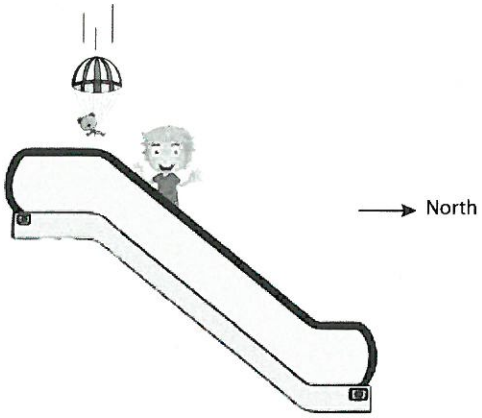
	Total	K+E	I+O
Students	32	16	16
Average	55.3 /100	53.3/100	57.3/100
Best	97.0/100	97.0/100	81.5/100

11thG Physics (2017– 18)

1st Q Exam- Honors

(November 2, 2017)

Class	No.	Name Solutions

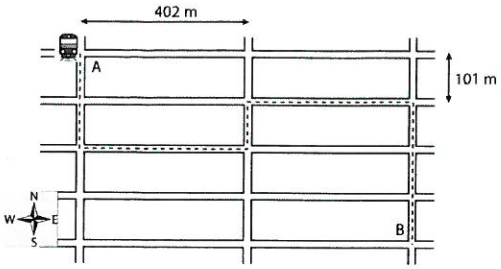


In calculation problems, describe equations clearly and systematically enough to show how to solve the problems.

5 points/problem x 21 problems= 105 points(Max 100 points)

Exam	/[Total 100 points]
Lab Reports	

The circular constant	$\pi = 3.14159...$
Mile	1 mile = 1609 m
Gravitational acceleration rate	$g = 9.80\ m/s^2$
Universal Gravitational Constant	$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$
Mass of the Earth	$M_E = 5.97 \times 10^{24}$ kg



(1) In Manhattan, 1 avenue block (east/west) is 1/4 mile (402 m) and a street block (north/south) is 1/16 mile (101 m). You leave a subway station (A in the map) and walk to the corner B in the map. The route you take is shown by dashed line.

(1-a) What is your <u>distance</u> you've covered in your walk?

(1-b) In the above walk, what is the <u>displacement</u>?

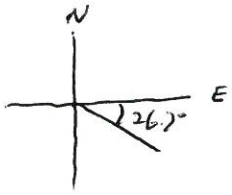
Equations

(a) $d = 101 \times 6 + 402 \times 2 = 606 + 804 = 1410$

(b) $r = \sqrt{804^2 + 404^2} = 899.8 \rightarrow 900$

$\theta = \tan^{-1}\left(\frac{-404}{804}\right) = -26.68^\circ$

$\rightarrow -26.7^\circ$



(1-a) Answer

1410 m

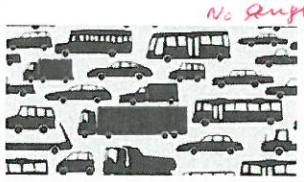
(1-b) Answer

900 m

26.7° South of east

(54%)

No Angle −1



(2) In heavy rush-hour traffic you drive in a straight line at 12 m/s for 1.5 minutes, then you have to stop for 3.5 minutes, and finally you drive at 15 m/s for another 2.5 minutes. Draw a position-time graph for this motion.

