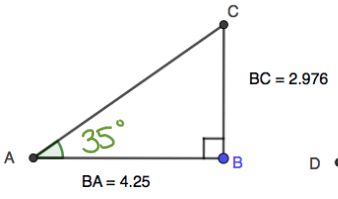
Applying the Tangent Ratio

To save a bit of time, what we figured out in our last class is referred to as the **tangent ratio**.

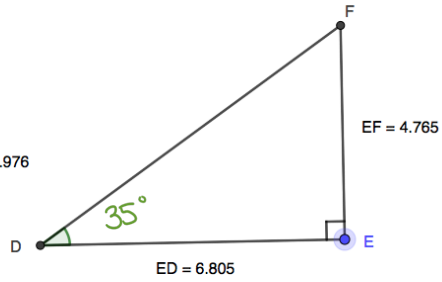
That is, given a right triangle of any size, the slope always matches a given angle.

Or, given a right triangle of any size, the ratio of the opposite and adjacent side lengths always matches a given angle.

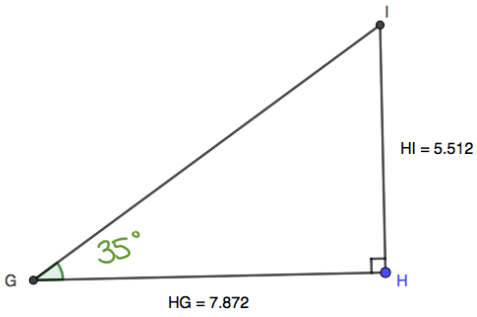
For example, a slope (or tangent ratio) of 0.700 always corresponds to a $35°$ angle.



$$\frac{BC}{BA} = \frac{2.976}{4.25} = 0.7$$



$$\frac{EF}{ED} = \frac{4.765}{6.805} = 0.7$$

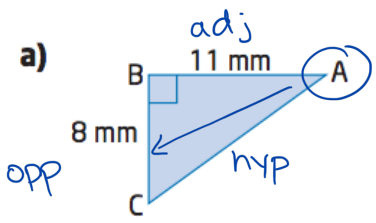


$$\frac{HI}{HG} = \frac{5.512}{7.872} = 0.7$$

Example 1

Find the measures of both acute angles in each triangle, to the nearest full degree.

a)



$\tan A = \frac{opp}{adj}$

$= \frac{8}{11}$

$\doteq 0.727$

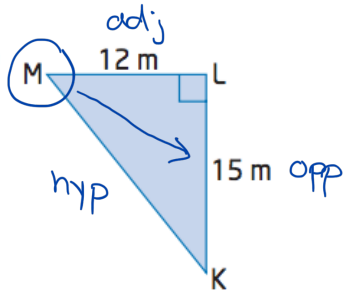
(from the table) $\angle A = 36°$

(a ratio of 0.727 always corresponds to an angle of 36°)

$\angle C = 180° - 90° - 36°$

$= 54°$

b)



$\tan M = \frac{15}{12}$

$= 1.25$

* $\angle M$ = between 51° and 52°
* 1.25 is closer to 1.235 than to 1.280

$\therefore \angle M \doteq 51$

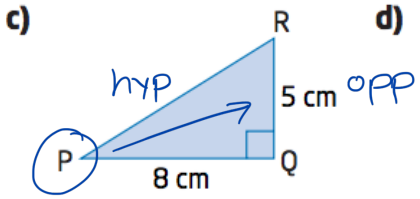
$\angle K \doteq 180° - 90° - 51°$

$\doteq 39°$

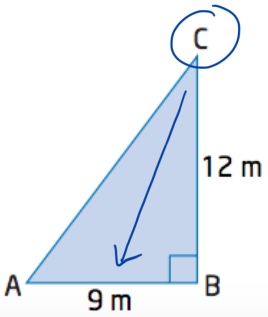
6	0.105
7	0.123
8	0.141
9	0.158
10	0.176
11	0.194
12	0.213
13	0.231
14	0.249
15	0.268
16	0.287
17	0.306
18	0.325
19	0.344
20	0.364
21	0.384
22	0.404
23	0.424
24	0.445
25	0.466
26	0.488
27	0.510
28	0.532
29	0.554
30	0.577
31	0.601
32	0.625
33	0.649
34	0.675
35	0.700
36	0.727
37	0.754
38	0.781

51	1.235
52	1.280
53	1.327
54	1.376
55	1.428
56	1.483
57	1.540
58	1.600
59	1.664
60	1.732
61	1.804
62	1.881
63	1.963
64	2.050
65	2.145
66	2.246
67	2.356
68	2.475
69	2.605
70	2.747
71	2.904
72	3.078
73	3.271
74	3.487
75	3.732
76	4.011
77	4.331
78	4.705
79	5.145
80	5.671
81	6.314
82	7.115
83	8.144

c)



d)



$\tan P = \frac{5}{8}$

$= 0.625$

$\angle P = 32°$

or... on calculator...

