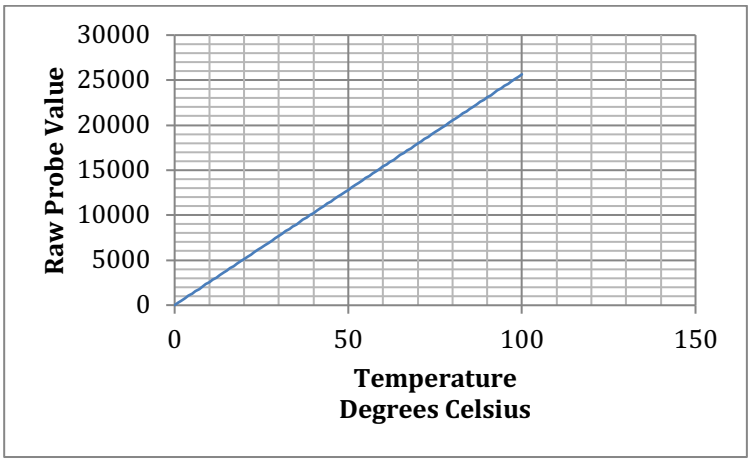
Appendix D

Part 1

Coding Connections at the Interface of Algebra I and Physical World Concepts Post-Test

Name: _____

1. **The following chart is from a datasheet describing the characteristics of the Lego temperature sensor. If the sensor is reading a raw value of 9000 what is the temperature in the room? Write your answer in Celsius.**



Temperature = _____C

2. **When you did the calculation in problem Problem 1, which variable is the independent variable and which is the dependent variable? Explain your reasoning.**

3. **The design of the temperature probe creates a relationship between the raw output value and temperature. In this relationship, which is the independent variable and which is the dependent variable? Explain your reasoning.**

4. **If the temperature is 60º Celsius, what is the raw output value from the temperature sensor?**

Raw Value = _____

5. **Again using Problem 1, write an equation describing the input temperature / raw ouput value. Let the variable 'x' be the raw value and f(x) the temperature (in degrees Celsius).**

   f(x) = _____

6. **Using your equation from Problem 5, write a Python function that returns the temperature in Fahrenheit given some raw value. The formula to convert degrees Celsius to degrees Fahrenheit is F = 9/5 C + 32.**

   def RawToFahr(r_value):

   tempC = _____

   tempF = _____

   return tempF

7. **After running the following code on your EV3 robot, which direction (toward the left motor or the right motor) will the robot drift as it moves forward? Explain your answer.**

```
steer = 10
left = ev3dev.large_motor('outA')
right = ev3dev.large_motor('outB')
left.time_sp=5000
right.time_sp=5000
left.duty_cycle_sp= 50 + steer
right.duty_cycle_sp= 50 - steer
left.run_timed()
right.run_timed()
```

8. **What is output to the terminal window after running the following Python code?**

```
x = 4
y = 2
z = 5
print(x**y)
```

9. **A robot has wheels that are 5cm in diameter and an effective wheel base of 20cm. If the right wheel remains stationary, how many rotations must the left wheel perform to turn the robot 90º to the right?**

10. **What is the output of the following Python code?**

```
print(3 + 4 * 7 - 6 / 2)
```

11. **Consider the following anecdotal story:**

    "Carl Friedrich Gauss was born in 1777 and later became one of the greatest mathematicians of all time. Once, as a youth in elementary school, his teacher made him add up all the numbers from 1 to 100 as punishment for misbehavior. He was able to solve the problem in seconds."

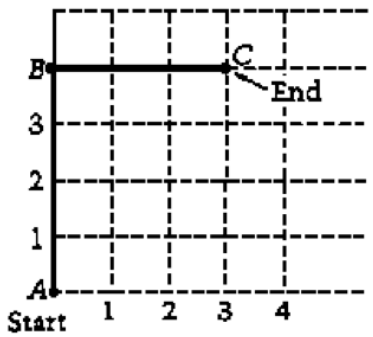
    Finish the Python code below to find the same solution.

```
sum = ___________
for n in range(101):
     sum += ____
print(sum)
```

12. What is the output of the following Python code?

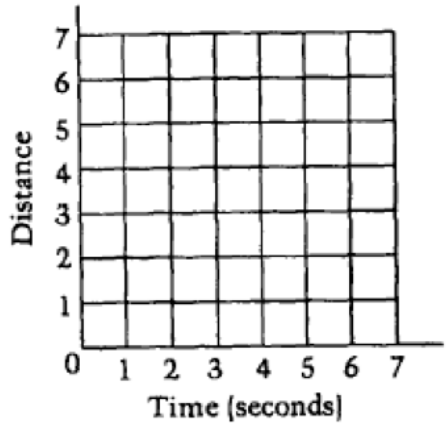
```
x = 23
if x < 12:
     print("Option 1")
else:
     print("Option 2")
```

13. The darkened segments in the figure below show the path of a robot that starts at point *A* and moves to point *B* and then on to point *C*. The robot moves at a constant rate of 1 unit per second. The robot's distance from a point is the <u>shortest</u> distance between the robot and the point.



What is the distance between point A and point C?

14. Referring back to Problem 13, sketch the graph of the distance of the robot from point *A* as a function of time on the 7-second interval.