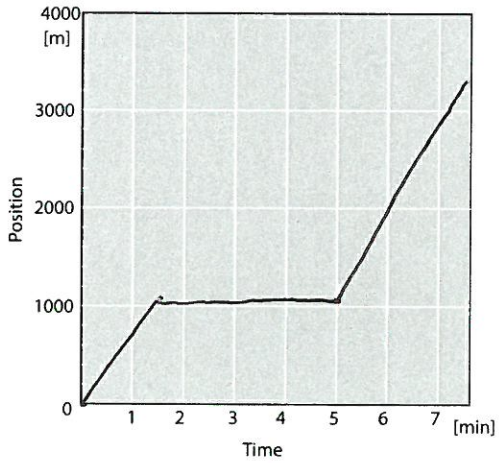
Equations

$x_1 = 12 \times 1.5 \times 60 = 1080$

$x_2 = 1080 + 15 \times 2.5 \times 60$

$= 1080 + 2250$

$= 3330$



(2) Answer

Draw a graph

(86%)

(3,4) One ride called the Detonator at Worlds of Fun in Kansas City, passenger accelerate straight downward from rest to 45 mile/h in 2.2 seconds.
(3) What is the average acceleration of the passengers on this ride?

(4) How far the passengers move in the first 2.2 seconds?

Equations

$1\ \text{mile} = 1609\ \text{m}$

$$45\ \text{mi/h} \times \frac{1609\ \text{m}}{1\ \text{mi}} \times \frac{1\ \text{h}}{3.6\times10^{3}\ \text{s}} = \frac{45\times1.609}{3.6}\ \text{m/s}$$

$$= 45\times0.4469 = 20.11\ (\text{m/s})$$

$$a = \frac{20.11-0}{2.2} = 9.14 \longrightarrow 9.1\ (\text{m/s}^2)$$

$$x = \frac{1}{2}at^2 = \frac{1}{2}\times 9.14\times 2.2^2 = 22.1$$

$$\longrightarrow 22\ (\text{m})$$

(3) Answer: 9.1 m/s^2 (70%)

(4) Answer: 22 m (58%)

(5,6) A park ranger driving on a back country road suddenly sees a deer "frozen" in the headlights. The ranger, who is driving at 11.4 m/s, immediately applied the brakes and slows with an acceleration of 3.80 m/s^2. The deer is 20.0 m from the ranger's car when the brakes are applied.

(5) Find the distance between the car and the deer when the car stops?

(6) How much time is needed for the ranger's car to stop?

Equations

(5) $v_0 = 11.4$ m/s

$a = -3.80$ m/s^2

$v^2 - v_0^2 = 2ax$

$x = \dfrac{v^2 - v_0^2}{2a} = \dfrac{0 - 11.4^2}{-2 \times 3.80}$

$= 17.10$ +3.5

$d = 20.00 - 17.10 = 2.90 \longrightarrow 2.9$ (m)

20.0
−) 17.10
2.90

(6) $v = v_0 + at$

$t = \dfrac{v - v_0}{a}$

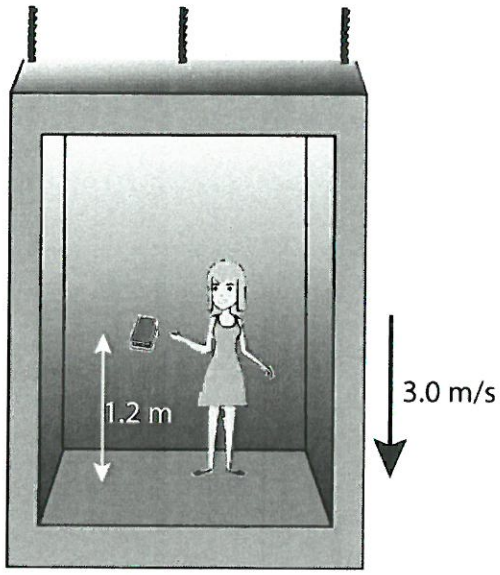
$= \dfrac{0 - 11.4}{-3.80}$

$= 3.000 \longrightarrow 3.00$

(5) Answer	2.9 m	(83%)

(6) Answer	3.00 s	(85%)

(7) While riding on an elevator going down with a constant speed of 3.0 m/s, you accidentally drop a book from under your arm. How long does it take for the book to reach the elevator floor, 1.2 m below your arm?



