National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	**Compiler**	**Course Code:**	
	Degree Program:	**BS (CS)**	**Semester:**	**Fall 2020**
	Exam Duration:	**90 min**	**Total Marks:**	**30**
	Paper Date:	**24-Nov-2020**	**Weight**	
	Section:		**Page(s):**	**3**
	Exam Type:	**Mid-2**		

No separate answer sheets required. Rough sheet are allowed, however. Do not attach additional sheets with this question paper.

Question 1 (5+5 marks)

a) Left factor the following grammar:

```
S -> a b c | R
R -> a x y | i j k
```

b) Give three-address code for the following C++ program:

```
p = 1;
for (i = 2; i <= n; ++i)
     p = p * i;
```

Question 2 (3+7 marks)

Consider the following translation scheme:

```
L -> L1 , num     {L.t = L1.t + num.lex + "\t"}
L -> Marks : num  {L.t = num.lex + "\t"}
```

Here '+' is used for concatenation.

a) Give output of the above scheme for the following input:

```
Marks : 50 , 60 , 40
```

b) Remove left recursion from the above scheme. The order of marks should not change in the output!

Question 3 (10 marks)

Consider the following object represented in JSON-like format:

```
circle : { x : 10 , y : 20 , radius : 15 }
```

Following is its translation in XML-like language:

```
<circle>
    <x>10</x>
    <y>20</y>
    <radius>15</radius>
</circle>
```

Consider another example:

```
student : { name : "Junaid" , age : 21 , city : "Multan" }
```

Following is its translation in XML-like language:

```
<student>
    <name>Junaid</name>
    <age>21</age>
    <city>Multan</city>
</student>
```

Following is a CFG for such a translator:

```
S -> N : { L }

L -> L , P

L -> P

P -> id : V

V -> num

V -> str
```

Your task is to add actions into the above CFG to generate the output in XML format.