5.6.4. CONNECTIONS AND APPLICATIONS

Example 1:

The wave height in a bay t hours after midnight is given by the formula $f(t) = 1.7\sin\left(\frac{t}{1.9} - 3\right) + 2$. The function is graphed in the following link:

https://www.geogebra.org/calculator/cxdvxwcf

The ship can set sail only if the wave height is below 0.6 m.

a) Determine all time intervals in which the ship can exit the bay. (Help: plot the line representing the height required, then read the intersections).

b) Determine all moments in time for which the height is the largest.

c) Determine all moments when the wave height is 2 m.

Solution:

The complete solution is in the following app:

https://www.geogebra.org/calculator/uj4kcmq4

a) The line $h(x) = 0.6$ represents the required wave height of 0.6 m. To find all intervals in which the ship can exit the bay, find all the intersection points of the graph and the line.
The solutions should look like this:

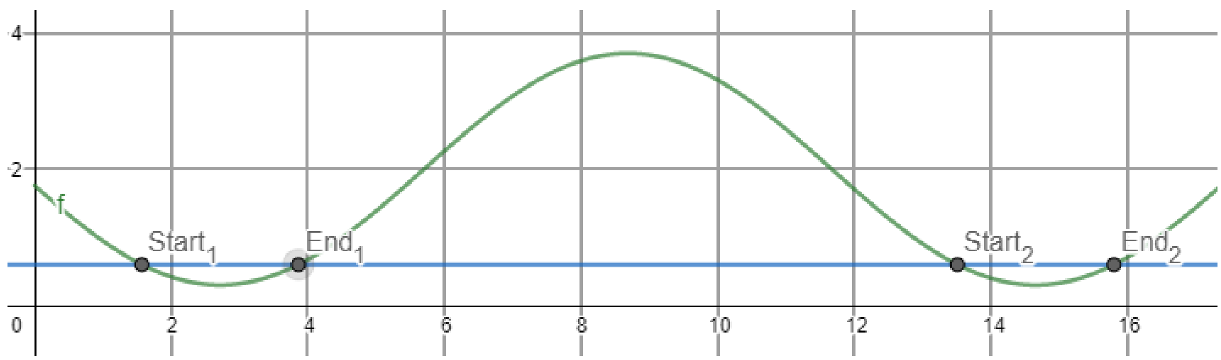

Figure 5.64

The corresponding intervals are from Start$_1$ to End$_1$, and from Start$_2$ to End$_2$, approximately from 1:40 to 4:00 and 13:45 – 15:50. If you are using the solution app, just show the corresponding elements (Start and end points, and the line).

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b) To determine the maximum height, use the Extremum tool in Geogebra from the left side panel. The solutions are:

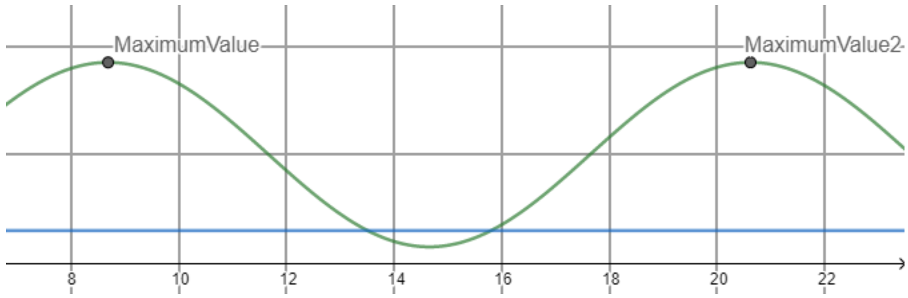

Figure 5.65

To find the exact value, read the x coordinate of the points. The maximum height occurs around 8:20 and 20:20. If you are using the solution app, just show the points named MaximumValue.

c) To find the required points, draw the line $g(x) = 2$ and find the intersection of the function and line using the Geogebra Intersection tool. The solution should look like this:

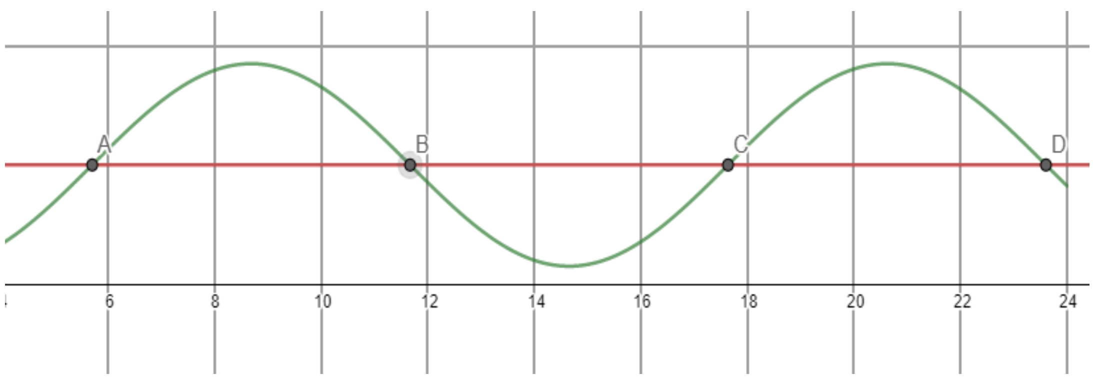

Figure 5.66

If you are using the solution app, highlight the corresponding elements (the line and the intersection point named A,B,C and D).