Equations

Book $y_1 = v_0 t + \frac{1}{2} g t^2$

$= 3.0t + \frac{1}{2} \times 9.80 \times t^2$

floor $y_2 = 1.2 + 3.0t$

$y_1 = y_2$

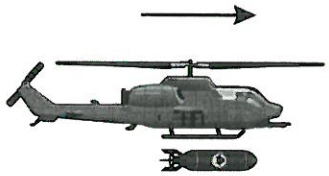
$3t + 4.9t^2 = 1.2 + 3t$

$t = \sqrt{\frac{1.2}{4.9}} = 0.4949$

$\longrightarrow 0.49$ (s)

(7) Answer

0.49 s (49%)



(8,9) A military helicopter on a training mission is flying horizontally at a speed of 60.0 m/s and accidentally drops a bomb at an elevation of 300.0 m. Ignore air resistance.

(8) How much time is required for the bomb to reach the earth?

(9) How far does it travel horizontally while falling?

Equations

(8) $y = \frac{1}{2} g t^2$

$t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2 \times 300}{9.80}}$

$= 7.8246 \longrightarrow 7.82 \text{ s}$

(9) $x = v_0 t$

$= 60.0 \times 7.8246$

$= 468.47$

$\longrightarrow 469 \text{ (m)}$

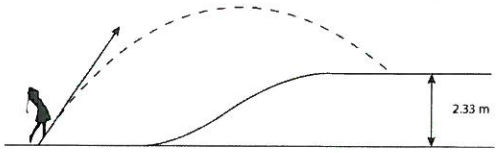
(8) Answer

7.82 s (95%)

(9) Answer

469 m (66%)

(10~12) A golfer tees off at an initial speed of 36.4 m/s and at an angle of 48.0° above the horizontal toward a target 2.33 m high from the tee ground.
(10) How long does the ball take to reach the highest point in air?



(11) How long does it travel before it hit the ground?

(12) How far does it travel before it hit the ground?
Equations

(10) $v_{ox} = 36.4 \cos 48.0^\circ = 24.36$ (m/s)

$v_{oy} = 36.4 \sin 48.0^\circ = 27.05$ (m/s)

$v_y = v_{oy} - gt = 0$

$t = \frac{v_{oy}}{g} = \frac{27.05}{9.80} = 2.760$

→ 2.76 (s)

(11) $y = v_{oy} t - \frac{1}{2} g t^2$

$2.33 = 27.05t - 4.9t^2$

$t^2 - 5.520t + 0.4694 = 0$

$t = \frac{5.520 \pm \sqrt{5.520^2 - 4 \times 0.4694}}{2}$

$= \frac{5.520 \pm 5.347}{2} = 5.434$ or 0.0900

→ 5.43 s

(0.090 s is the time the ball reached 2.33 m in the air)

(12) $x = v_{ox} t$

$= 24.36 \times 5.434$

$= 132.36$

→ 132

(10) Answer: 2.76 s (83½)

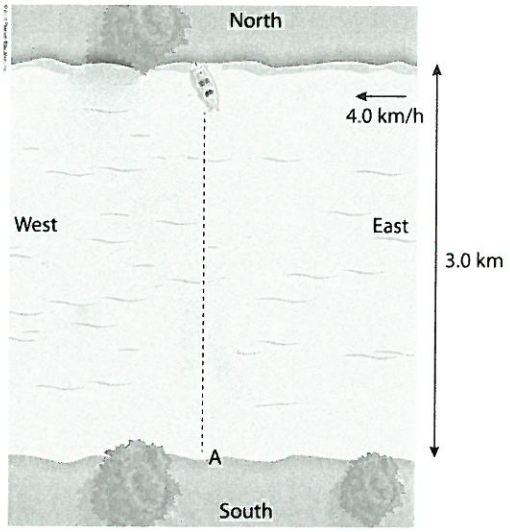
(11) Answer: 5.43 s (54½)

(12) Answer: 132 m (42½)

(13~15) A boat is moving at 5.0 km/h relative to the water. It is crossing a river from north to south. The river is 3.0 km wide in which the current is flowing from East to West at 4.0 km/h.
(13) In what direction should the boat head in order to get across the river in the shortest possible time, and how many minutes will it take?

