

## ☐ Centrifugal Pump Performance Test –Worksheet

### ☒ Context (Empathize & Define):

A rural village with 200 households and 5 hectares of farmland relies on a centrifugal pump for water. Water delivery is inconsistent during peak hours. Your task is to test if the current pump setup is sufficient, and suggest improvements using design thinking principles.

### ☒ Problem Data (Given):

- Daily water demand: 150,000 liters
- Pump operating time: 8 hours/day
- Static head: 15 meters
- Frictional loss: 5 meters
- Pump efficiency: 65%
- Motor power: 5 HP
- Water density ( $\rho$ ): 1000 kg/m<sup>3</sup>
- Gravitational acceleration ( $g$ ): 9.81 m/s<sup>2</sup>
- Power conversion: 1 HP = 746 Watts

### ☒ Part A: Numerical Analysis

1. Calculate the required flow rate (Q) in L/s:

Q = Daily demand / Total operating time in seconds

Q = \_\_\_\_ L/s

2. Calculate the Total Dynamic Head (TDH):

TDH = Static head + Friction loss

TDH = \_\_\_\_ m

3. Convert Q to m<sup>3</sup>/s and calculate Hydraulic Power (P<sub>hydraulic</sub>):

P<sub>hydraulic</sub> =  $\rho \times g \times Q \times H$

P<sub>hydraulic</sub> = \_\_\_\_ Watts

4. Calculate Actual Power required considering efficiency:

P<sub>actual</sub> = P<sub>hydraulic</sub> /  $\eta$  = \_\_\_\_ Watts

5. Compare with Motor Power (in Watts):

Motor Power = 5 × 746 = \_\_\_\_ Watts

☒ Is the motor sufficient? Circle one: YES / NO

### ☒ Part B: Ideate Solutions (Creative Thinking)

Based on your analysis, suggest 2–3 design improvements to make the water system more efficient, reliable, or sustainable.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

### **Part C: Prototype Ideas (Optional Extension)**

Sketch or describe a new system setup including components like:

- Solar panels
- Smart controllers
- Parallel pumps
- Local maintenance plans

Use the space below or attach an additional sheet.