PocketLab HotRod Ramp Answers to Questions

1. Explain what is happening during each of the following intervals:
   a. The interval from A to B *[The HotRod is accelerating down the ramp on its axles.]*
   b. The interval from B to C *[The front wheels are impacting the table top.]*
   c. The interval from C to D *[The HotRod is rolling on the table with its front wheels, but the rear wheels are still in contact with the ramp.]*
   d. The interval from D to E *[The rear wheels are impacting the table top.]*
   e. The interval from E to F *[The HotRod is rolling on the table top with both sets of wheels.]*
2. Why is there a fairly regular but small periodic variation in the angular velocity during the interval from A to B? *[With Voyager attached to the wheel and the masses to the other front wheel, an uneven distribution of mass may be causing some wobble of angular velocity.]*
3. What is the angular velocity of the front wheels just before making contact with the table top? *[Based upon the provided Excel graph, it appears to be about 1370 ^{o}/s, or 1370/360 x 2π = 23.9 rad/s.]*
4. What is the translational speed of the HotRod just before making contact with the table top? *[Since v = ωr and we know ω from the answer to question 3, we need the radius of the axle, which is the current moment arm of the system. It is about 3.8 mm. Therefore, the translational speed just before making contact with table top is 23.9/s x 3.8 mm = 90.8 mm/s.]*
5. What is the angular velocity of the front wheels during the interval from C to D? *[Based upon the provided Excel graph, it appears to be about 170 ^{o}/s, or 170/360 x 2π = 2.97 rad/s.]*
6. What is the translational speed of the HotRod during the interval from C to D? *[Again, since v = ωr and we know ω from the answer to question 5, we need the radius of the front wheels, which are the current moment containing Voyager. It is about 33.7 mm. Therefore, the translational speed when the front wheels only are on the table top is 2.97/s x 33.7 mm = 100 mm/s]*
7. Explain the physics of why the translational speed increased when the *front* wheels contacted the table top. *[The translational speed has increased by about 10%. While some of the original rotational kinetic energy of the system gained while rolling down the ramp may have been lost due to friction upon contacting the table top, enough of this rotational kinetic energy has been transferred to translational kinetic energy of the system to increase the translational speed.]*
8. What is the angular velocity of the wheels during the interval from E to F? *[Based upon the provided Excel graph, it appears to be about 260 ^{o}/s, or 260/360 x 2π = 4.54 rad/s.]*
9. What is the translation speed of the HotRod during the interval from E to F? *[Once again, since v = ωr and we know ω from the answer to question 8, we use the radius (33.7 mm) of the HotRod wheels. Therefore, the translational speed when both sets of wheels only are on the table top is 4.54/s x 33.7 mm = 153 mm/s. This is about a 69% overall increase in translational speed.]*
10. Explain why the translational speed has increased when the *rear* wheels contacted the tabletop. *[Similar to the answer to question 7.]*