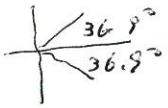
(14) In what direction should the boat head if it is to reach the point A directly opposite the starting point?

(15) How many minutes will the crossing take in case (14)?
Equations



(13) moving to the direction perpendicular to the flow

$$t = \frac{d}{v} = \frac{3.0\ \text{km}}{5.0\ \text{km/h}} = 0.600\ \text{h}$$
$$= 0.600 \times 60\ \text{min}$$
$$= 36.0 \rightarrow 36$$



(14) $\vec{v} = \vec{v}_w + \vec{v}_B$

$$\begin{cases} v_x = v_{wx} + v_{Bx} & 0 = -4.0 + v_{Bx} = -4.0 + 5\cos\theta \\ v_y = v_{wy} + v_{By} & v_y = 0 + v_{By} = 0 + 5\sin\theta \end{cases}$$

$$\cos\theta = \frac{4.0}{5} = 0.80$$
$$\theta = \cos^{-1}(0.80) = 36.87^\circ \rightarrow 37^\circ$$

(15) $v_y = 5 \sin 36.87^\circ$
$= 3.000$

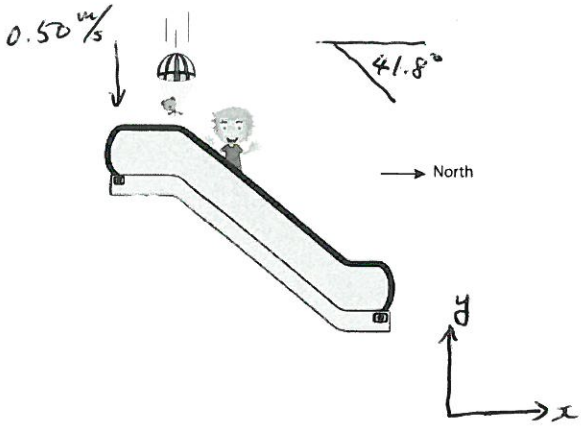
$$t = \frac{d}{v_y} = \frac{3.0}{3.000}$$
$$= 1.00\ (\text{h})$$
$$= 60.0\ (\text{min})$$

(13) Answer
To due south on water
36 min (31½)

(14) Answer
37° south of east (27½)

(15) Answer
60 min (24½)

(16) An escalator is moving downward due north at an angle of 41.8° below the horizontal at an constant speed of 0.75 m/s. At the same time a toy parachute is falling at a steady vertical speed of 0.50 m/s. Determine the velocity (magnitude and direction) of the parachute toy as observed from a boy on the moving escalator.



Equations

P : parachute

E : Escalator

$$\vec{v} = \vec{v}_P - \vec{v}_E$$

$$v_x = v_{Px} - v_{Ex} = 0 - 0.75\cos 41.8^\circ = -0.5591$$

$$v_y = v_{Py} - v_{Ey} = -0.50 - (-0.75\sin 41.8^\circ) = -0.0001$$

$$v = \sqrt{v_x^2 + v_y^2} \fallingdotseq v_x = 0.5591$$

$$\rightarrow 0.56\ (m/s)$$

(16) Answer

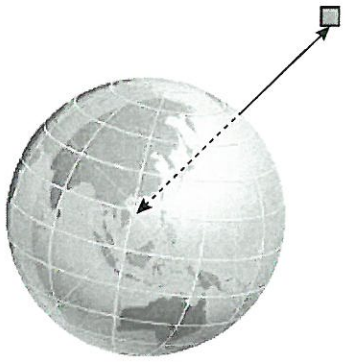
0.56 m/s

to due South horizontally

(33⅓)

No direction −2

(17,18) At a certain distance from the center of the Earth, a 4.6-kg object has a weight of 2.2 N.



