



Coimisiún na Scrúduithe Stáit  
State Examinations Commission

Leaving Certificate Examination 2022

# Computer Science

Section C

Higher Level

Wednesday 25 May    Morning 11:30 – 12:30

50 marks

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## Instructions

There is one section in this paper.

<b>Section C</b>	Programming	One question	50 marks
		Answer all question parts	

Answer all parts of the question on your digital device.

Calculators may be used during this section of the examination.

The *Formulae and Tables* booklet cannot be used for this section of the examination.

The superintendent will give you a copy of the *Python Reference Guide*.

Ensure that you save your work regularly.

Save your files using the naming structure described at the beginning of the question.

If you are unable to get some code to work correctly, you can comment out the code so that you can proceed. The code that has been commented out will be reviewed by the examiner.

Rough work pages are provided at the end of this booklet. Please note that this booklet is not to be handed up and will **not** be reviewed by an examiner.

At the end of the examination it is your responsibility to ensure that you have saved your file onto your external media.

You will be provided with a brown envelope for your external media. Write your examination number on this envelope and place your external media into it before sealing. Place this envelope in the pouch at the front of the red envelope that contains your examination booklet from Section A and B.

There is no examination material on this page

Answer all question parts.

### Question 16

- (a) Open the program called **Question16\_A.py** from your device. The source code is shown below.

Before making any changes, you should save your working copy of the file using the format **ExaminationNumberQuestion16\_A.py**. For example, you would save the file as **123456Question16\_A.py** if your Examination Number was 123456.

Enter your Examination Number in the space provided on **line 2** in your Python file.



The program simulates the rolling of a die 100 times.

The result of each roll (throw) is stored in a variable called `throw_result`. Each of the 100 results are appended to a list called `results` as they are generated.

The program also contains code to keep track of the number of times a one and a two are rolled. These are stored in a list called `frequencies`.

```
1 # Question 16(a)
2 # Examination Number:
3 from random import randint
4
5 print("Dice simulation program")
6 results = []
7 frequencies = [0, 0, 0, 0, 0, 0]
8
9 # Loop 100 times
10 for i in range (100):
11     throw_result = randint(1,6) # store a random value between 1 and 6
12     results.append(throw_result) # append each value to results
13
14     # Start to build up a list of frequencies for each value thrown
15     if throw_result == 1:
16         frequencies[0] = frequencies[0] + 1
17     elif throw_result == 2:
18         frequencies[1] = frequencies[1] + 1
19
20 print()
21 print("Results:", results)
```

*This question continues on the next page.*

When the program is run, the output may look as follows:  
(Your output will be different because the dice numbers are generated randomly.)

```
Dice simulation program

Results: [1, 4, 1, 4, 2, 3, 2, 2, 2, 4, 3, 1, 6, 1, 3, 3, 5,
1, 1, 3, 2, 2, 4, 1, 6, 4, 4, 5, 2, 2, 4, 2, 1, 2, 4, 2, 6, 6,
5, 4, 3, 5, 5, 1, 1, 6, 5, 1, 3, 3, 5, 3, 1, 5, 3, 5, 3, 2, 1,
1, 1, 1, 4, 2, 5, 6, 4, 3, 4, 6, 4, 5, 2, 5, 5, 3, 1, 5, 4, 3,
2, 2, 6, 2, 2, 3, 3, 2, 3, 1, 5, 2, 5, 4, 6, 4, 3, 5, 5, 2]
```

Make the following changes to the program:

- (i) Currently the first line in the program output is *Dice simulation program*.

Change the program so that the first line in the output is *Dice simulation and analysis program*.

