

### 3. Mathematica

The constructs For, While, Do, Table and If are forbidden.

#### 3.1)

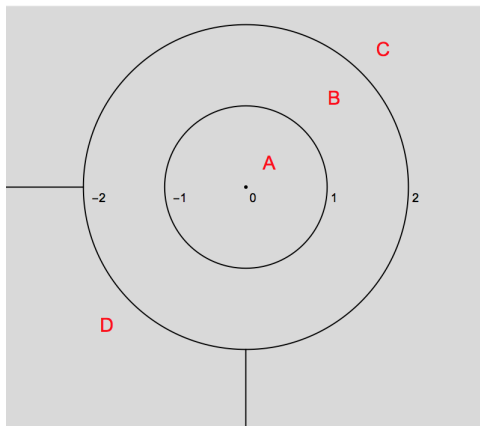
Explain in words the expression `f[x_., n_Integer] /; Length[{x}] > n -> g[x]`

#### 3.2)

What is the output of the following program?

```
Map[
  {#[[1]][#[[2]]], #[[1]][2]#[[2]], #[[2]]#[[1]][#[[1]][1]]}&,
  {#^2 - 1&, 2}, {(# - 1)(# + 1)&, -2}
]
```

#### 3.3)



The function `ABC[x, y]` is defined as  $x^2 + y^2$  in the region A (including the borders),  $\cos(\sqrt{x^2 + y^2})$  in B (including the external borders), 0 in C, and  $\pi$  in D (including the borders).

Define the function `ABC` in Mathematica.

#### 3.4)

Let `listR` be a list of replacement rules. Write a program to generate the list `listRinv` that contains the same rules as `listR`, but flipped.

Each rule `lhs -> rhs` becomes `rhs -> lhs`.

#### 3.5)

Recall that `Range[3]` returns `{1, 2, 3}`.

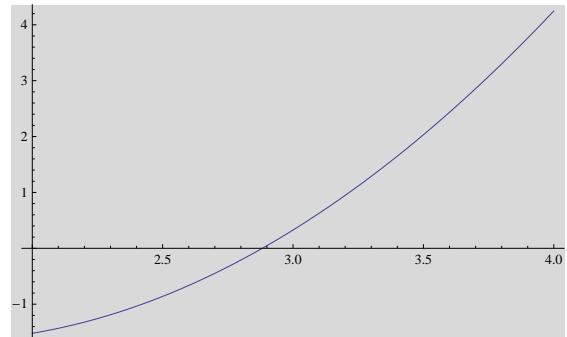
What is the output of the following program? Show the intermediate steps.

```
Apply[Plus,
  Map[2^# &, Flatten[Map[Range, {4, 3, 2, 1}]]]
]
```

## 4. C

### 4.1)

Let  $P$  be a C function that evaluates the polynomial  $p$  shown in the picture. You know that in the interval  $[2, 4]$ , there exists only one point  $x_0$  such that  $p(x_0) = 3$ . Write an iterative algorithm to find  $x_0$ . Complete the body of the following main.



```
#include <stdlib.h>
#include <stdio.h>

double P(double x);

int main( int argc, char *argv[] )
{
    // your program

}
```

### 4.2)

Princess Leia enjoys programming in C. She successfully compiles the following program.

```
#include <stdlib.h>
#include <stdio.h>

void function( int *array, int n )
{
    int i, j, tmp, current, idx;

    for(i=0; i<n; i++){
        current = -1;
        idx = -1;

        for(j=i; j<n; j++){
            if(array[j] > current){
                current = array[j];
                idx = j;
            }
        }

        tmp = array[i];
        array[i] = array[idx];
        array[idx] = tmp;
        printf("iter:%d\tidx:%d\n", i, idx);
    }
}
```

```

int main( int argc, char *argv[] )
{
    int i, n = 6;

    int *input = (int *) malloc(sizeof(int) * n);
    for(i=0; i<n; i++) input[i] = (7*i+2)%5;

    function(input, n);

    printf("[");
    for(i=0; i<n; i++){ printf("%d ", input[i]); }
    printf("]\n");

    free(input);
    return 0;
}

```

- a) [2 points] When she executes this program, what is it printed on her screen?
- b) [1 point] In general, what does the function `function` do?
- c) [1 point] If she changed the line  
`for(i=0; i<n; i++)` (in the function `function`) with  
`for(i=0; i<n-1; i++)`,  
would the result of the line  
`for(i=0; i<n; i++){ printf("%d ", input[i]);`  
change? Why?
- d) [1 point] If she changed the line  
`for(j=i; j<n; j++)` (in the function `function`) with  
`for(j=i+1; j<n; j++)`,  
would the result of the line  
`for(i=0; i<n; i++){ printf("%d ", input[i]);`  
change? Why?