Mathematics for Computing 1

Graphs and equations 2: worksheet questions

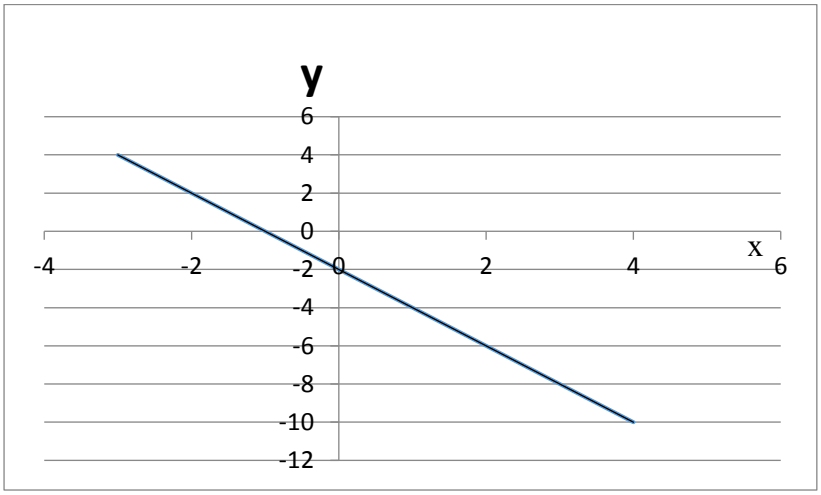
Q1

Determine the equation of the straight line represented by the points shown in the table below.

x	-4	-3	-2	-1	0	1	2	3	3
f(x)	-7.9	-5.4	-2.9	-0.4	2.1	4.6	7.1	9.6	12.1

$$\boldsymbol{f(x) = 2.5x + 2.1}$$

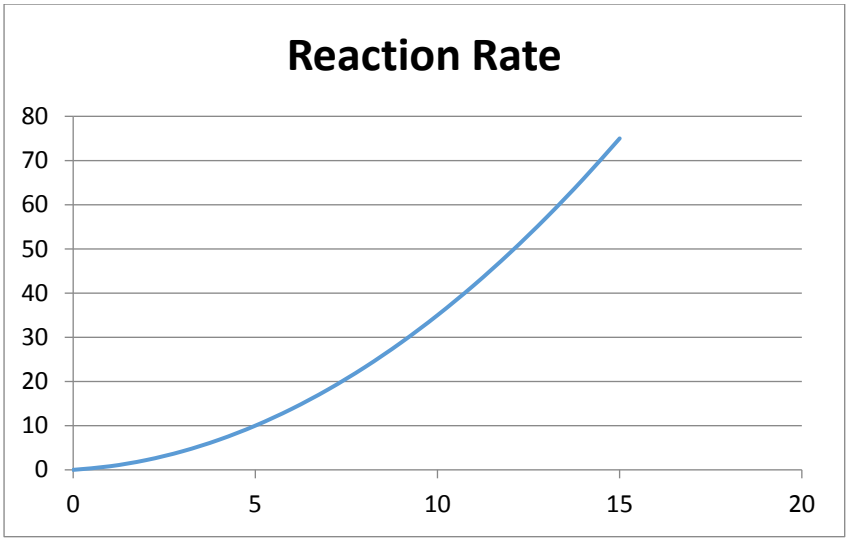
From the graph below, determine the equation of the straight line.



$$\boldsymbol{y = -2x - 2}$$

Q2

A student has produced some results from an experiment and would look to find an equation that would model the results. The results have been recorded as a graph shown below showing the rate of a reaction (y axis – grams/second) for a new material MagiFlubber as a function of time (x axis - seconds). Determine a suitable equation to model the results, stating clearly any assumptions that you have made.



To help you with accuracy, a table of results for this graph is also available:

Time (seconds)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rate (g/s)	0	0.8	2.2	4.2	6.8	10	13.8	18.2	23.2	28.8	35	41.8	49.2	57,2	65.8	75

$$\boldsymbol{rate = 0.3t^2 + 0.5t}$$

We assume that the model is only valid in the given domain.

