

Map Algebra

Kernels

Cost Surface

Friction Surface

Slope

Slope

Calculation

There will be
questions about
these on the test

(Use Calculator)

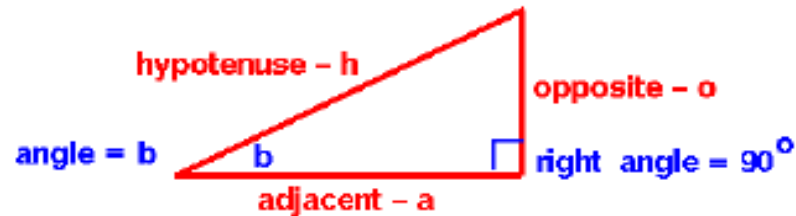


Sine – Cosine – Tangent

Very Basic Trigonometry

Glenn
Research
Center

Terminology:



Definitions:

Assign a name to the **ratio** of the length of the sides of a right triangle

Sine:

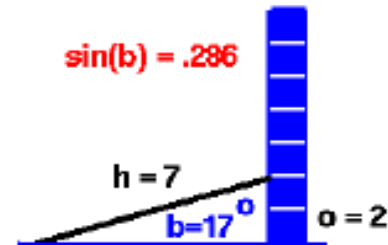
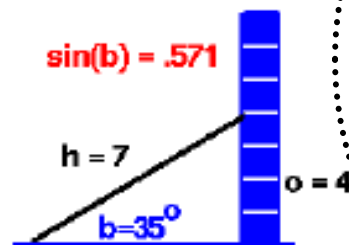
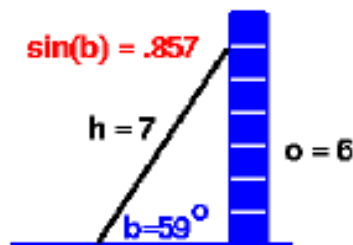
$$\sin(b) = \frac{o}{h}$$

Cosine:

$$\cos(b) = \frac{a}{h}$$

Tangent:

$$\tan(b) = \frac{o}{a}$$



The value of each ratio depends only on the size of the angle.

Table of tan(angle)

Angle	tan(a)
0.0	0.00
1.0	.0175
2.0	.0349
3.0	.0524
4.0	.0699
5.0	.0875
6.0	.1051
7.0	.1228
8.0	.1405
9.0	.1584
10.0	.1763
11.0	.1944
12.0	.2126
13.0	.2309
14.0	.2493
15.0	.2679
16.0	.2867
17.0	.3057
18.0	.3249
19.0	.3443
20.0	.3640
21.0	.3839
22.0	.4040
23.0	.4245
24.0	.4452

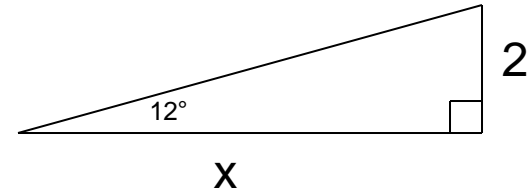
Angle	tan(a)
25.0	.4663
26.0	.4877
27.0	.5095
28.0	.5317
29.0	.5543
30.0	.5773
31.0	.6009
32.0	.6249
33.0	.6494
34.0	.6745
35.0	.7002
36.0	.7265
37.0	.7535
38.0	.7813
39.0	.8098
40.0	.8391
41.0	.8693
42.0	.9004
43.0	.9325
44.0	.9657
45.0	1.000

Angle	tan(a)
46.0	1.0355
47.0	1.0724
48.0	1.1106
49.0	1.1504
50.0	1.1918
51.0	1.2349
52.0	1.2799
53.0	1.3270
54.0	1.3764
55.0	1.4281
56.0	1.4826
57.0	1.5399
58.0	1.6003
59.0	1.6643
60.0	1.7321
61.0	1.8040
62.0	1.8907
63.0	1.9626
64.0	2.0503
65.0	2.1445
66.0	2.2460
67.0	2.3559
68.0	2.4751
69.0	2.6051
70.0	2.7475

Angle	tan(a)
71.0	2.9042
72.0	3.0777
73.0	3.2709
74.0	3.4874
75.0	3.7321
76.0	4.0108
77.0	4.3315
78.0	4.7046
79.0	5.1446
80.0	5.6713
81.0	6.3138
82.0	7.1154
83.0	8.1443
84.0	9.5144
85.0	11.430
86.0	14.301
87.0	19.081
88.0	28.636
89.0	57.290
90.0	infinite

If you know the slope angle (in degrees) and one of the legs of the Right Triangle

