Q1: Conceptual Question C2.2
Q2: Conceptual Question C2.9
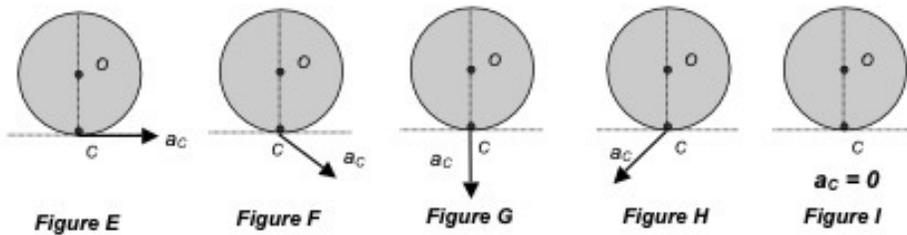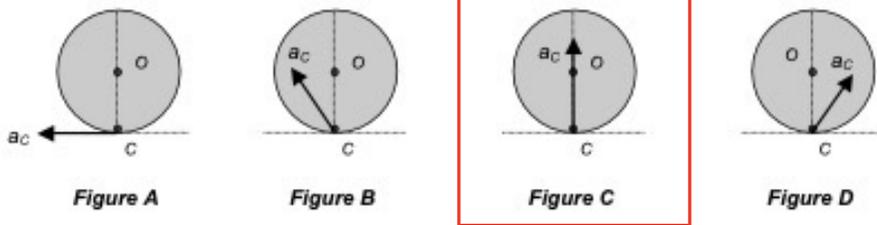Q3: Conceptual Question C2.13

Question C2.2

A sphere of radius r rolls without slipping to the right on a rough, horizontal surface. The center of the sphere, O, has a speed of v_O, with this speed decreasing at a rate of a_O.
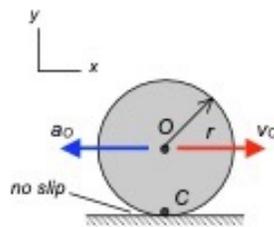
Circle the figure below that most accurately represents the direction of the acceleration of the contact point C.

$\curlyvee\llcorner_x$

Figure A   Figure B   Figure C   Figure D

Figure E   Figure F   Figure G   Figure H   Figure I

$$\vec{a}_c = a_c\hat{\jmath} = \vec{a}_O + \vec{\alpha} \times \vec{r}_{c/O} - \omega^2 \vec{r}_{c/O} = -a_O\hat{\imath} + \overbrace{(\alpha\hat{k}) \times (-r\hat{\jmath})}^{r\alpha\hat{\imath}} - \omega^2(-r\hat{\jmath})$$

$\hookrightarrow \hat{\imath}: \ 0 = -a_O + r\alpha \Rightarrow \vec{\alpha} = \frac{a_O}{r}\hat{\imath}$

$\hat{\jmath}: \ a_c = r\omega^2 \Rightarrow \vec{a}_c = r\omega^2\hat{\jmath} \longleftarrow$

$\overline{\vec{a}_c}$

Question C2.9
Link AB of the mechanism shown below is rotating counterclockwise when at the configuration shown (when AB and DE are vertical, and BD is horizontal). At this configuration (circle the correct answer):
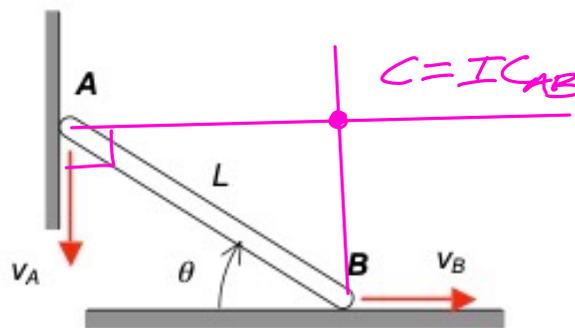
(a) Link BD is rotating counterclockwise IC_{BD} @ ∞

(b) Link BD is rotating clockwise

(c) Link BD instantaneously has zero speed

Since IC_{BD} @ ∞ $\Rightarrow$
$$\omega_{BD} = 0$$

path of D
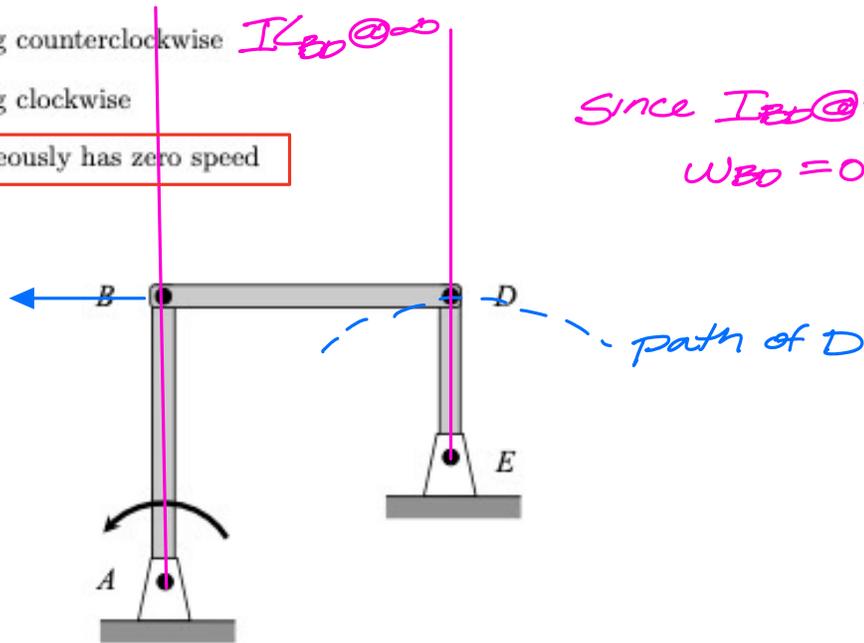
Question C2.13
Ends A and B of a thin bar slide on vertical and horizontal surfaces, respectively. At the position shown, $\theta < 45°$. For this position, circle the answer below that most accurately describes the relative sizes of the speeds v_A and v_B:

(a) $v_A > v_B$

(b) $v_A = v_B$

(c) $v_A < v_B$

(d) Additional information is needed to answer this question.

$C = IC_{AB}$

$$V_A = (L\cos\theta)\,\omega_{AB}$$
$$V_B = (L\sin\theta)\,\omega_{AB}$$

since $\theta < 45° \Rightarrow V_A > V_B$