When the program is run the output may now look as follows:

```
Dice simulation and analysis program

Results: [1, 4, 1, 5, 3, 6, 2, 6, 6, 1, 3, 6, 4, 5, 1, 2, 5,
3, 5, 6, 5, 6, 5, 3, 3, 3, 4, 1, 2, 6, 1, 2, 4, 4, 6, 2, 4, 6,
5, 3, 4, 6, 4, 1, 4, 5, 6, 1, 1, 3, 5, 6, 6, 1, 2, 2, 5, 4, 3,
2, 6, 2, 2, 2, 2, 1, 2, 3, 4, 3, 3, 4, 3, 1, 6, 4, 1, 2, 4, 1,
3, 4, 1, 5, 3, 3, 5, 4, 4, 1, 2, 4, 4, 5, 6, 5, 6, 1, 5, 3]
```

- (ii) Insert a new line of code at the end of the program to display the list of dice frequencies.

When the program is run the output may now look as follows:

```
Dice simulation and analysis program

Results: [1, 3, 5, 1, 5, 1, 2, 4, 2, 5, 5, 5, 6, 4, 1, 1, 6,
4, 2, 1, 2, 6, 5, 3, 6, 5, 3, 6, 3, 3, 2, 1, 4, 2, 3, 4, 6, 6,
3, 3, 6, 5, 6, 6, 6, 5, 3, 2, 1, 3, 3, 6, 1, 4, 2, 5, 6, 4, 2,
1, 6, 6, 6, 4, 2, 2, 4, 5, 6, 3, 2, 6, 2, 2, 3, 3, 3, 1, 5, 6,
3, 6, 2, 5, 5, 1, 4, 5, 4, 1, 5, 4, 6, 4, 4, 5, 3, 3, 1, 4]
Frequencies: [14, 15, 0, 0, 0, 0]
```

The frequencies list tells us that the number one has been rolled 14 times and the number two has been rolled 15 times.

The frequencies for the numbers three, four, five and six are not calculated by the program yet. This is the reason they are all zero.

*This question continues on the next page.*

- (iii) Complete the code to calculate the frequencies for the numbers three, four, five and six.

When the program is run the output may now look as follows:

```
Dice simulation and analysis program

Results: [2, 4, 6, 2, 1, 4, 1, 3, 1, 3, 3, 6, 5, 5, 4, 3, 2,
2, 2, 1, 3, 4, 4, 3, 4, 6, 4, 2, 3, 1, 3, 3, 1, 5, 3, 3, 6, 5,
4, 6, 1, 5, 3, 4, 2, 1, 6, 6, 5, 2, 6, 4, 5, 2, 2, 6, 6, 5, 5,
6, 2, 3, 5, 6, 4, 1, 6, 2, 2, 6, 2, 6, 3, 3, 4, 2, 5, 5, 5, 3,
1, 2, 3, 4, 2, 6, 2, 1, 5, 6, 6, 2, 5, 2, 3, 2, 5, 2, 2, 6]
Frequencies: [11, 23, 18, 13, 16, 19]
```

In this case the frequencies list tells us that the number one has been rolled 11 times, the number two has been rolled 23 times, the number three has been rolled 18 times, the number four has been rolled 13 times, the number five has been rolled 16 times and the number six has been rolled 19 times.

- (iv) Comment out the line that displays the list of individual results.

When the program is run the output may now look as follows:

```
Dice simulation and analysis program

Frequencies: [17, 21, 17, 18, 11, 16]
```

- (v) Extend the program to display the frequency of each number in a tabular format as shown in the sample output here.

```
Dice simulation and analysis program

Frequencies: [15, 10, 25, 15, 15, 20]
Dice Frequency
-----
1      15
2      10
3      25
4      15
5      15
6      20
```

*This question continues on the next page.*

- (vi) Extend the program so that it determines and displays the number that was rolled most often along with its frequency. For example, in the output below the number five was rolled most often (25 times). You can ignore the possibility of ties.

When the program is run the output may now look as follows:

```
Dice simulation and analysis program

Frequencies: [16, 14, 12, 20, 25, 13]
Dice Frequency
-----
1      16
2      14
3      12
4      20
5      25
6      13

5 was rolled the most often (25 times)
```

- (vii) Extend the program to display a horizontal bar chart of the frequencies.

The number of asterisks (\*) in each row should correspond to each frequency. For example, in the output below there are eight asterisks in row one because the frequency for the number one is eight.

