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**ENGI1020:** Introduction to Programming
**Mid-term test**
**12 Feb 2020**

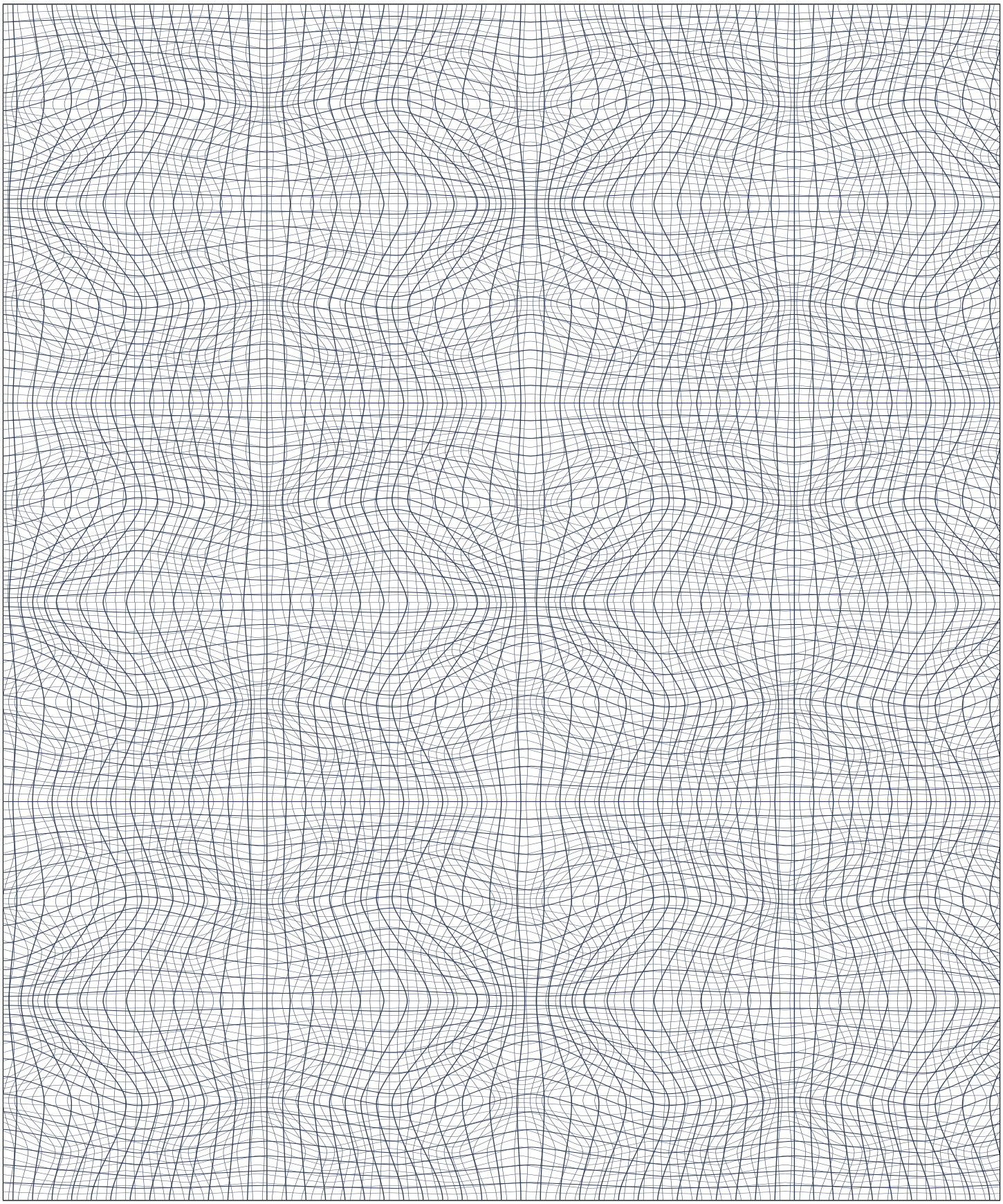
Name:

Student ID:

## Instructions

1. Answer all questions.
2. Write your answers in the space provided on this paper.
3. Write your student number at the top of every answer page.
4. This is a closed-book exam: written aids are not permitted.
5. Calculators, phones and all other electronic aids are not permitted.
6. Unless otherwise specified, all code listed in this exam compiles and executes correctly.

| Question: | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Points: | 10 | 8 | 12 | 8 | 12 | 50 |
| Score: | | | | | | |