15. On your graph for Problem 14, sketch the distance of the robot from point *C* as a function of time on the 7-second interval.

16. Using your graph for Problems 14 and 15, determine between which two consecutive seconds is the robot equidistant from points *A* and *C*.

17. Briefly outline an experiment Chloe could do at her school, using a robot with a zip-line, to explain the conversion of potential to kinetic energy. Indicate what materials Chloe will need, what measurements she will take, and what computations she will make.

18. Using the zip-line experiment described in the previous question, four teams in Chloe's class did the experiment you described. Each team got a different answer. Explain one reason why this might happen.

19. An engineer made a model of a ship to help him think about how it works. He made sure that some characteristics of the ship were accurately represented, but he did not include all of the ship's characteristics in his model. Is it okay that he ignored some of the ship's characteristics?

A. It is okay, but only if he represented the characteristics that affect how the ship works, because models need to include the characteristics that are relevant to what is being studied.

B. It is okay, but only if he represented the characteristics that affected whether the model looks like the ship, because models should look like the things that they represent.

C. It is okay, but only if he represented the characteristics that people would be interested in knowing about, because models are only used to communicate information to others.

D. It is not okay that he ignored some of the ship's characteristics. A model should be like the object it is representing in every way possible.

20. An architect is designing a house and shows the plans to his coworker. The coworker likes the design but tells the architect that he now needs to make a three-dimensional (3-D) model of the house before the construction company can begin building it.

The architect says that even though the plans are just drawings on paper, they can be thought of as a model of the house. The coworker disagrees and says that a model of a house has to be three-dimensional.

As they discuss it further, they agree that the plans have all the information the construction company will need to build the house, including designs for building the floors and walls, but the architect and his coworker still disagree about whether the plans can be called a model.

Which of them is correct and why?

A. The architect is correct because he is the one who made the plans and therefore knows whether they can be considered a model.

B. The architect is correct because the plans represent the features of the house that are to be built.

C. The coworker is correct because a model needs to be three-dimensional.

D. Neither is correct because the house has not yet been built, and there cannot be a model of something that does not exist.

Items 17 & 18

TIMSS Assessment (1995). International Association for the Evaluation of Educational Achievement (IEA). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. *H29 a & b page 178*
https://isc.bc.edu/timss1995i/TIMSSPDF/CitemPhy.pdf

Items 19 & 20

American Association for the Advancement of Science (2020). Science Assessment.
http://assessment.aaas.org/pages/home

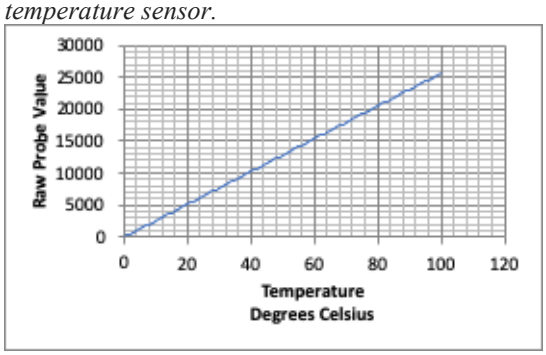
Part 2

(A) **Using your equation from Problem 5 (*included below*), write a Python function that returns the temperature in Fahrenheit given some raw value. The formula to convert degrees Celsius to degrees Fahrenheit is F = 9/5 C + 32.**

```
def RawToFahr(r_value):
        tempC = _____
        tempF = _____
        return tempF
```

Previous problems for reference.

The following chart is from a datasheet describing the characteristics of the Lego temperature sensor.



Write an equation describing the input temperature / raw output value. Let the variable 'x' be the raw value and f(x) the temperature (in degrees Celsius).

f(x) = _____

Sample Correct Participant Response:

```
def RawToFahr(r_value):
        tempC = r_value/250
        tempF =  9/5 * tempC +32
        return tempF
```

(B) **Using your graph for Problems 14 and 15, determine between which two consecutive seconds is the robot equidistant from points *A* and *C*.**

Correct Response: Between 3 and 4 seconds

(C) **After running the following code on your EV3 robot, which direction (toward the left motor or the right motor) will the robot drift as it moves forward? Explain your answer.**

```
steer = 10
left = ev3dev.large_motor('outA')
right =
ev3dev.large_motor('outB')
left.time_sp=5000
right.time_sp=5000
left.duty_cycle_sp= 50 + steer
right.duty_cycle_sp= 50 - steer
left.run_timed()
right.run_timed()
```

Sample Correct Participant Response:
It will veer right because the power of the left motor will be 60% and the power to the right will be 40%, making the left wheels turn faster.

(D) **Briefly outline an experiment Chloe could do at her school, using a robot with a zip-line, to explain the conversion of potential to kinetic energy. Indicate what materials Chloe will need, what measurements she will take, and what computations she will make**.

Sample Correct Participant Response:
An ultrasonic sensor will allow her to create a graph showing a function of time versus height. This will show the relationship that as time increases the height decreases at a faster rate. She can then calculate the acceleration of the object as a function of distance over time squared. Knowing the mass of the robot will allow her to calculate the potential and kinetic energies.
PE=mgh & KE=1/2mv^2

(E) **What is the output of the following Python code?**

```
x = 23
if x < 12:
     print("Option 1")
else:
     print("Option 2")
```

Correct Response: Option 2