Each asterisk (\*) can be printed using the single statement: `print("*", end="")`

When the program is run the output may now look as follows:

```
Dice simulation and analysis program

Dice frequencies: [8, 12, 22, 26, 22, 10]
Dice Frequency
-----
1      8
2     12
3     22
4     26
5     22
6     10

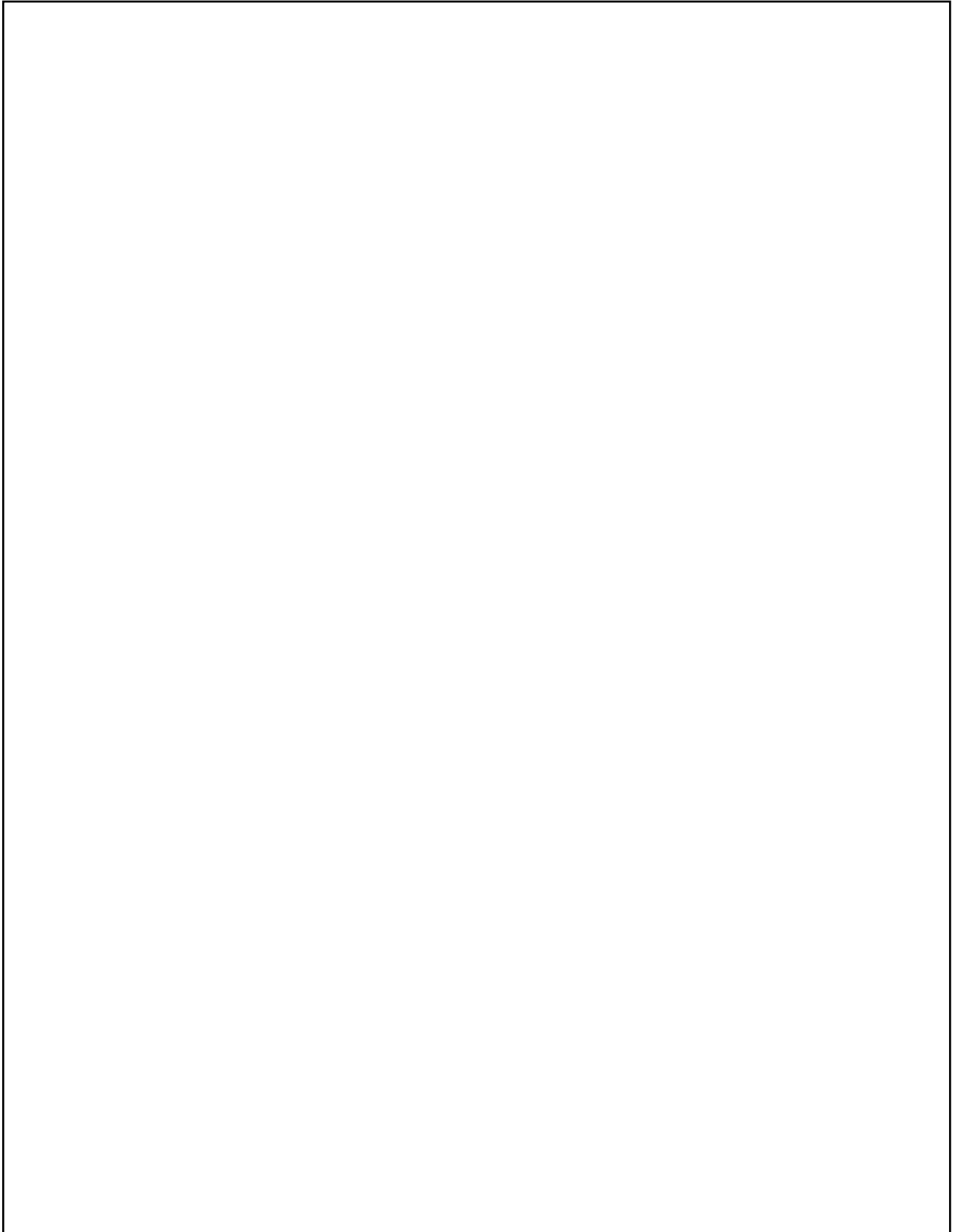
4 was rolled most often - 26 times

*****
*****
*****
*****
*****
*****
```

Save your file using the format **ExaminationNumberQuestion16\_A.py**. For example, you would save the file as **123456Question16\_A.py** if your Examination Number was 123456.

