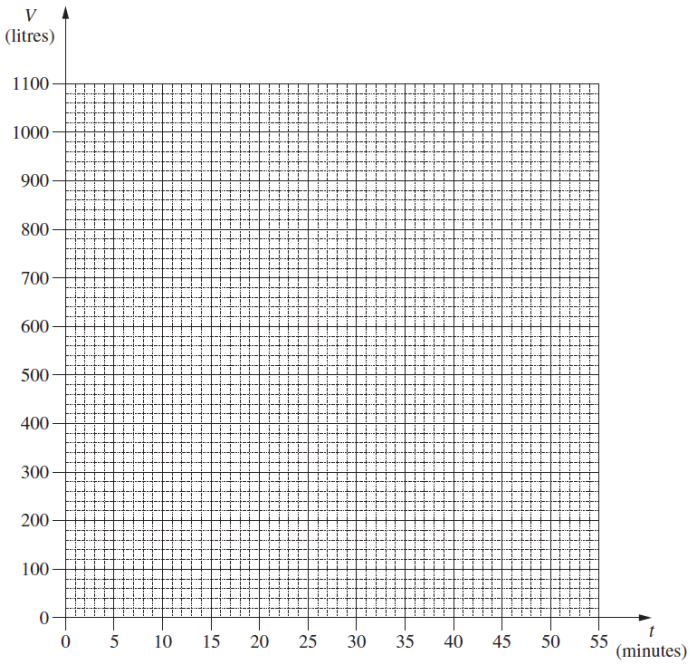
20 MA **11** There are two tanks on a property, Tank *A* and Tank *B*. Initially, Tank *A* holds 1000 litres of water and Tank *B* is empty.

(a) Tank *A* begins to lose water at a constant rate of 20 litres per minute.

The volume of water in Tank *A* is modelled by $V = 1000 - 20t$ where V is the volume in litres and t is the time in minutes from when the tank begins to lose water.

On the grid below, draw the graph of this model and label it as Tank *A*. **1**

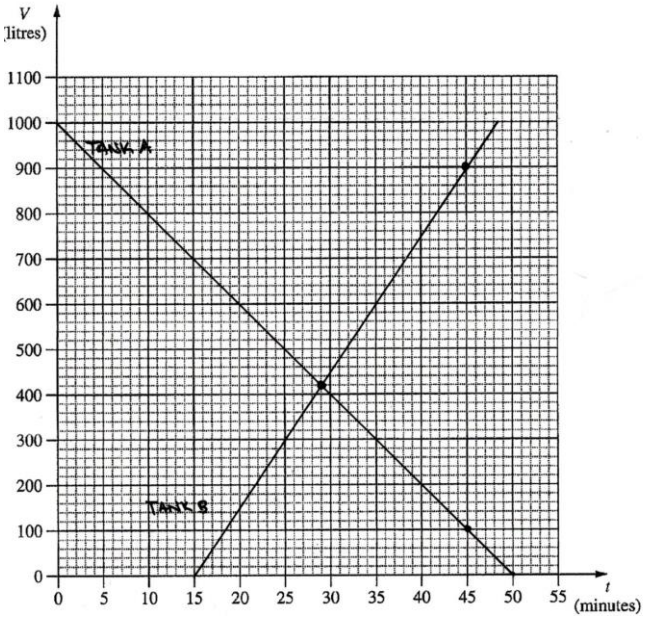


(b) Tank *B* remains empty until $t = 15$ when water is added to it at a constant rate of 30 litres per minute. **2**

By drawing a line on the grid on the previous page, or otherwise, find the value of t when the two tanks contain the same volume of water.

(c) Using the graphs drawn, or otherwise, find the value of t (where $t > 0$) when the total volume of water in the two tanks is 1000 litres. **1**

(a)



✔

(b) Look for the intersection of both graphs: After 29 minutes the tanks contain the same amount. ✔ ✔

Alternately, solve simultaneously the equations $V = 1000 - 20t$ and $V = 30(t - 15)$.

$$1000 - 20t = 30(t - 15)$$
$$1000 - 20t = 30t - 450$$
$$1000 + 450 = 30t + 20t$$
$$50t = 1450$$
$$t = 29$$

(c) By inspection, after 45 minutes, Tank A contains 100 L and Tank B contains 900 L, which is a total of 1000 L.

✔

Alternately, Tank *A* is modelled by the equation $V_A = 1000 - 20t$.

Tank *B* is modelled by the equation $V_B = 30(t - 15)$.

Now solve $1000 - 20t + 30(t - 15) = 1000$

$$1000 - 20t + 30t - 450 = 1000$$
$$10t = 450$$
$$t = 45$$

State Mean:
0.96/1
1.63/2
0.61/1

HSC Marking Feedback

Question 11 (a)

Students should:

- interpret given information to draw the linear function
- use initial conditions to construct the graph representing volume
- calculate the intercepts of a linear function at each axis.

In better responses, students were able to:

- draw an accurate graph using the given information
- label the graph as instructed.

Areas for students to improve include:

- using a ruler to draw linear graphs
- starting at the stated volume.

Question 11 (b)

Students should:

- interpret a direct variation relationship to model a second linear function on the same Cartesian plane
- use graphical techniques to find the point of intersection
- use algebraic techniques to solve linear equations.

In better responses, students were able to:

- interpret the given description to produce the correct graph
- represent a practical situation graphically
- construct an accurate graph to find the correct point of intersection
- read the intersection point correctly.

Areas for students to improve include:

- graphically representing practical situations
- finding the point of intersection using the graph
- developing an equation using given information
- substituting coordinates to find unknown values
- appreciating that time is positive.

Question 11 (c)

Students should:

- solve a practical problem graphically
- construct an equation to solve algebraically.

In better responses, students were able to:

- interpret the question as the cumulative volume
- solve a practical problem graphically.

Areas for students to improve include:

- understanding the graphical interpretation of linear graphs
- interpreting the question as the cumulative volume
- understanding that finding a solution graphically is dependent on the accuracy of the graph.

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by NESA.