



## Teacher Notes for Diagrams

Compatibility: TI-83+/83+SE/84+/84+SE

Run The Program Called: **DGM1** or **DGM2**

### ► Summary

This program provides students with practice of drawing diagrams in order to answer questions that are presented to them as text only. These include simple geometrical constructions, angles of elevation and depression, bearings and compass-and-ruler constructions of triangles. They may be solved using algebraic methods (Pythagoras' Theorem or Trigonometry) or by construction of scale drawings. See **Appendix 1** for examples of each type of the 12 types of problem.

The unique feature of the program is that it will present a step-by-step solution of how to construct a scale drawing, with both a textual description and an animation of each step. See **Appendix 2** for an example of this.

Students obtain a percentage score based upon the accuracy of their submitted answers.

### ► Suggestions

The program can be used with the lower years to practise the construction of scale drawings with a clear emphasis on accuracy of measuring both the angles and the lengths.

Experienced students can tackle the more complex diagrams, as well as opting to solve them using trigonometry. Either way, they still nurture the skill of drawing sketch diagrams from text-only descriptive questions.

Providing students with plain paper to work on, rather than squared paper, has been found to be helpful to stress the need for accuracy using both a protractor and a ruler (and a sharp pencil!)

### ► Features

- Due to memory limitations, "Diagrams" has been split into two separate programs, stored in two separate groups: **DIAGRAM1** and **DIAGRAM2**.
- You must clear the RAM memory before ungrouping (press **2<sup>nd</sup>**, press **+**, press **7**, press **1**, press **2**) to ensure sufficient space is available. Ungroup **DIAGRAM1** and run the program **DGM1**, or ungroup **DIAGRAM2** and run **DGM2**. The program file **DGMX** is common to both parts.

**DIAGRAM1** includes the following problems:

#### **QUADRILATERAL GEOMETRY**

**SQUARE:** Draw a square of given side length. Work out the length of its diagonal.

**RECTANGLE:** Draw a rectangle of given dimensions. Work out the length of its diagonal and the angle between the diagonal and one of the longest sides.

**RHOMBUS:** Draw a rhombus of given side length and given interior angles. Work out the length of either the shortest or longest diagonal.

#### **ANGLES OF ELEVATION**

**ONE ANGLE:** Work out the height of a tower knowing the angle of elevation from a point of known distance from the base.

**TWO ANGLES:** Work out the height of a tower knowing the angles of elevation from two points at ground level, whose distance apart is known

*cont/*

<b>ANGLES OF DEPRESSION</b>	Work out the distance between two points knowing the angles of depression of each, and the vertical distance that they are below the point of observation.
<b>ELEVATION &amp; DEPRESSION</b>	Work out the altitude of a point knowing its angles of elevation and depression from two points a known vertical distance apart.
<b>BEARINGS</b>	<p><b>TWO 1 STAGE JOURNEYS:</b> Two ships depart the same port on different bearings and go different distances. Work out their final distance apart and the bearing of one from the other.</p> <p><b>TWO STAGE JOURNEY:</b> One ship departs from a port on a bearing and travels a distance. It then starts on a second leg of the journey with a new bearing and travels a new distance. Work out the final distance from port and the bearing of either the ship from the port, or the port from the ship</p>

**DIAGRAM2** includes the following problems:

- construct a triangle given the lengths of all 3 sides (SSS) and work out its area.
- construct a triangle given two sides and an angle (SAS) and work out its perimeter and/or area
- construct a triangle given a side and two angles (SAA) and work out its perimeter and/or area

Where the area of a triangle is required, the step-by-step solution provides a hint to measure the altitude of the triangle, supporting the use of  $A = \frac{1}{2}bh$ , but clearly  $A = \frac{1}{2}ab \sin C$  is an alternative method that could be used (and may indeed be more appropriate). The “base and height” method was chosen to support the progress of students who have not yet met trigonometry.

- All menus offer the opportunity of **RANDOM CHOICE**, allowing students to “test themselves” once they have become familiar with the program and the questions that it contains.

- After the question type has been selected, a question is designed and then displayed. Once the question is in view, a progress bar along the foot of the screen indicates the program’s headway through the construction of the step-by-step solution. Only once this is complete can the user move on from the question screen to the next stage.

