1. (a) (10) Figure 1a shows a snail-shaped cam with a roller follower. What is wrong with this design? State two drawbacks.
   (b) (10) Indicate the pressure angle on the sketch of Figure 1b.

![Figure 1a](image1a.png)

![Figure 1b](image1b.png)

2. In an assembly plant, it is required to move a hoist carrying liquid from level 1 to level 2 as shown below. The hoist is driven at a constant speed of 0.5 m/s.
   (a) (10) Use a simple harmonic function to design the ramp section connecting levels 1 and 2.
   (b) (10) Calculate the maximum vertical acceleration the load will be subjected to.

![Diagram of hoist](image2.png)

3. (20) It is required to have a reduction ratio \( \omega_{in}/\omega_{out} = 2 \). Is this possible with the planetary gear configuration shown? Justify your answer.
4. (a) (10) Design a gear train to give an exact gear ratio of 26 to 1.
(b) (10) In the gear train shown, input 1 turns at 120 rpm counter-clockwise and input 2 turns at 360 rpm clockwise. Determine the speed and direction of rotation of the output shaft.

5. The figure shows the arrangement of gears in a lathe gearbox. Shaft A is driven by a motor at a speed of 720 rpm. By sliding the cluster of gears (2,3,4) on shaft A we can have 3 possible meshing pairs: 2 with 5, 3 with 6 and 4 with 8. The gears on shaft C can also slide along the shaft so as to mesh either 7 with 9 or 8 with 10. The numbers of teeth are: N₂=16, N₃=36, N₄=25, N₅=64, N₆=44, N₇=17, N₈=55, N₉=79, N₁₀=41.

(a) (10) Make a table showing all possible gear arrangements, beginning with the slowest speed for shaft C and ending with the highest, and enter in this table the speeds of shafts B and C.
(b) (10) If all gears have a module of 5, what must be the shaft center distances?