(17) Find the distance between the object and the center of the Earth.

(18) If the object is released at this location and allowed to fall toward the Earth, what is its initial acceleration?
Equations

(17) $F = G\dfrac{Mm}{r^2}$

$r = \sqrt{\dfrac{GMm}{F}}$

$= \sqrt{\dfrac{6.67\times10^{-11}\times 5.97\times10^{24}\times 4.6}{2.2}}$ +1.5

$= \sqrt{\dfrac{6.67\times5.97\times4.6}{2.2}\times10^{13}}$

$= \sqrt{8.326\times10^{14}}$ +2.5

$= 2.885\times10^{7}$

$\rightarrow 2.9\times10^{7}$ (m)

(17) Answer

2.9×10^{7} m (53½)

(18)

$a = \dfrac{F}{m}$

$= \dfrac{2.2}{4.6}$

$= 0.478$

$\rightarrow 0.48$ (m/s^2)

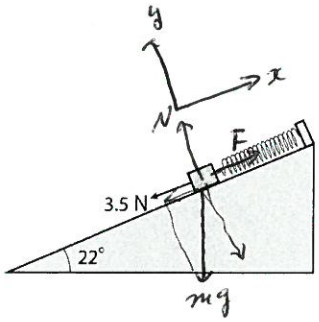
(18) Answer

0.48 m/s^2 (24½)

(12) Answer

(19) A force 3.5 N is exerted on a body downward and parallel to the slope. The body with a mass of 4.00 kg is at rest on the frictionless slope as shown.

(a) Illustrate force vectors acting on this body with arrows in the figure below.
(b) Describe the name of the forces in the figure below.
(c) Determine the magnitude of the forces and show them in the figure below.



(20) The spring shows an elongation of 16.5 cm from its original length. What is the spring constant of this spring?
Equations

$mg = 4.00 \times 9.80$

$= 39.2\ N$

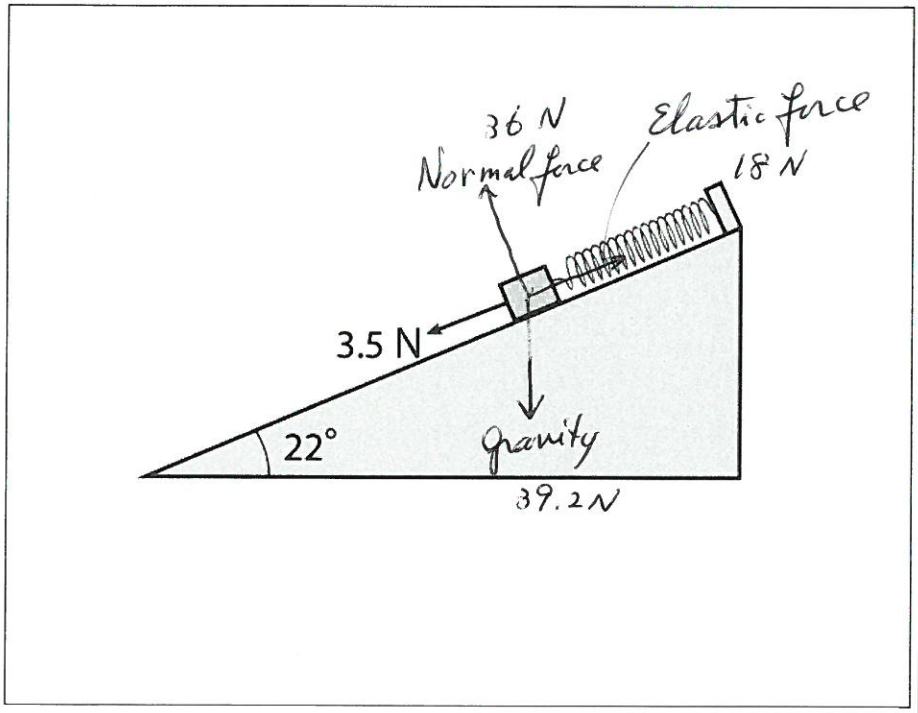
$N = 39.2 \cos 22°$

$= 36.3\ (N) \longrightarrow 36\ N$

$F = 3.5 + 39.2 \sin 22°$

$= 3.5 + 14.68$

$= 18.18 \rightarrow 18\ N$



(19) Answer

Draw arrows and describe names and magnitude (6½)

