AQUALIBRIUM

SCHOOLS WATER NETWORK COMPETITION

RULES AND INSTRUCTIONS

1. Introduction

Water distribution systems are important for supplying safe and clean drinking water to people. Many communities in South Africa still lack this basic service and are often burdened by having to walk large distances to obtain water. Water is often obtained from polluted sources causing various health problems in the community. This competition will give you some insight into the functioning of water distribution systems and the complexity of their design.

2. Goal

The goal of the competition is to distribute water equally between three points through a *pipe network*. You will be judged on how well you can achieve this task using a maximum of three tries in a period of one hour.

3. Equipment

The equipment required for the competition can be obtained from hardware stores or pet shops, and need not be expensive. If you can't find all the recommended equipment below, you can look for alternatives. The most important factor is that all teams taking part in a competition use exactly the same equipment. A list of recommended equipment is given on the next page

Recommended Equipment

No	Item	Description	Quantity
1	Competition sheet	The competition background sheet with numbered network grid.	1
2	Table	A table to provide a flat, horizontal support for the *competition sheet*.	1
3	Source container	A 4 l container or bucket to act as water source. The container should have a hole in its floor where the *main supply pipe* should be connected. This connection can be made by gluing the *main supply pipe* in place, or using some kind of fitting. The other end of the pipe has to be connected to the *pipe network* at point 1 on the *competition sheet*.	1
4	Source stand	A stand to support the *source container* at a convenient level above the *competition Sheet*. The ideal distance between the bottom of the *source container* and the *competition sheet* is 1 m.	1
5	Reservoirs	Small containers or buckets with capacities of at least 2 l each. These buckets are used to collect the water distributed by the *pipe network*.	3
6	Measuring cylinder	A graduated cylinder used to measure the volumes of water placed in the *source container*, and distributed to the *reservoirs*. The *measuring cylinder* should ideally have graduations of 1 ml.	1
7	Main supply pipe	A section of 6 mm internal diameter clear plastic pipe, 1.1 m long. This pipe is used to connect the *source container* to the *pipe network*.	1
8	Large pipes	Sections of 6 mm internal diameter clear plastic pipe, each 28 cm long. These pipes are used in combination with the *small pipes* to build the *pipe network*.	12
9	Small pipes	Sections of 4 mm internal diameter clear plastic or silicon rubber pipe, each 28 cm long. These pipes are used in combination with the *large pipes* to build the *pipe network*.	12
10	Reservoir pipes	Sections of 6 mm internal diameter clear plastic pipe, each 20 cm long. These pipes are used to connect the *pipe network* to the *reservoirs*.	3
11	Straight connectors	4 mm internal diameter straight connector	8

		couplings.	
12	Bends	4 mm internal diameter elbow (90°) couplings.	8
13	T – junctions	4 mm internal diameter T-couplings.	8
14	Four way junctions	4 mm internal diameter four-way (cross) couplings.	8
15	Expanders	4 mm internal diameter silicon pipes, each about 5 mm long. These pieces of pipe are used to connect the *large pipes* to the connector pieces.	25
16	Shut-off valve	Any small valve or clamp to allow the *main supply pipe* to be closed off.	1

4. Method

i. The *competition sheet* is placed horizontally on the *table*, (To make the competition more difficult, the *table* can also be tilted). The *source container* is placed on the *source stand* arm and the *main supply pipe* attached to its bottom.

ii. The judges indicate three points on the grid at which the *reservoirs* have to be placed.

iii. The participants construct a ***pipe network*** using the *small* and *large* and *reservoir pipes*, *straight connectors*, *bends*, *T-junctions*, *fourway junctions* and *expanders*. The *main supply pipe* has to be connected at point 1 on the *competition sheet*. The operating word is **network.** Pipes must align with the grid on the *competition sheet*, and where two or more pipes meet at a junction they must all be connected to each other. Not more than 8 lines on the *competition sheet*'s grid may be left without a pipe.

iv. To remove the air from the system, water is poured into the *source container* and the system is allowed to run. While the system is running, the team members remove the air by flicking the pipes and connections with their fingers. If the air is sufficiently removed, the *shut-off valve* is used on the *main supply pipe* to stop the flow.

v. The *source container* and *reservoirs* are emptied while leaving the network pipes full of water.

vi. Three litres of tap water is measured using the *measuring cylinder*. The water is then poured into the *source container* and the *shut-off valve* opened to distribute the water between the three *reservoirs*. Nobody is allowed to touch the setup for the duration of the run.

vii. When a run is finished, the system is stopped using the *shut-off valve.*

viii. The volume of water in each of the *reservoir* is measured using the *measuring cylinder* and the penalty points are calculated (see section on calculating the penalty points below).

ix. Each group has three chances within an hour to find the best network. The result of the **last** run is used to determine the points achieved in the competition.

x. The group with the lowest number of penalty points wins the competition.

5. Calculating penalty points

The perfect network will distribute the 3 l of water in the *source container* equally between the *reservoirs*. Each *reservoir* should thus have exactly 1 l (or 1 000 ml) of water in it. Penalty points are calculated by determining the difference between the actual quantity of water in each *reservoir* (measured in millilitres) and 1000 ml. Negative differences should be converted to positive values. The penalty points accrued is then calculated by adding these values for all three *reservoirs*.

Example
If the three *reservoirs* end up with volumes of 950 ml, 990 ml and 1045 ml respectively, the penalty points will be calculated as 50 + 10 + 45 = 105 points. Note that the total volume of the three containers may not always make up 3 l. However, if you have more or less than 3 l of water in the *reservoirs*, you will always get more penalty points than for exactly 3 l. Thus you should try to work as accurately as possible.