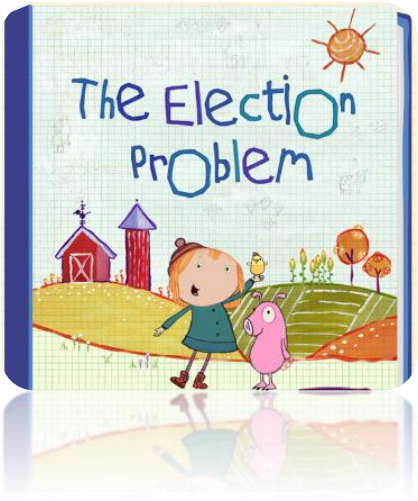
Practice Problems for PE01



For PE01, you'll complete an IPO console program from scratch. For this exam you'll need to know:

- How to do input and output with `cin` and `cout`
- How to print escape sequences (easiest with raw strings)
- How to do formatting with `<iomanip>` (`fixed` and `setprecision`)
- How to read a formula and convert it to a C++ expression.
- How real division and integer division differ
- How to use the `sqrt` and pow function in the `<cmath>` header
- How to include the correct headers
- How to write the program in the correct IPO order.

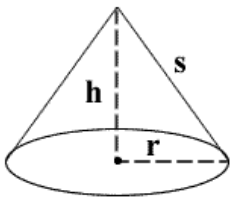
After you submit your exam, your instructor will test it and assign you a grade. The exam will be tested in two parts. Part I will check to see that the format exactly matches the mockup that is provided. Especially make sure that your program produces exactly the correct number of lines. Part II will check that your calculations are correct. Here is what the instructor testing looks like (no tests passing).

```
TESTING PE01-H--YOUR CANVAS ID GOES HERE
-----------------------------------------------------------------
  PART I - Output structure matches specification
  ..............................................
   X Checking lines in output.: expected [7] but found [0]
   X No first line of output printed.

   X No seventh line of output printed

PART II - Check Correctness of Wind Chill Calculations
..................................................
   X For input of t->0.0, v->12.0, WindChill-> : expected [-25
   X For input(t->23.2, v->31.9), WindChill-[w/ formatting]: e
   X For input(t->-33.4, v->47.9), WindChill-[w/ formatting]:
   X For input(t->-61.8, v->26.1), WindChill-[w/ formatting]:
```

Below are some sample problems that you can use for practice.

1 THE CONE VOLUME PROBLEM

Write a program to calculate the **volume** of a right-circular code, like the one pictured here. To calculate the volume (**V**) of a cone, given a radius (**R**) and a height (**H**), the formula is:



$$V = \frac{1}{3}\pi R^2 H$$

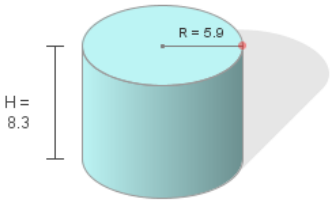
Here is the program running. Your program should reproduce exactly this output. Pay attention to these items:

→ Seven lines of output including 2 blank lines
→ Your name on the first line (not mine)
→ Escape sequences on the second line
→ Lines 3 and 6 are blank
→ Result inside brackets [ ] without formatting
→ Use **`acos(-1.0)`** for PI

```
Gilbert, Stephen: Cone Volume Calculator
\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\

Enter the radius of the cone: 5.9
Enter the height of the cone: 8.3

Cone Volume [302.559]
```

2 THE CYLINDER AREA PROBLEM

Write a program to calculate the **surface area** of a cylinder; you'll need the area of the top, plus the area of the bottom, plus the area around the cylinder (the lateral surface area). The formula for calculating the total surface area of a cylinder (**A**) with radius (**R**) and height (**H**) is:



$$A = 2\pi R^2 + 2\pi RH$$

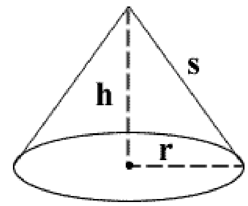
Here is the program running. Your program should reproduce exactly this output. Pay attention to these items:

→ Seven lines of output (2 blank lines)
→ Your name on the first line (not mine)
→ Escape sequences on the second line
→ Result inside brackets [ ] without no extra formatting
→ Use **`acos(-1.0)`** for PI

```
Gilbert, Stephen: Cylinder Area Calculator
-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\

Enter the radius of the cylinder: 5.9
Enter the height of the cylinder: 8.3

Cylinder Area [526.405]
```

3 THE CONE SURFACE AREA PROBLEM

Write a program to calculate the **total surface area** of a right-circular code, like the one pictured here. To calculate the area (**A**) of a cone, given a radius (**r**) and a height (**h**), the formula is:



$$A = \pi r(r + \sqrt{h^2 + r^2})$$

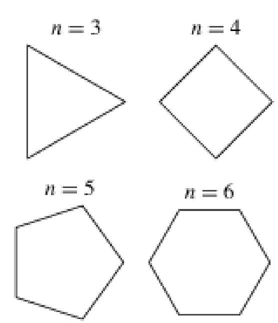
Here is the program running. Your program should reproduce exactly this output. Pay attention to these items:

- → Seven lines of output (2 blank lines)
- → Your name on the first line (not mine)
- → Escape sequences on the second line
- → Lines 3 and 6 are blank
- → Result inside brackets [ ] without no extra formatting
- → Use **`acos(-1.0)`** for PI

```
Gilbert, Stephen: Cone Surface Area Calculator
\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\"/\

Enter the radius of the cone: 5.9
Enter the height of the cone: 8.3

Cone Surface Area [298.111]
```

4 THE POLYGON AREA PROBLEM

Write a program to calculate the **surface area** of a regular polygon, one where all sides have the same length, like those in the picture to the right. To calculate the surface area you need the number of sides (**n**) and the length of any side (**s**). The formula you'll use is:



$$area = \frac{s^2 n}{4\tan\left(\frac{\pi}{n}\right)}$$

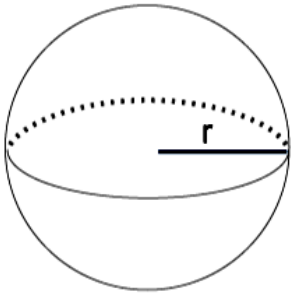
Here is the program running. Produce exactly this output. Pay attention to:

- → Seven lines of output (2 blank lines)
- → Your name on the first line (not mine)
- → Escape sequences on the second line
- → Result inside brackets [ ] without no extra formatting
- → Use **`acos(-1.0)`** for PI

```
Gilbert, Stephen: Polygon Area Calculator
"'"'"'"'"'"'"'"'"'"'"'"'"'"'"'"'"'"'"'"'"

Enter the number of sides (as an integer): 6
Enter the length of each side: 4.25

Polygon Area: [46.9278]
```

5 THE SPHERE STATISTICS PROBLEM

Write a program to calculate both the volume and the area of a sphere, given a radius **r**. The volume **V**, and the area **A**, are calculated by using the formulas:



- $V = \frac{4}{3}\pi r^3$
- $A = 4\pi r^2$

Here is the program running. Your program should reproduce exactly this output. Pay attention to these items:

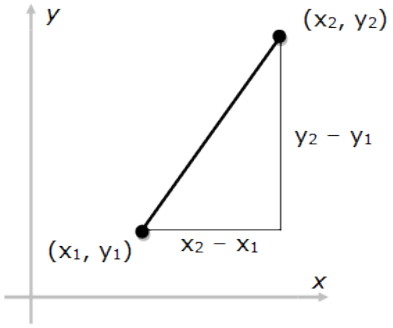
→ Seven lines of output (2 blank lines)
→ Your name on the first line (not mine)
→ Escape sequences on the second line
→ Lines 3 and 5 are blank
→ Result inside brackets [ ] without no extra formatting
→ Use **`acos(-1.0)`** for PI

```
Gilbert, Stephen: Sphere Calculator
\|/|\|/\|/\|/\|/\|/\|/\|/\|/\|/\

Enter the radius of the sphere: 8.3

Sphere Volume: [2395.1]
Sphere Surface Area: [865.697]
```