(20) $F = kx$

$k = \frac{F}{x} = \frac{18.18}{16.5 \times 10^{-2}}$

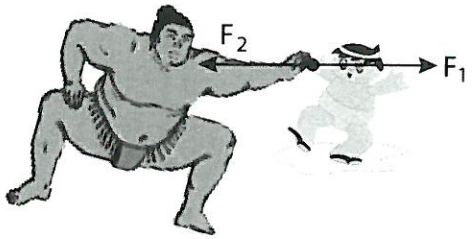
$= 1.10 \times 10^{2}$

$\rightarrow 110$

(20) Answer

110 N/m (12½)

(21) A kid and a sumo wrestler push each other. According to the Newton's third law, the force F1 exerted on the kid by the wrestler and the force F2 exerted on the wrestler by the kid must be equal in magnitude and opposite in direction. Explain in terms of Physics why the sumo wrestler can win in this push?



(21) Answer

The sumo wrestler can win because he has much more mass than the kid.

Assuming the masses of the wrestler and the kid are M and m, respectively, According to the Newton's 2nd law, the acceleration rate just after the push is given:

$$a(\text{wrestler}) = \frac{F_2}{M} \quad \text{and} \quad a(\text{kid}) = \frac{F_1}{m}.$$

(29%)

$F_1 = F_2$ and $M \gg m$,

Then, $a(\text{wrestler}) \ll a(\text{kid})$,

The kid moves much more quickly than the wrestler

mass, weight +1.5

Trigonometric Function Table

角	正弦 (sin)	余弦 (cos)	正接 (tan)
0.0°	0.0000	1.0000	0.0000
0.5°	0.0087	1.0000	0.0087
1.0°	0.0175	0.9998	0.0175
1.5°	0.0262	0.9997	0.0262
2.0°	0.0349	0.9994	0.0349
2.5°	0.0436	0.9990	0.0437
3.0°	0.0523	0.9986	0.0524
3.5°	0.0610	0.9981	0.0612
4.0°	0.0698	0.9976	0.0699
4.5°	0.0785	0.9969	0.0787
5.0°	0.0872	0.9962	0.0875
5.5°	0.0958	0.9954	0.0963
6.0°	0.1045	0.9945	0.1051
6.5°	0.1132	0.9936	0.1139
7.0°	0.1219	0.9925	0.1228
7.5°	0.1305	0.9914	0.1317
8.0°	0.1392	0.9903	0.1405
8.5°	0.1478	0.9890	0.1495
9.0°	0.1564	0.9877	0.1584
9.5°	0.1650	0.9863	0.1673
10.0°	0.1736	0.9848	0.1763
10.5°	0.1822	0.9833	0.1853
11.0°	0.1908	0.9816	0.1944
11.5°	0.1994	0.9799	0.2035
12.0°	0.2079	0.9781	0.2126
12.5°	0.2164	0.9763	0.2217
13.0°	0.2250	0.9744	0.2309
13.5°	0.2334	0.9724	0.2401
14.0°	0.2419	0.9703	0.2493
14.5°	0.2504	0.9681	0.2586
15.0°	0.2588	0.9659	0.2679
15.5°	0.2672	0.9636	0.2773
16.0°	0.2756	0.9613	0.2867
16.5°	0.2840	0.9588	0.2962
17.0°	0.2924	0.9563	0.3057
17.5°	0.3007	0.9537	0.3153
18.0°	0.3090	0.9511	0.3249
18.5°	0.3173	0.9483	0.3346
19.0°	0.3256	0.9455	0.3443
19.5°	0.3338	0.9426	0.3541
20.0°	0.3420	0.9397	0.3640
20.5°	0.3502	0.9367	0.3739
21.0°	0.3584	0.9336	0.3839
21.5°	0.3665	0.9304	0.3939
22.0°	0.3746	0.9272	0.4040
22.5°	0.3827	0.9239	0.4142

