1 | (*Algebra: solve quadratic equations*) The two roots of a quadratic equation $ax^2 + bx + c = 0$ can be obtained using the following formula:

$$r_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad \text{and} \quad r_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

$b^2 - 4ac$ is called the discriminant of the quadratic equation. If it is positive, the equation has two real roots. If it is zero, the equation has one root. If it is negative, the equation has no real roots.

Write a program that prompts the user to enter values for a, b, and c and displays the result based on the discriminant. If the discriminant is positive, display two roots. If the discriminant is 0, display one root. Otherwise, display "The equation has no real roots".

Note that you can use `Math.pow(x, 0.5)` to compute $\sqrt{x}$. Here are some sample runs.

```
Enter a, b, c: 1.0 3 1  ⏎ Enter
The roots are -0.381966 and -2.61803
```

```
Enter a, b, c: 1 2.0 1  ⏎ Enter
The root is -1
```

```
Enter a, b, c: 1 2 3  ⏎ Enter
The equation has no real roots
```

2	(*Algebra: solve 2 × 2 linear equations*) You can use Cramer's rule to solve the following 2 × 2 system of linear equation: $$ax + by = e \qquad x = \frac{ed - bf}{ad - bc} \quad y = \frac{af - ec}{ad - bc}$$ $$cx + dy = f$$ Write a program that prompts the user to enter *a*, *b*, *c*, *d*, *e*, and *f* and displays the result. If *ad* − *bc* is **0**, report that "The equation has no solution". ``` Enter a, b, c, d, e, f: 9.0 4.0 3.0 -5.0 -6.0 -21.0 ↵Enter x is -2.0 and y is 3.0 ``` ``` Enter a, b, c, d, e, f: 1.0 2.0 2.0 4.0 4.0 5.0 ↵Enter The equation has no solution ```	
3	(*Sort three integers*) Write a program that sorts three integers. The integers are entered from the input dialogs and stored in variables **num1**, **num2**, and **num3**, respectively. The program sorts the numbers so that $num1 \le num2 \le num3$.	
4	(*Check a number*) Write a program that prompts the user to enter an integer and checks whether the number is divisible by both 5 and 6, or neither of them, or just one of them. Here are some sample runs for inputs **10**, **30**, and **23**. ``` 10 is divisible by 5 or 6, but not both 30 is divisible by both 5 and 6 23 is not divisible by either 5 or 6 ```	

5

(*Game: scissor, rock, paper*) Write a program that plays the popular scissor-rock-paper game. (A scissor can cut a paper, a rock can knock a scissor, and a paper can wrap a rock.) The program randomly generates a number 0, 1, or 2 representing scissor, rock, and paper. The program prompts the user to enter a number 0, 1, or 2 and displays a message indicating whether the user or the computer wins, loses, or draws. Here are sample runs:

```
scissor (0), rock (1), paper (2): 1  ↵Enter
The computer is scissor. You are rock. You won
```

```
scissor (0), rock (1), paper (2): 2  ↵Enter
The computer is paper. You are paper too. It is a draw
```

6   (*Science: day of the week*) Zeller's congruence is an algorithm developed by Christian Zeller to calculate the day of the week. The formula is

$$h = \left(q + \frac{26(m + 1)}{10} + k + \frac{k}{4} + \frac{j}{4} + 5j \right) \% 7$$

where

- h is the day of the week (0: Saturday, 1: Sunday, 2: Monday, 3: Tuesday, 4: Wednesday, 5: Thursday, 6: Friday).
- q is the day of the month.
- m is the month (3: March, 4: April, . . ., 12: December). January and February are counted as months 13 and 14 of the previous year.
- j is the century (i.e., $\frac{year}{100}$).
- k is the year of the century (i.e., $year \% 100$).

Note that the division in the formula performs an integer division. Write a program that prompts the user to enter a year, month, and day of the month, and displays the name of the day of the week. Here are some sample runs:

```
Enter year: (e.g., 2012): 2015  ⏎Enter
Enter month: 1-12: 1  ⏎Enter
Enter the day of the month: 1-31: 25  ⏎Enter
Day of the week is Sunday
```

```
Enter year: (e.g., 2012): 2012  ⏎Enter
Enter month: 1-12: 5  ⏎Enter
Enter the day of the month: 1-31: 12  ⏎Enter
Day of the week is Saturday
```

(*Hint*: January and February are counted as 13 and 14 in the formula, so you need to convert the user input 1 to 13 and 2 to 14 for the month and change the year to the previous year.)

7	(*Game: pick a card*) Write a program that simulates picking a card from a deck of 52 cards. Your program should display the rank (Ace, 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack, Queen, King) and suit (Clubs, Diamonds, Hearts, Spades) of the card Here is a sample run of the program:

```
The card you picked is Jack of Hearts
```

8	(*Use the &&, || and ^ operators*) Write a program that prompts the user to enter an integer and determines whether it is divisible by 5 and 6, whether it is divisible by 5 or 6, and whether it is divisible by 5 or 6, but not both. Here is a sample run of this program:
|   | ```
Enter an integer: 10 ↵Enter
Is 10 divisible by 5 and 6? false
Is 10 divisible by 5 or 6? true
Is 10 divisible by 5 or 6, but not both? true
``` |
| 9 | (*Financials: currency exchange*) Write a program that prompts the user to enter the exchange rate from currency in U.S. dollars to Chinese RMB. Prompt the user to enter 0 to convert from U.S. dollars to Chinese RMB and 1 to convert from Chinese RMB and U.S. dollars. Prompt the user to enter the amount in U.S. dollars or Chinese RMB to convert it to Chinese RMB or U.S. dollars, respectively. Here are the sample runs: |
|   | ```
Enter the exchange rate from dollars to RMB: 6.81 ↵Enter
Enter 0 to convert dollars to RMB and 1 vice versa: 0 ↵Enter
Enter the dollar amount: 100 ↵Enter
$100.0 is 681.0 yuan
``` |

10

(*Decimal to hex*) Write a program that prompts the user to enter an integer between 0 and 15 and displays its corresponding hex number. Here are some sample runs:

```
Enter a decimal value (0 to 15): 11  ↵Enter
The hex value is B
```

```
Enter a decimal value (0 to 15): 5  ↵Enter
The hex value is 5
```

```
Enter a decimal value (0 to 15): 31  ↵Enter
Invalid input
```