1. Degrees of freedom of a planar chain with 4 links and 4 pin or slider joints?

   _____

2. Crank speed at 300 rpm (two decimals, rad/s)?

   _____ rad/s

3. Rotating force of 38.4 g m at 150.8 rad/s (N, whole number)?

   _____ N

4. Natural frequency of 120 kg on 300 kN/m (one decimal, rad/s)?

   _____ rad/s

5. Force from 1.2 g m at 150.8 rad/s (one decimal, N)?

   _____ N

6. In mode 2 the pump and frame move:

   ☐ in opposite directions

   ☐ only the pump moves

   ☐ together

   ☐ only the frame moves

7. Links 40, 100, 80 and 110 mm satisfy Grashof because:

   ☐ the ground is the longest

   ☐ 40 + 110 is at most 100 + 80

   ☐ the crank is shorter than the rocker

   ☐ all links are shorter than 120

8. The velocity of C relative to B on one rigid link is:

   ☐ zero

   ☐ perpendicular to the link

   ☐ along the link

   ☐ parallel to the crank

9. A long rotor balanced statically only still has:

   ☐ an unbalanced couple

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   ☐ a secondary force

   ☐ no unbalance

10. Light damping changes the oscillation frequency:

    ☐ only slightly

    ☐ to zero

    ☐ by about a half

    ☐ to twice omega_n

1. **1**

   3(4 - 1) - 2 x 4.

2. **31.42 rad/s**

   300 x 2 pi / 60.

3. **873 N**

   m r omega squared.

4. **50.0 rad/s**

   Root of k over m.

5. **27.3 N**

   m e omega squared.

6. **in opposite directions**

   The second entry of u2 is negative.

7. **40 + 110 is at most 100 + 80**

   s + l = 150 against p + q = 180.

8. **perpendicular to the link**

   A rigid link cannot stretch.

9. **an unbalanced couple**

   The moments of the masses along the shaft remain.

10. **only slightly**

    omega_d = omega_n root(1 - zeta^2).

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