角	正弦 (sin)	余弦 (cos)	正接 (tan)
22.5°	0.3827	0.9239	0.4142
23.0°	0.3907	0.9205	0.4245
23.5°	0.3987	0.9171	0.4348
24.0°	0.4067	0.9135	0.4452
24.5°	0.4147	0.9100	0.4557
25.0°	0.4226	0.9063	0.4663
25.5°	0.4305	0.9026	0.4770
26.0°	0.4384	0.8988	0.4877
26.5°	0.4462	0.8949	0.4986
27.0°	0.4540	0.8910	0.5095
27.5°	0.4617	0.8870	0.5206
28.0°	0.4695	0.8829	0.5317
28.5°	0.4772	0.8788	0.5430
29.0°	0.4848	0.8746	0.5543
29.5°	0.4924	0.8704	0.5658
30.0°	0.5000	0.8660	0.5774
30.5°	0.5075	0.8616	0.5890
31.0°	0.5150	0.8572	0.6009
31.5°	0.5225	0.8526	0.6128
32.0°	0.5299	0.8480	0.6249
32.5°	0.5373	0.8434	0.6371
33.0°	0.5446	0.8387	0.6494
33.5°	0.5519	0.8339	0.6619
34.0°	0.5592	0.8290	0.6745
34.5°	0.5664	0.8241	0.6873
35.0°	0.5736	0.8192	0.7002
35.5°	0.5807	0.8141	0.7133
36.0°	0.5878	0.8090	0.7265
36.5°	0.5948	0.8039	0.7400
37.0°	0.6018	0.7986	0.7536
37.5°	0.6088	0.7934	0.7673
38.0°	0.6157	0.7880	0.7813
38.5°	0.6225	0.7826	0.7954
39.0°	0.6293	0.7771	0.8098
39.5°	0.6361	0.7716	0.8243
40.0°	0.6428	0.7660	0.8391
40.5°	0.6494	0.7604	0.8541
41.0°	0.6561	0.7547	0.8693
41.5°	0.6626	0.7490	0.8847
42.0°	0.6691	0.7431	0.9004
42.5°	0.6756	0.7373	0.9163
43.0°	0.6820	0.7314	0.9325
43.5°	0.6884	0.7254	0.9490
44.0°	0.6947	0.7193	0.9657
44.5°	0.7009	0.7133	0.9827
45.0°	0.7071	0.7071	1.0000