$\angle P = \tan^{-1}(0.625)$

$= 32°$

$\angle R = 180° - 90° - 32°$

$= 58°$

$\tan C = \frac{9}{12}$

$= 0.75$

* $\angle C$ = between 36° and 37°

* 0.75 is closer to 0.754 than 0.727

$\therefore \angle C = 37°$

$\angle A = 180° - 90° - 37°$

$= 53°$

The Tangent Ratios

Angle	Ratio (tan)
0	0.000
1	0.017
2	0.035
3	0.052
4	0.070
5	0.087
6	0.105
7	0.123
8	0.141
9	0.158
10	0.176
11	0.194
12	0.213
13	0.231
14	0.249
15	0.268
16	0.287
17	0.306
18	0.325
19	0.344
20	0.364
21	0.384
22	0.404
23	0.424
24	0.445
25	0.466
26	0.488
27	0.510
28	0.532
29	0.554
30	0.577
31	0.601
32	0.625
33	0.649
34	0.675
35	0.700
36	0.727
37	0.754
38	0.781
39	0.810
40	0.839
41	0.869
42	0.900
43	0.933
44	0.966
45	1.000

Angle	Ratio (tan)
45	1.000
46	1.036
47	1.072
48	1.111
49	1.150
50	1.192
51	1.235
52	1.280
53	1.327
54	1.376
55	1.428
56	1.483
57	1.540
58	1.600
59	1.664
60	1.732
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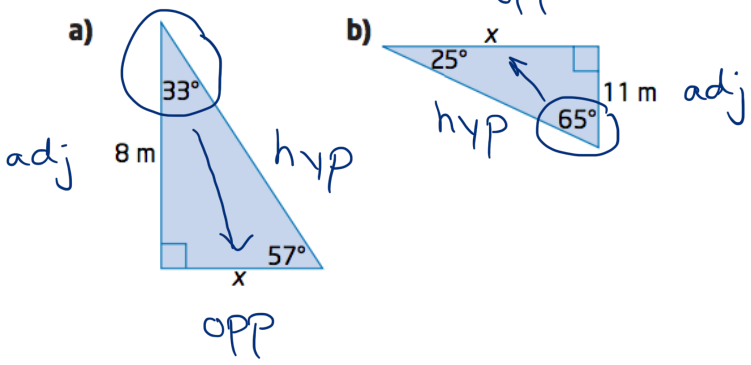
64	2.050
65	2.145
66	2.246
67	2.356
68	2.475
69	2.605
70	2.747
71	2.904
72	3.078
73	3.271
74	3.487
75	3.732
76	4.011
77	4.331
78	4.705
79	5.145
80	5.671
81	6.314
82	7.115
83	8.144
84	9.514
85	11.430
86	14.301
87	19.081
88	28.636
89	57.290
90	undefined

Example 2

Find the length of x, to the nearest tenth of a metre.

- pick an angle to look from
- aim to have the unknown in numerator if possible



adj 8 m hyp opp

opp x hyp 65° 11 m adj

$\tan 33° = \frac{x}{8}$

$8[\tan 33°] = [\frac{x}{8}]8$

$8(0.649) = x$

$5.2 = x$

$\tan 65° = \frac{x}{11}$

$11[\tan 65°] = [\frac{x}{11}]11$

$11(2.145) = x$

$23.6 = x$

The Tangent Ratios

Angle → Ratio (tan) | Angle → Ratio ($\tan^{-1}$)

Angle	Ratio
0	0.000
1	0.017
2	0.035
3	0.052
4	0.070
5	0.087
6	0.105
7	0.123
8	0.141
9	0.158
10	0.176
11	0.194
12	0.213
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41	0.869
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44	0.966
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Angle	Ratio
45	1.000
46	1.036
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84	9.514
85	11.430
86	14.301
87	19.081
88	28.636
89	57.290
90	undefined

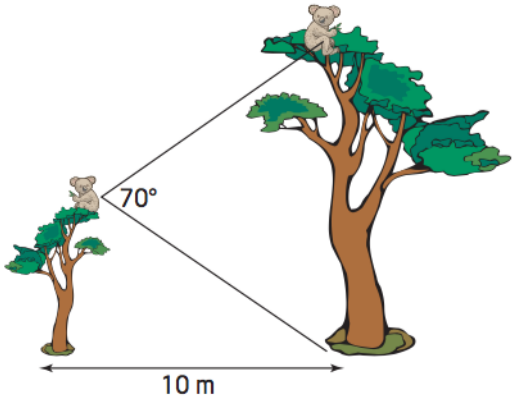
Opportunity to Learn

1. Two koalas sit at the top of two eucalyptus trees.

   The first tree is exactly half as tall as the second tree.

   How high off the ground is each koala?

   NOTE: Assume that the 10m side at the bottom of the diagram extends only to the vertex at which there is a 70° angle.



2. Complete questions 9 to 12 from the file at this link (http://tinyurl.com/y3uutckl). Final answers are on the second page of the file. Use a separate sheet of paper to complete those questions.