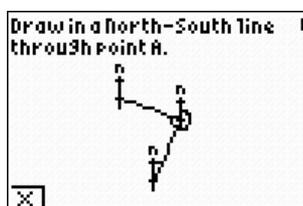
```
C and L both watch a bird, B.
C is 6.3 m above L.
The angle of elevation of B
from L is 32.
The angle of depression of B
from C is 55.

How high is B above L?
_____
```

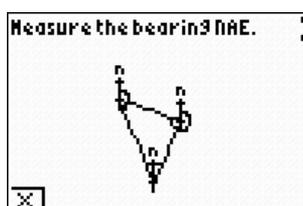
```
The bearing of P from E is 025.
The distance EP is 88 km.
The bearing of A from P is 288.
The distance PA is 84 km.

What is...
a) the distance from E to A?
b) the bearing of E from A?
Solution is now ready
```

- Where **BEARINGS** questions are chosen, the step-by-step solution advises the user to draw “North-South” lines, rather than just North lines. This is judged to be more helpful when solving bearings problems algebraically, as they better assist the student in identifying alternate angles in the diagram between the parallel North-South lines. It has also been found to assist the weaker students with bearings of greater than  $180^\circ$ .



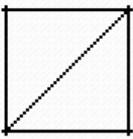
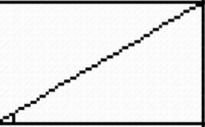
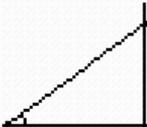
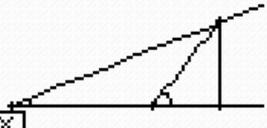
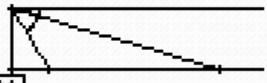
- When answering **BEARINGS** questions, the angle is required to have three figures. e.g.  $047^\circ$



Performance Comparison		
Your answer	Correct answer	Error
104	114	10 km
159	158	1 deg
Your overall score: 77%		
Press any key to continue		

## Appendix 1 - Examples of each of the 12 Problems

- Each problem's labels, lengths and angles are randomly generated according to designed criteria. The text generally remains unchanged.

DGM1 Quadrilateral Geometry	Square	<p>Draw a square of side 7.8 cm</p> <p>What is... the length of its diagonal?</p> <p style="text-align: center;">Solution is now ready</p>	<p>Measure the length of line DB.</p> 
DGM1 Quadrilateral Geometry	Rectangle	<p>Draw a rectangle with dimensions 7.9 cm and 4.6 cm</p> <p>What is... a) the length of its diagonal? b) the angle between the diagonal and one of the longest sides?</p>	<p>Measure the angle ADB.</p> 
DGM1 Quadrilateral Geometry	Rhombus	<p>Draw a rhombus of side length 5.4 cm with interior angles 130 and 50</p> <p>What is... the length of the longest diagonal?</p> <p style="text-align: center;">Solution is now ready</p>	<p>Measure the length of line DB.</p> 
DGM1 Angles of Elevation	One Angle	<p>The angle of elevation of T from A is 37</p> <p>The horizontal distance from A to D is 7.5 m</p> <p>What is... the height of T above D?</p>	<p>Measure the length of line DT.</p> 
DGM1 Angles of Elevation	Two Angles	<p>The horizontal distance from A to S is 2.2 m.</p> <p>The angles of elevation of T from A is 22 and from S is 51.</p> <p>Point D is vertically below T.</p> <p>What is the height DT?</p>	<p>Measure the length of line DT.</p> 
DGM1 Angles of Depression		<p>T is the top of 6.7 m high cliff.</p> <p>Points B and L are at sea level</p> <p>The angle of depression of B from T is 16.</p> <p>The angle of depression of L from T is 58.</p> <p>What is the distance L to B?</p> <p style="text-align: center;">Solution is now ready</p>	<p>Measure the length of line LB.</p> 
DGM1 Elevation + Depression		<p>G and J both watch a bird. B.</p> <p>G is 8.9 m above J.</p> <p>The angle of elevation of B from J is 35.</p> <p>The angle of depression of B from G is 42.</p> <p>How high is B above J?</p> <p style="text-align: center;">Solution is now ready</p>	<p>Measure the length of line JB.</p> 
DGM1 Bearings	Two 1 Stage Journeys	<p>The bearing of H from L is 071</p> <p>The distance LH is 83 km</p> <p>The bearing of C from L is 137</p> <p>The distance LC is 89 km</p> <p>What is... a) the distance from H to C? b) the bearing of H from C?</p>	<p>Measure the bearing of H from C.</p> 

DGM1  
Bearings

Two Stage Journey

The bearing of F from G is  $331^\circ$   
The distance GF is 82 km  
The bearing of H from F is  $211^\circ$   
The distance FH is 92 km

What is...

a) the distance from G to H?  
b) the bearing of H from G?

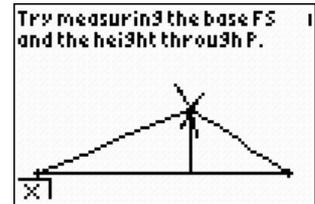


DGM2  
SSS (side-side-side)

Triangle FPS has side lengths  
9 cm, 5.9 cm and 4.2 cm.

What is...

the area of FPS?