角	正弦 (sin)	余弦 (cos)	正接 (tan)
45.0°	0.7071	0.7071	1.0000
45.5°	0.7133	0.7009	1.0176
46.0°	0.7193	0.6947	1.0355
46.5°	0.7254	0.6884	1.0538
47.0°	0.7314	0.6820	1.0724
47.5°	0.7373	0.6756	1.0913
48.0°	0.7431	0.6691	1.1106
48.5°	0.7490	0.6626	1.1303
49.0°	0.7547	0.6561	1.1504
49.5°	0.7604	0.6494	1.1708
50.0°	0.7660	0.6428	1.1918
50.5°	0.7716	0.6361	1.2131
51.0°	0.7771	0.6293	1.2349
51.5°	0.7826	0.6225	1.2572
52.0°	0.7880	0.6157	1.2799
52.5°	0.7934	0.6088	1.3032
53.0°	0.7986	0.6018	1.3270
53.5°	0.8039	0.5948	1.3514
54.0°	0.8090	0.5878	1.3764
54.5°	0.8141	0.5807	1.4019
55.0°	0.8192	0.5736	1.4281
55.5°	0.8241	0.5664	1.4550
56.0°	0.8290	0.5592	1.4826
56.5°	0.8339	0.5519	1.5108
57.0°	0.8387	0.5446	1.5399
57.5°	0.8434	0.5373	1.5697
58.0°	0.8480	0.5299	1.6003
58.5°	0.8526	0.5225	1.6319
59.0°	0.8572	0.5150	1.6643
59.5°	0.8616	0.5075	1.6977
60.0°	0.8660	0.5000	1.7321
60.5°	0.8704	0.4924	1.7675
61.0°	0.8746	0.4848	1.8040
61.5°	0.8788	0.4772	1.8418
62.0°	0.8829	0.4695	1.8807
62.5°	0.8870	0.4617	1.9210
63.0°	0.8910	0.4540	1.9626
63.5°	0.8949	0.4462	2.0057
64.0°	0.8988	0.4384	2.0503
64.5°	0.9026	0.4305	2.0965
65.0°	0.9063	0.4226	2.1445
65.5°	0.9100	0.4147	2.1943
66.0°	0.9135	0.4067	2.2460
66.5°	0.9171	0.3987	2.2998
67.0°	0.9205	0.3907	2.3559
67.5°	0.9239	0.3827	2.4142

角	正弦 (sin)	余弦 (cos)	正接 (tan)
67.5°	0.9239	0.3827	2.4142
68.0°	0.9272	0.3746	2.4751
68.5°	0.9304	0.3665	2.5386
69.0°	0.9336	0.3584	2.6051
69.5°	0.9367	0.3502	2.6746
70.0°	0.9397	0.3420	2.7475
70.5°	0.9426	0.3338	2.8239
71.0°	0.9455	0.3256	2.9042
71.5°	0.9483	0.3173	2.9887
72.0°	0.9511	0.3090	3.0777
72.5°	0.9537	0.3007	3.1716
73.0°	0.9563	0.2924	3.2709
73.5°	0.9588	0.2840	3.3759
74.0°	0.9613	0.2756	3.4874
74.5°	0.9636	0.2672	3.6059
75.0°	0.9659	0.2588	3.7321
75.5°	0.9681	0.2504	3.8667
76.0°	0.9703	0.2419	4.0108
76.5°	0.9724	0.2334	4.1653
77.0°	0.9744	0.2250	4.3315
77.5°	0.9763	0.2164	4.5107
78.0°	0.9781	0.2079	4.7046
78.5°	0.9799	0.1994	4.9152
79.0°	0.9816	0.1908	5.1446
79.5°	0.9833	0.1822	5.3955
80.0°	0.9848	0.1736	5.6713
80.5°	0.9863	0.1650	5.9758
81.0°	0.9877	0.1564	6.3138
81.5°	0.9890	0.1478	6.6912
82.0°	0.9903	0.1392	7.1154
82.5°	0.9914	0.1305	7.5958
83.0°	0.9925	0.1219	8.1443
83.5°	0.9936	0.1132	8.7769
84.0°	0.9945	0.1045	9.5144
84.5°	0.9954	0.0958	10.385
85.0°	0.9962	0.0872	11.430
85.5°	0.9969	0.0785	12.706
86.0°	0.9976	0.0698	14.301
86.5°	0.9981	0.0610	16.350
87.0°	0.9986	0.0523	19.081
87.5°	0.9990	0.0436	22.904
88.0°	0.9994	0.0349	28.636
88.5°	0.9997	0.0262	38.188
89.0°	0.9998	0.0175	57.290
89.5°	1.0000	0.0087	114.59
90.0°	1.0000	0.0000	− − −

Square and Root

n	n^2	$\sqrt{n}$
1	1	1.0000
2	4	1.4142
3	9	1.7321
4	16	2.0000
5	25	2.2361
6	36	2.4495
7	49	2.6458
8	64	2.8284
9	81	3.0000
10	100	3.1623

Opinions, excuses etc.