Q3

This one is more challenging, You will only be able to solve it if you know about integration. If you don't know what that means, don't worry – we will cover it in a later session.

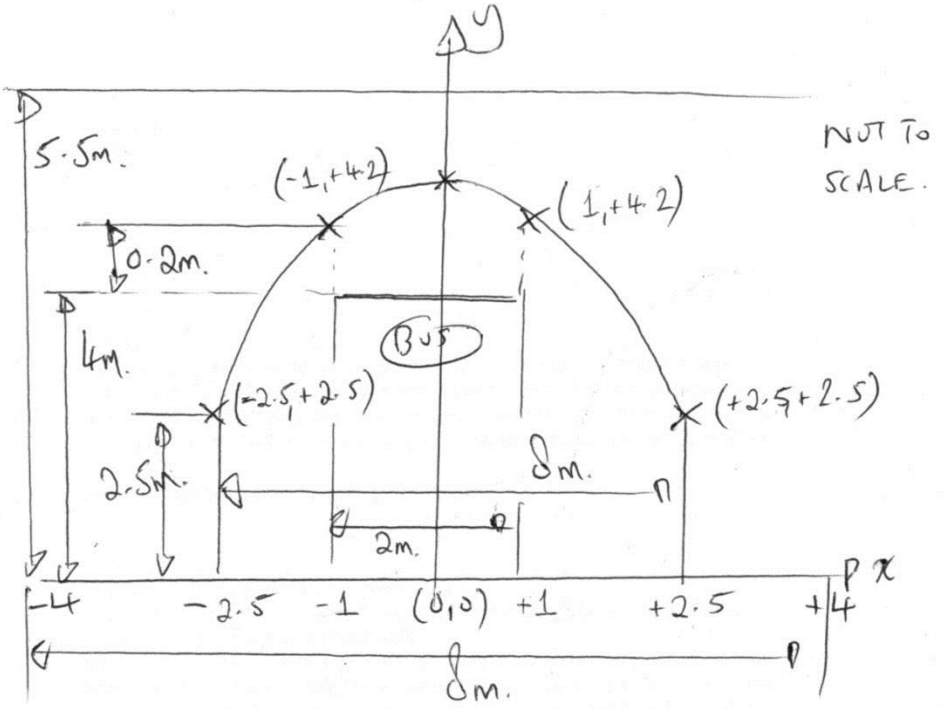
An arch bridge similar in style to the one shown below is to be designed:

The consulting designer and engineer have agreed on some parameters and constraints. The roadway that needs to fit under the bridge is 5m wide. The total width of the bridge is 8m. The vertical distance at each edge of the roadway up to the start of the curved section is 2.5m. The maximum dimensions of a vehicle that needs to fit safely under the bridge is 2m wide and 4m tall with a safety margin of 0.2m height. Such a vehicle is permitted to drive in the centre of the roadway. The total height of the bridge is 5.5m. Across the top of the bridge is another roadway that is 5m wide.

Produce a sketch of your design and determine the parameters of the curve section assuming that the Cartesian origin (0,0) is on the ground and in the middle of the roadway.

Calculate the volume of bricks required to construct the bridge (requires integration).

The model quadratic can be determined as (see over):



We have 4 points on curve:

x	y
-2.5	+2.5
-1	+4.2
+1	+4.2
+2.5	+2.5

→ using these points

$y = ax^2 + bx + c$ (Assume quadratic)

$4.2 = a - b + c$ (A)

$4.2 = a + b + c$ (B)

$2.5 = 6.25a + 2.5b + c$ (C)

We discover $b = 0$ ((A) − (B))

