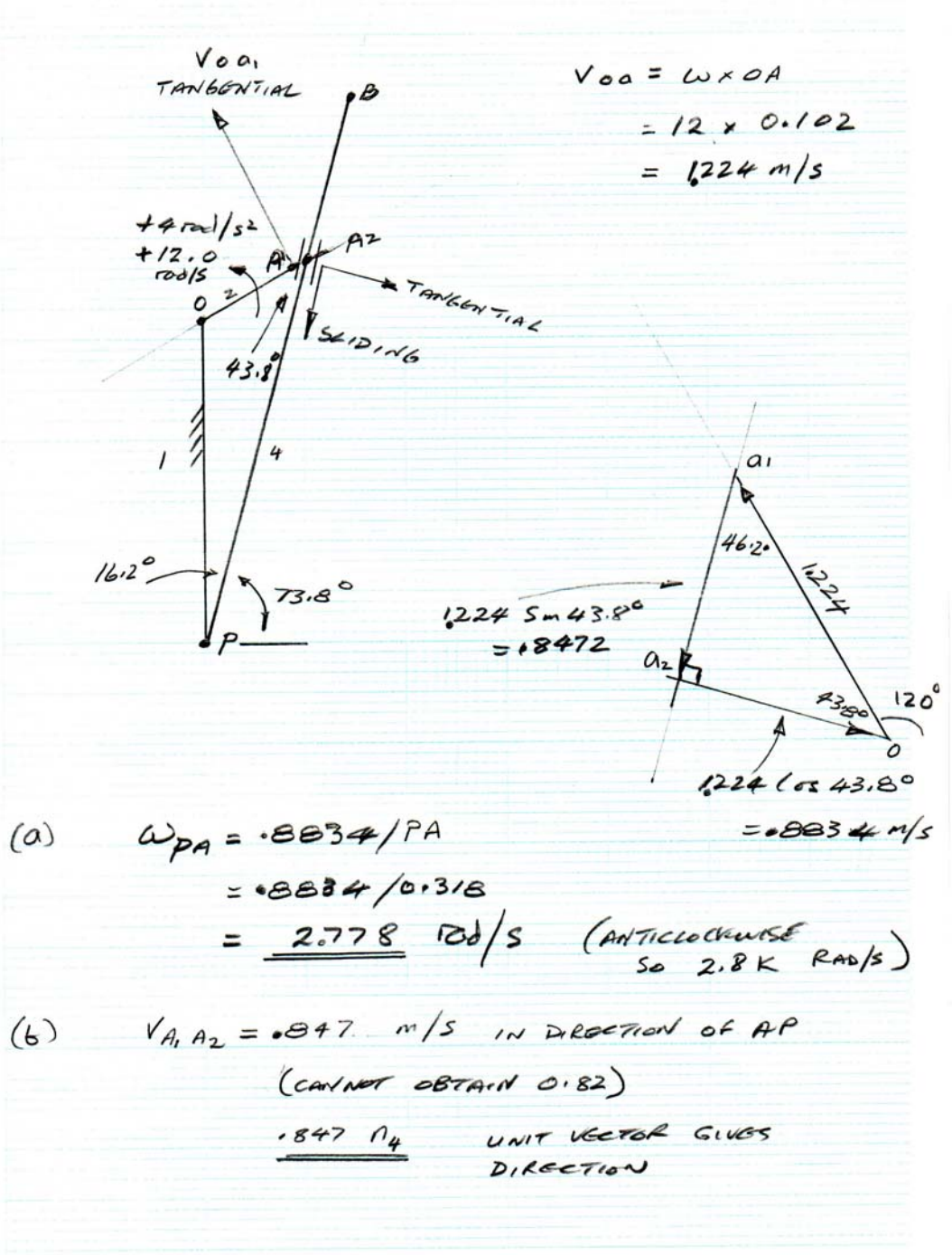
D225 Q6 1999

The original question clearly expects the use of vector mathematics to find the answers. I have used a graphical method. The link OA is 102 mm long. OP is 254 mm and PB is 450 mm. OA has an angular velocity of 12k rad/s and acceleration 4k rad/s. (The k indicates a unit vector normal to the paper so the tangential direction is positive anticlockwise)

(a) Show that the angular velocity of link 4 is 4k rad/s.
(b) Show that the velocity of A on 4 is $0.820.82n_4$ m/s. n_4 is a unit vector in direction of PB.
(c) Determine the angular velocity of link 4.
(d) Determine the acceleration of point B.