Space for rough work.

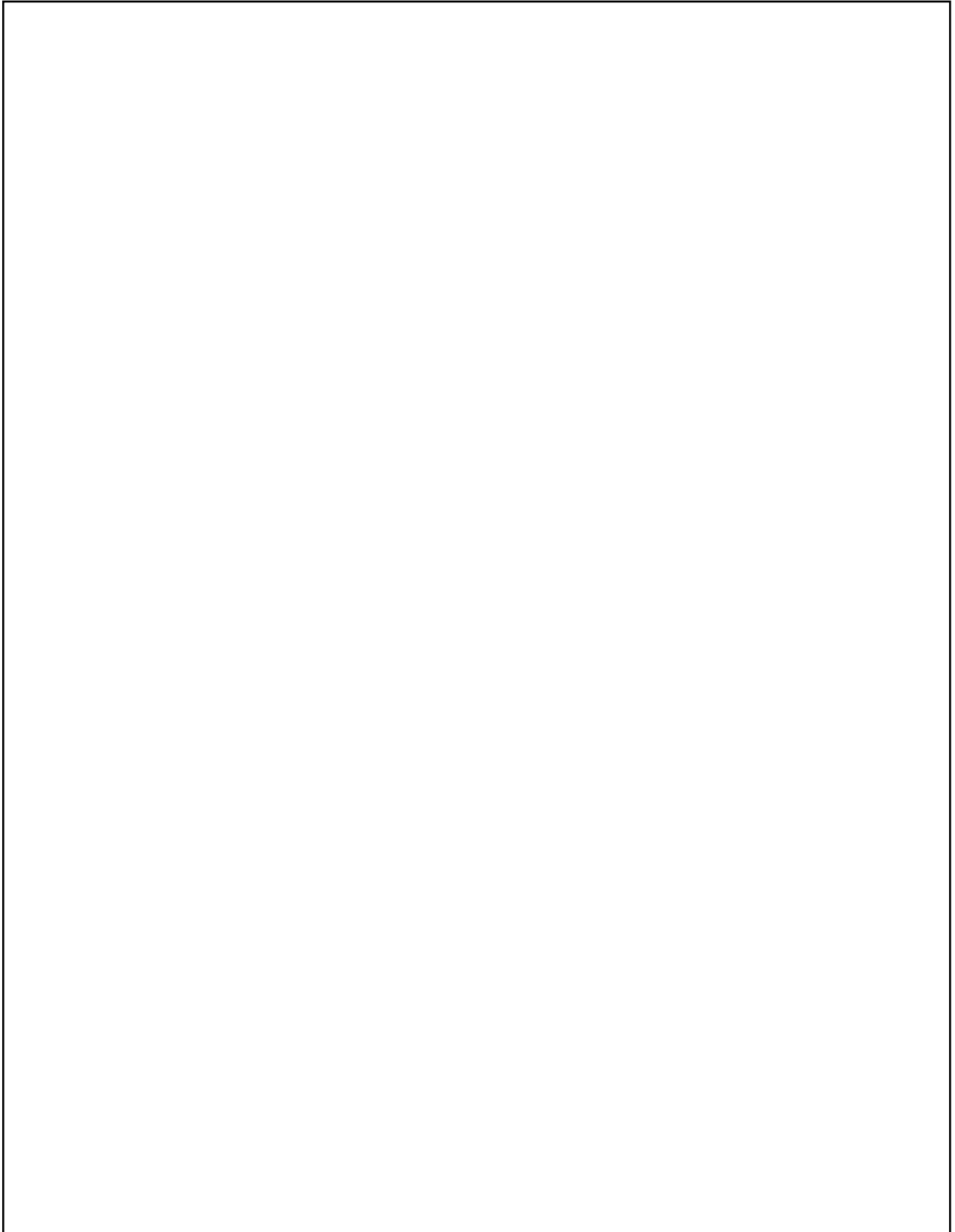
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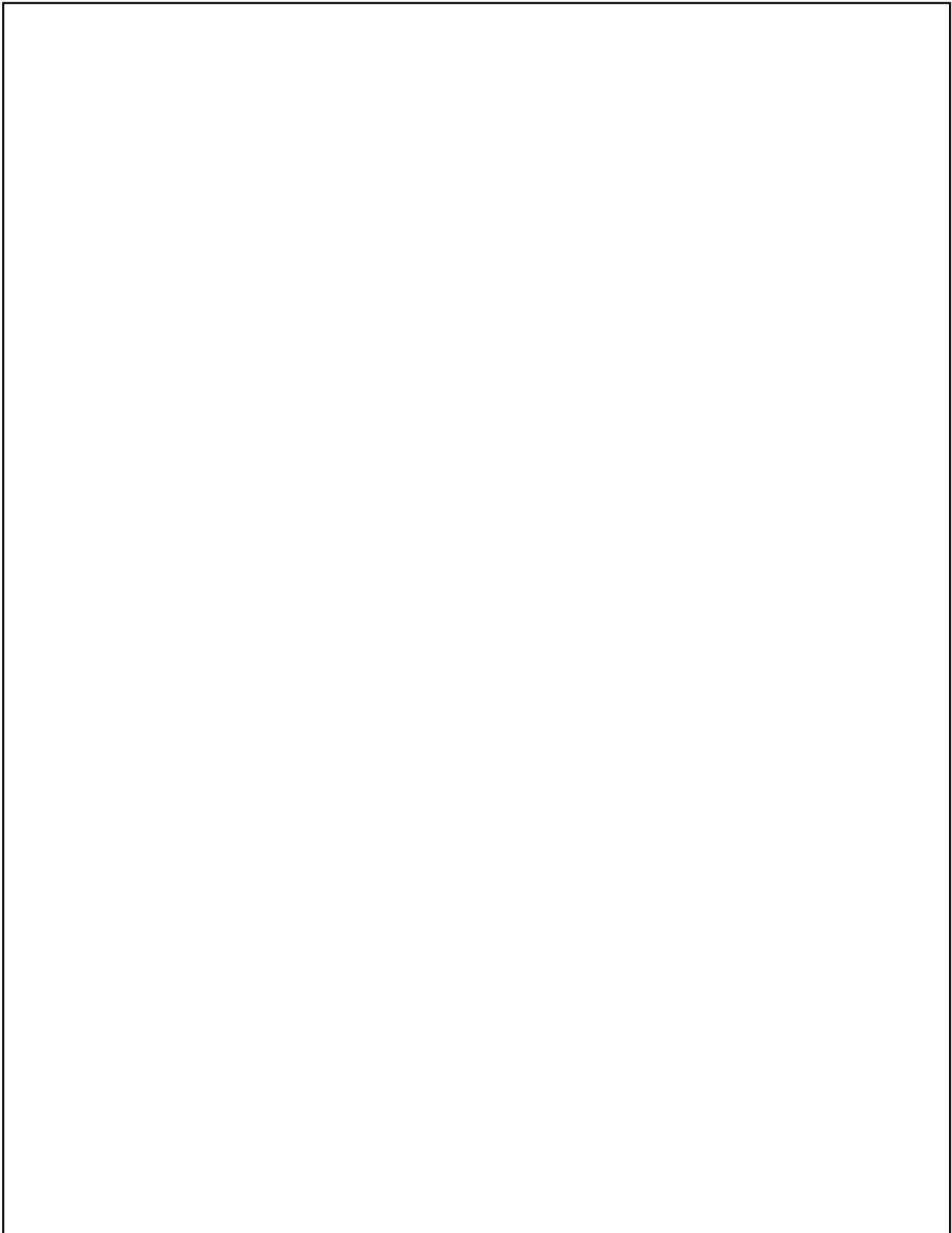