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## Programming concepts

1. Match the terms on the left to their definitions on the right. There are more definitions than terms: only match each term (a through j) **once**. [10]

a. algorithm
b. comment
c. condition
d. expression
e. keyword
f. literal
g. operator
h. syntax
i. type
j. variable

_____ Boolean value that determines which way control will flow
_____ Combination of values and operators that can be evaluated
_____ Decisions made as a program executes
_____ Grammatical rules of a language
_____ Ignored by the language; only for people
_____ Meaning
_____ Name reserved by the language itself
_____ Place in memory to hold a value
_____ Programmer-chosen name
_____ Step-by-step procedure with decisions
_____ Tells you a value's size, interpretation and operations
_____ Value passed into a function
_____ Value that means exactly what's written

2. Programming types [8]

What type(s) of variable (e.g., integer) would you choose to represent each of the following values? **Justify your choice** in a few words (complete sentences not required). There may be more than one correct answer.

(a) Cost of an airline ticket [1]

**Solution:** `float` dollars or `int` cents

(b) Prediction of how much snow we'll get next week [1]

**Solution:** `int` centimeters (nobody predicts 11.5 cm in advance)

(c) The probability of a snowstorm tomorrow [1]

**Solution:** `float` unless there's a strong justification

(d) Your name [1]

**Solution:** `str`

(e) Whether or not you'll pass this exam [1]

**Solution:** `bool`

(f) An analog sensor reading from an Arduino [1]

**Solution:** `int`

(g) A student's grade in a coure [1]

**Solution:** `char` for A, B, C, etc., or `int` for a numeric grade, or a floating-point type for part marks

(h) A compass direction [1]

**Solution:** `int`, `double` or even a string could be acceptable here

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## Program analysis

3. Determine how the following Python code will behave. **[12]**

(a) What will the following Python script print when it is run? 4

```
print(type(1))
print(type(1 / 2))
print(type(1 % 2))
print(type(1.0))
```

**Solution:**

```
int (or, more specifically, <class 'int'>)
float (or, more specifically, <class 'float'>)
int (or, more specifically, <class 'int'>)
float (or, more specifically, <class 'float'>)
```

(b) What will the following Python script print when it is run? 8

```
x = 100
y = 50
z = x / y

print(x, y, z)

x -= 25

if x % 10 == 0:
    z *= 2
elif y > z:
    y /= 2

print(x, y, z)

x -= 25

if x % 10 == 0:
    z *= 2
elif y > z:
    y /= 2

print(x, y, z)
```

**Solution:**

```
100 50 2.0
75 25.0 2.0
```

```
50 25.0 4.0
```

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## Program synthesis

4. The temperature sensor that we use in our labs in not a linear device. Rather, its resistance is given by the following equation:

$$R = R_0 \times e^B \times \left(\frac{1}{T} - \frac{1}{T_0}\right)$$

where $B$ and $R_0$ are properties of the particular sensor being used. Substituting in the reference temperature $T_0$ and solving for $T$ yields the following equations for temperature $T$ (in Kelvin) and resistance $R$ (in Ohms):

$$T = \frac{1}{B \log \frac{R}{R_0}} + \frac{1}{298.15} \qquad R = \frac{1023}{a} - 1 \tag{1}$$

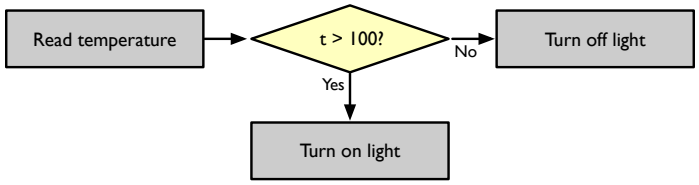
where $a$ is an analog reading from an appropriate Arduino port.

(a) Given variables `a`, `B`, `R` and `R0`, write a Python expression for the current temperature. **You may use the `log()` function from the `math` module.** [2]

**Solution:**

```
1.0 / (log(R / R0) / B + 1 / 298.15
```

(b) Assuming that you have an analog sensor connected to analog port 2 of your Arduino board and a light connected to digital port 4, write a Python script that corresponds to the following flowchart: [6]




**Solution:**

5. Write a Python script that will: 12

    1. prompt the user for their year of birth
    2. print out their age
    3. print out the number of years until their next "decade" birthday (10, 20, 30, 40, etc.)

**Solution:**

```
birth_year = int(input('Enter birth year> '))
age = 2020 - birth_year

print('You are', age, 'years old.')

remaining = 10 - (age % 10)
print(remaining, 'years left until the next big one!')
```