ACCELERATION DIAGRAM

CENTRIPETAL A to P $a_{PA} = \omega^2 \times PA = 2.778^2 \times .318$

$= 2.454 \text{ m/s}^2$

TANGENTIAL A P UNKNOWN

CORIOLIS A to P $= 2\omega V = 2 \times 2.778 \times 0.8472$

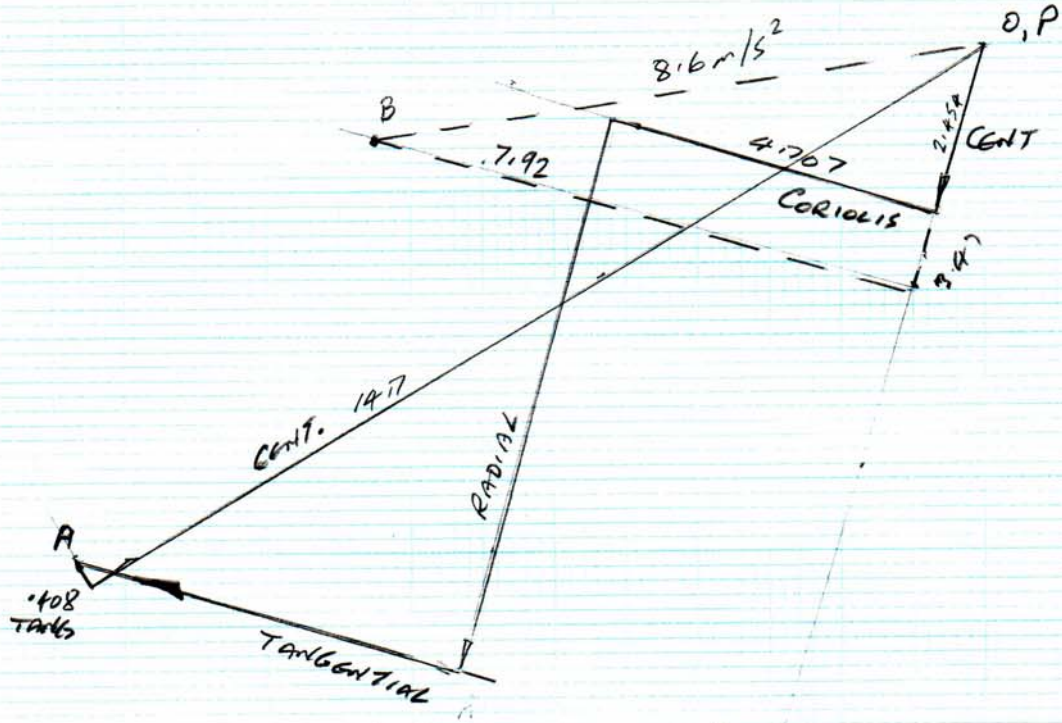
$= 4.707 \text{ m/s}^2$

CENTRIPETAL A to O $= \omega^2 \times AO$

$= 12^2 \times .102 = 14.688 \text{ m/s}^2$

TANGENTIAL A to O $= \alpha \times AO = 4 \times .102 = .408 \text{ m/s}^2$

ALSO UNKNOWN acc^n of LINK ON 4



(c)

TANGENTIAL ACC^n OF 'A' $= 5.6 \text{ m/s}^2$

α LINK 4 $= 5.6 \div PA = 5.6 / .318 = \underline{17.61 \text{ rad/s}^2}$

(d) ACCELERATION OF B

CENT. ACC $= \omega^2 \times PB = 2.778^2 \times .45 = 3.472 \text{ m/s}^2$

TANG ACC $= \alpha \times PB = 17.61 \times .45 = 7.924 \text{ m/s}^2$

TRUE ACC $= \underline{8.6 \text{ m/s}^2}$