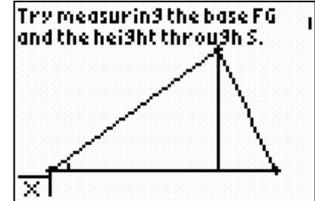
DGM2  
SAS (side-angle-side)

Perimeter+Area  
*(although you can  
opt for only one of  
these if you wish)*

Triangle FGS has side lengths  
FG is 7.6 cm, FS is 7 cm  
and an angle F is  $36^\circ$ .

What is...

a) the perimeter of FGS?  
b) the area of triangle FGS?



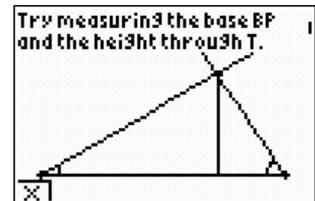
DGM2  
SAA (side-angle-angle)

Perimeter+Area  
*(although you can  
opt for only one of  
these if you wish)*

Triangle BPT has side  
BP length 7.8 cm, an angle B  
is  $30^\circ$  and an angle P is  $56^\circ$ .

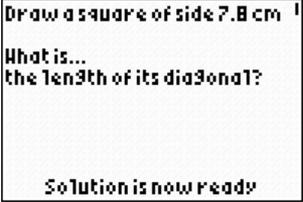
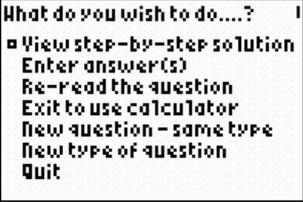
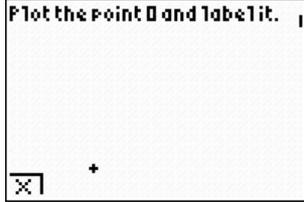
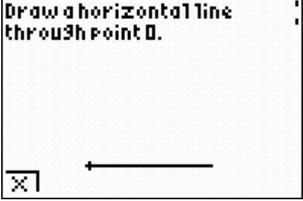
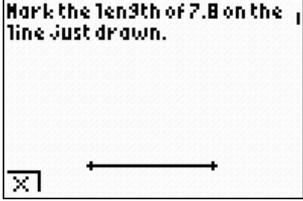
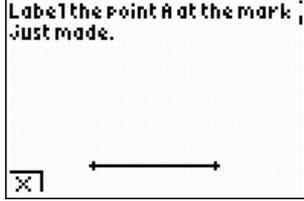
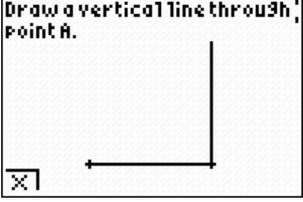
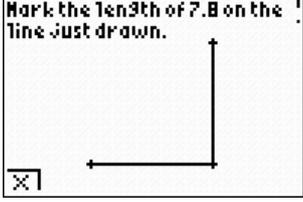
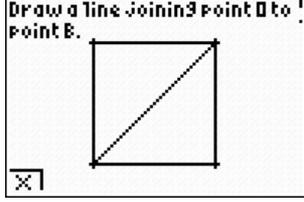
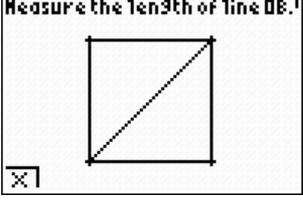
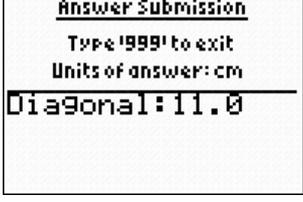
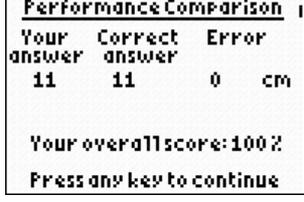
What is...

a) the perimeter of BPT?  
b) the area of triangle BPT?



## Appendix 2 - Example of a Step-by-Step Solution

Example question: DGM1 > Quadrilateral Geometry > Square

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 

### Notes:

- at any stage of the solution, the **Y=** button can be pressed to **QUIT** back to screenshot number two.
- the user does not need to view the step-by-step solution before opting to enter their answer.
- if the user, in error, opts to enter an answer before they are ready to, entering “999” as the answer returns them to screenshot number two, with no penalty.
- the user may temporarily exit the program to use the calculator’s normal functions (useful when solving the problems with Pythagoras, trigonometry or when processing an area calculation). Select the “Exit to use calculator” from screenshot number two. After the required calculations are done, re-running the program (either DGM1 or DGM2) returns the user to screenshot number two as if no interruption had happened.
- once an answer is submitted, the performance percentage score is calculated. Answers within  $2^\circ$  of the correct angle and within 2mm of the correct length will return scores of over 90%. Beyond these limits, the penalties increase, giving lower performance scores.
- once an answer is submitted, it cannot be altered.

### ► Acknowledgements

A section of code used in this program is gratefully acknowledged to Raymond Bonneau.