Example 2:

A ship is nearing a harbor. The ship's captain has been informed that only 25% of the docking surface is free. The distance of the boat to the harbor is 1000 m. The harbor has a surface of 1000 m. The following link models the situation:

https://www.geogebra.org/calculator/mutqk7p4

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a) Determine the course interval to successfully dock the ship

b) On the docking surface, there are 4 berths. Find the ships course for it to dock the fourth berth.

Solution:

The full solution can be viewed in the following app:

https://www.geogebra.org/calculator/qpf4hcqp

a) To calculate the appropriate course, the start point and the endpoint of the free space on the docking surface must be plotted. Since only 25% of the docking surface is free, the start point has coordinates (250,1000), and the endpoint has coordinates (500,1000). To find the direction an auxiliary object, point North, must be plotted. The point must be located directly north from the ship position. To find minimal valid direction, measure the angle from the starting point of the free part of the dock (point C), through the vertex at point Ship and the end point at point North. To find the maximal valid direction, measure the angle using the end point of the dock (point B) as the starting point, point Ship as the vertex and the end point at point North.

The solution should look like this:

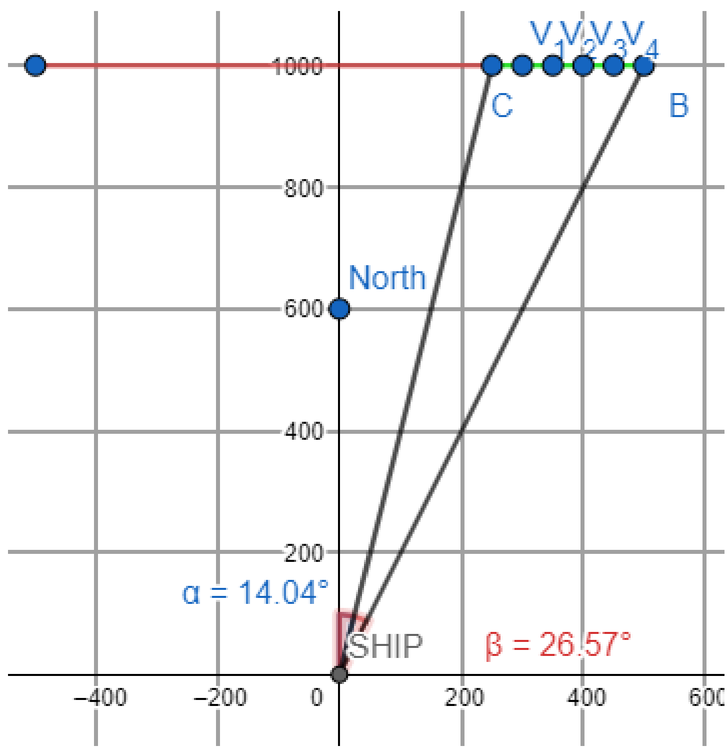

Figure 5.67

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The minimal required direction is 014, and the maximal is 026 (or 027).

If you are using the solution app, show the corresponding elements, line segments between point ship and points B and C, and the corresponding angles.

b) The fourth berth is located at point V_4. To find the direction, plot the line segment from point Ship to point V_4 and find the angle measure using the point V_4 as the starting point, the point Ship as the vertex, and the point North as the endpoint.
The solution should look like this:

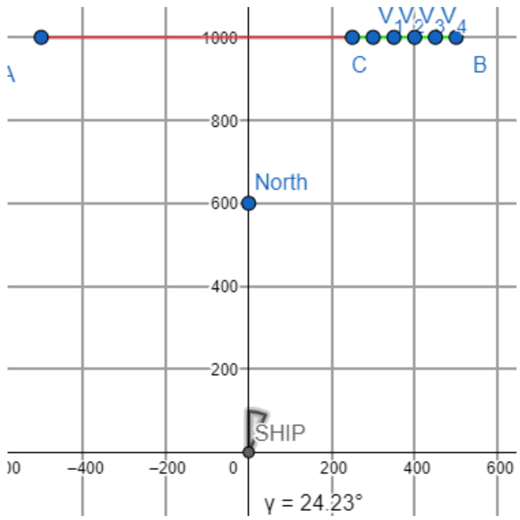

Figure 5.68

The required direction is 024.

If you are using the solution app, highlight the corresponding elements, angle γ.

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