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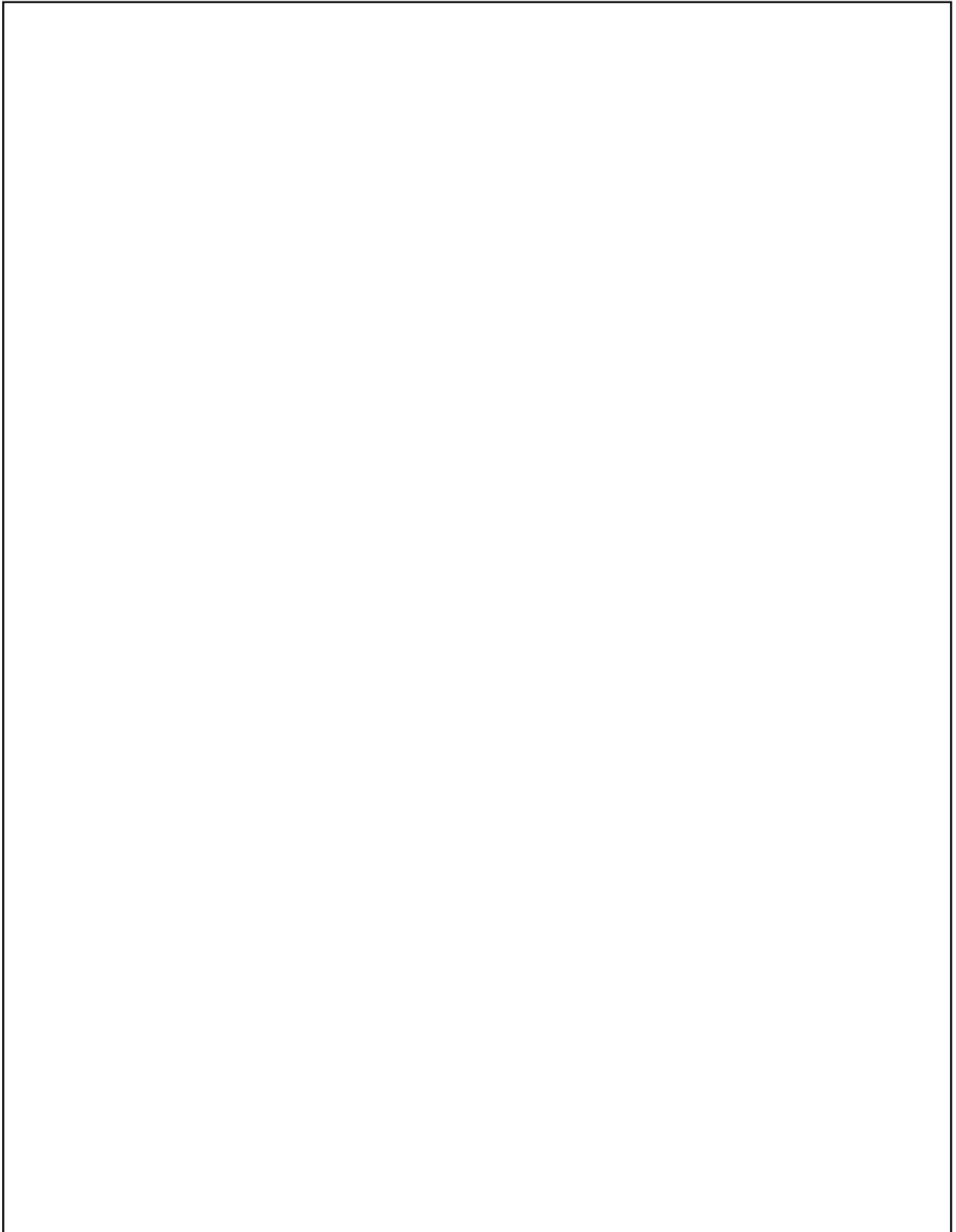
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## Acknowledgements

### Images

Image on P. 4: <https://freesvg.org/vector-image-of-game-dice-close-up>

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