6 THE POINT DISTANCE PROBLEM

Write a program to calculate the distance between two points (**x1**, **y1**) and (**x2**, **y2**) and displays the distance. The formula for calculating the distance between two points is:

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$



Here is the program running. Your program should reproduce exactly this output. Pay attention to these items:

→ Seven lines of output (2 blank lines)
→ Your name on the first line (not mine)
→ Escape sequences on the second line
→ Lines 3 and 6 are blank
→ Result inside brackets [ ] without no extra formatting

```
Gilbert, Stephen: Distance Calculator
\"\\"\\"\\"\\"\\"\\"\\"\\"\\"\\"\\"\\"\\

Enter x1 and y1: 1.5 -3.4
Enter x2 and y2: 4.0 5.1

Distance between points [8.86002]
```

7 THE NEW WINDCHILL PROBLEM

Write a program to calculate the "wind-chill" or "feels-like" temperature (**T**) given the wind speed (**v**) in miles per hour and the temperature (**t**) in Fahrenheit. Your program should use the "new" wind-chill formula adopted in 2001 by the National Weather Service:

$$T = 35.74 + 0.6215t - 35.75v^{0.16} + 0.4275tv^{0.16}$$

Here is the program running. Your program should reproduce exactly this output. Pay attention to these items:

→ Seven lines of output (2 blank lines)
→ Your name on the first line (not mine)
→ Escape sequences on the second line
→ Lines 3 and 6 are blank
→ Result inside brackets [ ] without no extra formatting

```
Gilbert, Stephen: Wind Chill Calculator
/"\"/"\"/"\"/"\"/"\"/"\"/"\"/"\"/"\"/"\"/"\

Enter the temperature in Fahrenheit: 0.0
Enter the wind speed in mile-per-hour: 12.0

Wind Chill: [-17.4641]
```

8 THE OLD WINDCHILL PROBLEM

Write a program to calculate the "wind-chill" or "feels-like" temperature (**T**) given the wind speed (**v**) in miles per hour and the temperature (**t**) in Fahrenheit. Your program should use the "old" wind-chill formula:

$$W = 0.0817\left(3.71\sqrt{v} + 5.81 - 0.25v\right)(t - 91.4) + 91.4$$

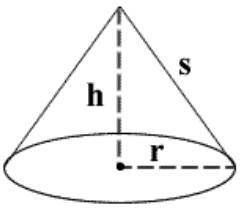
Here is the program running. Your program should reproduce exactly this output. Pay attention to these items:

→ Seven lines of output (2 blank lines)
→ Your name on the first line (not mine)
→ Escape sequences on the second line
→ Lines 3 and 6 are blank
→ Result inside brackets [ ] without no extra formatting

```
Gilbert, Stephen: Wind Chill Calculator
"\"/""\"/""\"/""\"/""\"/""\"/""\"/""\"/

Enter the temperature in Fahrenheit: 0.0
Enter the wind speed in mile-per-hour: 12.0

Wind Chill: [-25.5527]
```

9 THE CONE SLANT HEIGHT PROBLEM

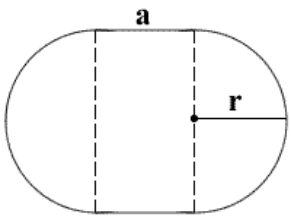
Write a program to calculate the **slant height** (**S**) of a right-circular code, like the one pictured here. Given a radius (**r**) and a height (**h**), the formula is:



$$S = \sqrt{h^2 + r^2})$$

10THE STADIUM AREA PROBLEM

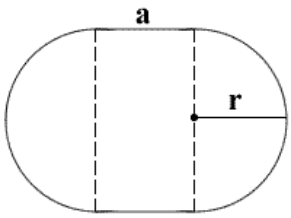
A stadium is a circle of radius **r** that has been cut in half through the center and the 2 ends are then separated by a rectangle of height **r** and width (or side length) of **a**. Write a program to calculate the area (**A**) using this formula.



