

A hospital supply company wants to market a program to assist with the calculation of intravenous rates. Design and implement a program that interacts with the user as follows.

Write a complete C++ program that helps the company to calculate intravenous rates. The program should perform the following steps. (*Note*: that the values in *italics* are input by the user while the values in **bold** are the final result for each problem.)

1. Provide a menu driven screen for user to select the problem choice.
2. If the user enters **1**, the program should ask the user
  - a) to enter the rate of intravenous drop in ml/hr
  - b) to enter the intravenous tubing drop factor (drops/ml)

From the given information calculate and display the intravenous drop rate per minute.

The screen display for problem 1 is as in **Figure 1**.

```
INTRA VENOUS RATE ASSISTANT

Enter the number of the problem you wish to solve.

      GIVEN A MEDICAL ORDER IN          CALCULATE RATE IN
(1) ml/hr & tubing drop factor           drops/min
(2) mg/kg/hr & concentration in mg/ml    ml/hr
(3) QUIT

Problem => 1
Enter rate in ml/hr => 150
Enter tubing's drop factor(drops/ml) => 15
The drop rate per minute is 38.
```

**Figure 1:** Screen Display for Problem 1

3. If the user enters **2**, the program should ask the user
  - a) to enter input rate in mg/hr
  - b) to enter the patient weight in kg
  - c) to enter the concentration rate of the drug in mg/hr

From the given information calculate and display rate in millilitres per hour. The screen display for problem 2 is as in **Figure 2**.

```
INTRA VENOUS RATE ASSISTANT

Enter the number of the problem you wish to solve.

      GIVEN A MEDICAL ORDER IN          CALCULATE RATE IN
(1) ml/hr & tubing drop factor          drops/min
(2) mg/kg/hr & concentration in mg/ml   ml/hr
(3) QUIT

Problem => 2
Enter rate in mg/hr => 0.6
Enter patient weight in kg => 70
Enter concentration in mg/ml => 1
The rate in millilitres per hour is 42.
```

**Figure 2:** Screen Display for Problem 2

4. If the user enters **3**, the program will display the screen as in Figure 3.

```
INTRA VENOUS RATE ASSISTANT

Enter the number of the problem you wish to solve.

      GIVEN A MEDICAL ORDER IN          CALCULATE RATE IN
(1) ml/hr & tubing drop factor          drops/min
(2) mg/kg/hr & concentration in mg/ml   ml/hr
(3) QUIT

Problem => 3
You have chosen to quit the program.
Thank you for using our system.
```

**Figure 3:** Screen Display for Problem 3

5. If the user enters any other problem number besides 1, 2 or 3, the program will display

the screen as in **Figure 4**.

```
INTRA VENOUS RATE ASSISTANT

Enter the number of the problem you wish to solve.

      GIVEN A MEDICAL ORDER IN          CALCULATE RATE IN
(1) ml/hr & tubing drop factor          drops/min
(2) mg/kg/hr & concentration in mg/ml   ml/hr
(3) QUIT

Problem => 6

Please run the system again and choose a problem number
between 1 and 3.
```

**Figure 4:** Screen Display for Invalid Problem Choice

To assist the company in developing the program, you should implement the following functions:

`getProblem` – A function with no input parameters. It will display the user menu, then inputs and returns from the function the value of the problem number selected.

`getRateDropFactor` – This is a non-returning function which prompts the user to enter the data required for problem 1, and sends this data back to the calling module through the use of reference parameters.

`getKgRateConc` – This is also a non-returning function which prompts the user to enter the data required for problem 2, and sends this data back to the calling module through the use of reference parameters.

`figDropsMin` – This function takes rate and drop factor as input parameters and it returns the value of drops/min (rounded to the **nearest** whole drop, for example 23.2 to 24 and 23.7 to 24).

`byWeight`– This function takes as input parameters rate in mg/hr, patient weight in kg, and concentration of drug in mg/ml and it returns the value ml/hr (rounded, for example 26.2 to

26 and 26.6 to 27). *Note:* Formula to calculate rate in ml/hr = rate in mg/hr × weight in kg × concentration of drug in mg/ml.

Your program should also be written to show the implementation of a loop(s).

You will be assessed according to the assessment criteria shown in **Table 1**.

**Table 1:** Assessment Criteria

Item	Criteria	Marks
A	The program is able to run	2
	Applying proper styles, <i>e.g.</i> indentation and comments	2
	Using an appropriate structure for the program ( <i>e.g.</i> all required header files are included, the function main is properly written, <i>etc.</i> )	2
B	Providing a menu driven screen for user to make choice of problem	2
	Reading the input value for problem number	1
	Reading the input values for each problem from the user with proper prompts	5
C	Validating range of values for problem numbers	2
	Proper handling of returning functions (headers & returns)	4
	Proper handling of non-returning functions (headers & reference parameters)	4
	Obtaining correct calculation of results for returning functions	3
	Activating function to get problem number	1
	Activating function(s) to call & calculate results of Problem 1	3
	Activating function(s) to call & calculate results of Problem 2	3
	Implementing valid cases of problem numbers in a loop	2
D	Printing the output for all cases including default case	4
<b>Total</b>		<b>40</b>

On the whole, the program execution for all problem choices will be depicted as follows:

INTRAVENOUS RATE ASSISTANT

Enter the number of the problem you wish to solve.

GIVEN A MEDICAL ORDER IN	CALCULATE RATE IN
(1) ml/hr & tubing drop factor	drops/min
(2) mg/kg/hr & concentration in mg/ml	ml/hr
(3) QUIT	

Problem => 1

Enter rate in ml/hr => 150

Enter tubing's drop factor(drops/ml) => 15  
The drop rate per minute is **38**.

Enter the number of the problem you wish to solve.

GIVEN A MEDICAL ORDER IN	CALCULATE RATE IN
(1) ml/hr & tubing drop factor	drops/min
(2) mg/kg/hr & concentration in mg/ml	ml/hr
(3) QUIT	

Problem => 2

Enter rate in mg/kg/hr => 0.6

Enter patient weight in kg => 70

Enter concentration in mg/ml => 1

The rate in millilitres per hour is **42**.

Enter the number of the problem you wish to solve.

GIVEN A MEDICAL ORDER IN	CALCULATE RATE IN
(1) ml/hr & tubing drop factor	drops/min
(2) mg/kg/hr & concentration in mg/ml	ml/hr
(3) QUIT	

Problem => 3

You have chosen to quit the program.

Thank you for using our system.

For choices which are not in the range of 1 to 3 example -1 or 6:

Problem => 6

Please run the system again and choose a problem number between 1 and 5.