$6.25a + c = 2.5$

$a + c = 4.2$

$5.25a = -1.7$

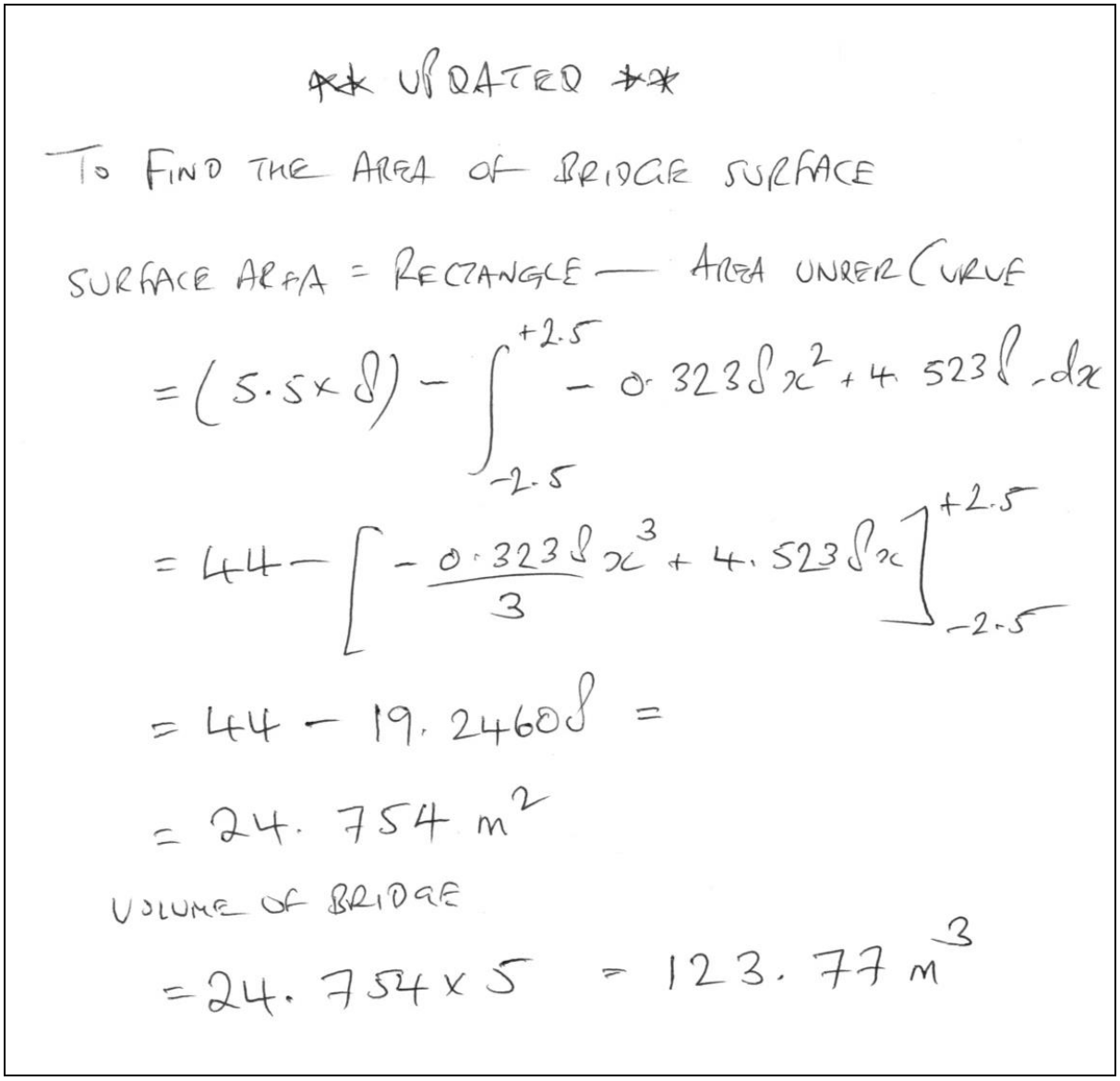
$\Rightarrow a = -0.3238$

$c = 2.5 - 6.25a$

$\Rightarrow c = +4.5238$

$y = -0.3238x^2 + 4.5238$

The area under the curve and the bridge volume can be determined as:



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