$$A = \pi r^2 + 2ra$$

11THE STADIUM PERIMETER PROBLEM

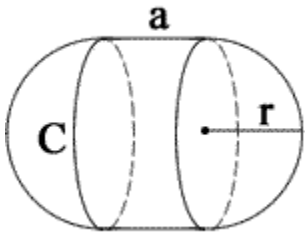
A stadium is a circle of radius **r** that has been cut in half through the center and the 2 ends are then separated by a rectangle of height **r** and width (or side length) of **a**. Write a program to calculate the perimeter (P) using this formula.



$$P = 2(\pi r + a)$$

12 THE CAPSULE VOLUME PROBLEM

Write a program to calculate the volume (**V**) of a capsule with a radius **r** and a side length **a**, using the formula:

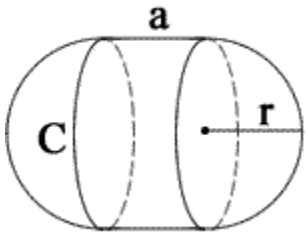


$$V = \pi r^2 \left(\frac{4}{3} r + a \right)$$

13 The Capsule Area Problem

Write a program to calculate the surface area (**A**) of a capsule with a radius **r** and a side length **a**, using the formula:

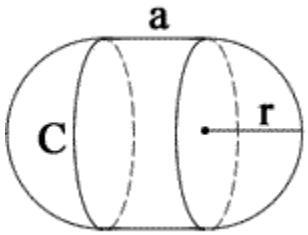
$$V = 2\pi r\left(2r + a\right)$$



14 The Capsule Circumference Problem

Write a program to calculate the circumference (**C**) of a capsule with a radius **r** and a side length **a**, using the formula:

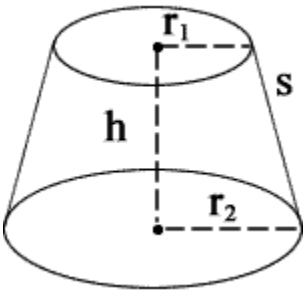
$$C = 2\pi r$$



15 The Conical Frustum Volume Problem

Write a program to calculate the volume (**V**) of a conical frustum with a height **h** and the two radius $\mathbf{r_1}$ and $\mathbf{r_2}$. Here is the formula:

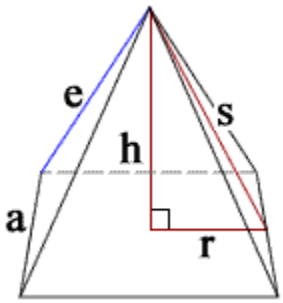
$$V = \frac{1}{3}\pi h\left(r_1^{\,2} + r_2^{\,2} + \left(r_1 r_2\right)\right)$$



16 The Pyramid Volume Problem

Write a program to calculate the volume (**V**) of a square pyramid as shown here. Here is the formula:

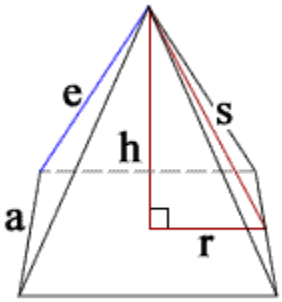
$$V = \frac{1}{3}a^2 h$$



17 The Pyramid Surface Area Problem

Write a program to calculate the total surface area (**A**) of a square pyramid as shown here. Here is the formula:

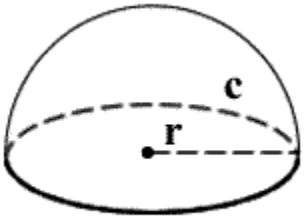
$$A = a\left(a + \sqrt{a^2 + 4h^2}\right)$$



18 The Hemisphere Volume Problem

Write a program to calculate the volume (**V**) of a hemisphere as shown here. Here is the formula:

$$V = \frac{2}{3}\pi r^3$$



19 The Hemisphere Surface Area Problem

Write a program to calculate the total surface area (**K**) of a hemisphere as shown here. Here is the formula:

$$K = 3\pi r^2$$