Then you can calculate the length of the other leg

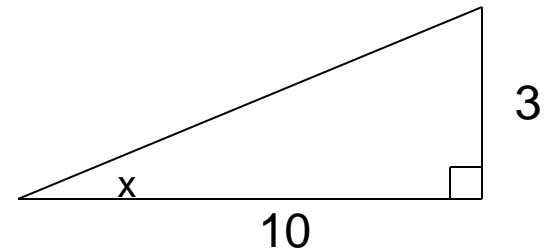


$$\text{Tangent of } 12^\circ = 2/x \quad .2126 = 2/x \quad x = 2/.2126 \quad x = 9.4$$

look up 12° on the Table

If you know the legs of the Right Triangle
Opposite/ Adjacent

Then you can calculate the angle (slope)
By using the Arctangent
of the ratio (opposite/adjacent)



$$\tan^{-1} x = 3/10 \quad \tan^{-1} = .3 \quad \text{look up } .3 \text{ on Table} \quad x = 17^\circ$$

what angle has tangent equal to .3

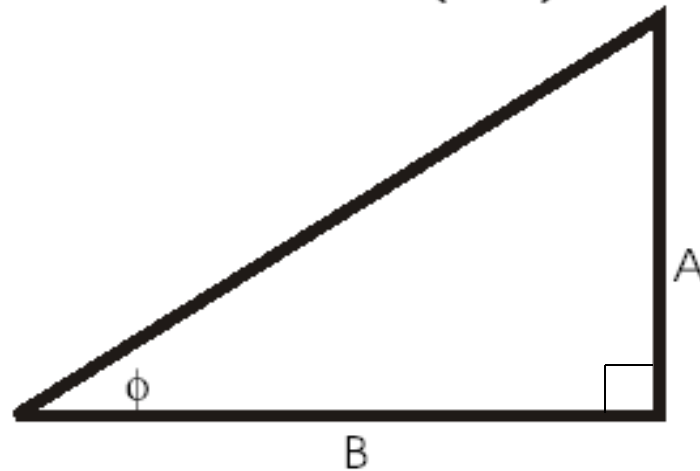
Slope

$$\text{Slope as Percent} = \frac{\text{rise}}{\text{run}} * 100$$

$$= A/B * 100$$

$$\text{Slope as Degrees} = \phi$$

$$= \tan^{-1}(A/B)$$



To convert from percent slope to degrees,
apply formula,
e.g. 3% = how many degrees?

$$\begin{aligned} A/B * 100 &= 3, \text{ then } A/B = 3/100 = 0.03 \\ &= \tan^{-1}(0.03) = 1.72 \text{ degrees} \end{aligned}$$

	C1	C2	C3	C4	C5	C6
R1	5	6	7	8	8	8
R2	5	6	8	8	9	9
R3	6	6	7	8	9	10
R4	6	7	7	9	9	10
R5	7	7	7	9	10	10
R6	8	8	8	9	10	10
R7	8	8	8	9	11	10
R8	9	9	9	9	10	10
R9	9	9	9	9	10	10
R10	9	9	10	10	10	11

cell size is 10

Calculate Slope
for cell R3C4
 $S = \tan^{-1} [(\Delta Z/\Delta x)^2 + (\Delta Z/\Delta y)^2]^{1/2}$

	C1	C2	C3	C4	C5	C6
R1						
R2						
R3				?		
R4						
R5						
R6						
R7						
R8						
R9						
R10						

cell size is 10

$$S = \tan^{-1} [(\Delta Z/\Delta x)^2 + (\Delta Z/\Delta y)^2]^{1/2}$$

	C1	C2	C3	C4	C5	C6
R1	5	6	7	8	8	8
R2	5	6	8	8	9	9
R3	6	6	7	8	9	10
R4	6	7	7	9	9	10
R5	7	7	7	9	10	10
R6	8	8	8	9	10	10
R7	8	8	8	9	11	10
R8	9	9	9	9	10	10
R9	9	9	9	9	10	10
R10	9	9	10	10	10	11

cell size is 10

Calculate Slope
for cell R3C4
 $S = \tan^{-1} [(\Delta Z/\Delta x)^2 + (\Delta Z/\Delta y)^2]^{1/2}$

	C1	C2	C3	C4	C5	C6
R1						
R2						
R3				?		
R4						
R5						
R6						
R7						
R8						
R9						
R10						

cell size is 10

$$S = \tan^{-1} [(\Delta Z/\Delta x)^2 + (\Delta Z/\Delta y)^2]^{1/2}$$

$$[((9-7)/20)^2 + ((8-9)/20)^2]^{1/2} = .111803$$

Look up .111803 on Table, find 6°

Slope Answers
(see previous page

	C1	C2	C3	C4	C5	C6
R1						
R2		9	6	3	4	
R3		4	6	6	6	
R4		4	6	6	4	
R5		3	6	9	4	
R6		3	4	6	4	
R7		3	4	9	3	
R8		3	3	3	4	
R9		0	3	4	3	
R10						
cell size is 10						

$$S = \tan^{-1} [(\Delta Z/\Delta x)^2 + (\Delta Z/\Delta y)^2]^{1/2}$$