Original Defect Data

	Requirement	Analysis	Design	Coding	Unit Testing	Integration Testing	System Testing	Field	Total
Requirement	102								102
Analysis	13	21							34
Design	45	17	123						185
Coding	34	13	55	213					315
Unit Testing	12	20	8	178	12				230
Integration Testing	7	15	7	27	0	17			73
System Testing	4	12	5	12	0	0	11		44
Field	2	1	1	1	0	0	0	5	10
Total	219	99	199	431	12	17	11	5	993

Product Size: **37 KLOC**

Questions and Answers

1. **Calculate the defect removal rate for every phase.**
2. **Calculate the defect injection rate for every phase**
3. **Calculate the defect escape rate for every phase.**

The formula for Defect Removal Rate of a phase is

Number of Defects Detected in that phase/ Size of Product (in KLOC).

The formula for Defect Injection Rate of a phase is

Number of Defects Injected in that phase/ Size of Product (in KLOC).

The formula for Defect Escaped Rate of a phase is

Number of Defects Escaped in that phase/ Size of Product (in KLOC).

Defect Injection, Removal and Escape Rates			
Phase	**Removal rate**	**Injection rate**	**Escape rate**
Requirement	2.76	5.92	3.16
Analysis	0.92	2.68	4.92
Design	5.00	5.38	5.30
Coding	8.51	11.65	8.43
Unit Testing	6.22	0.32	2.54
Integration Testing	1.97	0.46	1.03
System Testing	1.19	0.30	0.14

4. **Which phase is the most effective in removing defects?**
5. **Calculate the overall defect removal effectiveness.**

The Defect Removal Effectiveness is calculated differently for Development phases and Testing phases.

The formula for Defect Removal Effectiveness for Development phases (Requirement phase to Coding phase) is

$$\mathbf{DRE_{dev} = (N * 100) / (E + S)}$$

Where **N** is the Number of **defects detected** (removed) in the **current** phase,

E is the Number of **defects escaped** from **prior** phase(s),

And **S** is the Number of **defects injected** in the **current** phase.

The formula for Defect Removal Effectiveness for Testing phases (Unit testing phase to System Testing phase) is

$$\mathbf{DRE_{test} = (N * 100) / (N + S)}$$

Where **N** is the Number of **defects detected** (removed) in the **current** phase,

And **S** is the Number of **defects detected** in the **subsequent** phases.

The formula for Overall Defect Removal Effectiveness is

$$\mathbf{DRE_{all} = (1 - F/D) * 100}$$

Where **F** is the Number of **defects detected** in the **Field** phase,

And **D** is the **Total Number of defects** in the **product**.

Defect Removal Effectiveness	
Phase	**Value**
Requirement	47
Analysis	16
Design	49
Coding	50
Unit Testing	64
Integration Testing	57
System Testing	81
Overall Inspection Effectiveness	64
Overall Test Effectiveness	97
Overall DRE	99

The **System Testing** phase is most effective in removing defects and **Overall DRE** is **99%**.

6. Do you think the reviews and inspections were effective? Explain.

Yes. The reviews and inspections were effective. The **Overall Inspection Effectiveness** is around **64%** which means more than half the overall defects were detected and removed and thus we can say that the reviews and inspections were effective.

7. If the number of defects originated in requirements phase increased by 50% and defects detected in requirements review increased by 50%, do you think that will have a positive or negative impact on the defects originated in the coding phase? Explain your answer in detail (present data to support your answer).

The new Matrix will look as given below.

	Requirement	Analysis	Design	Coding	Unit Testing	Integration Testing	System Testing	Field	Total
Requirement	153								153
Analysis	20	21							41
Design	68	17	123						208
Coding	51	13	55	213					332
Unit Testing	18	20	8	178	12				236
Integration Testing	11	15	7	27	0	17			77
System Testing	6	12	5	12	0	0	11		46
Field	3	1	1	1	0	0	0	5	11
Total	330	99	199	431	12	17	11	5	1104

The cells indicating the increase in the number of defects injected in requirements phase (but detected across different phases) and the number of defects detected in requirements review are highlighted. As we can see the number of defects originated is not changed and even the defect removal effectiveness at requirement phase will remain the same (since both the defects injected and defects detected grew by 50%). Hence there will **not be any impact** on the defects originated from the coding phase.

If we **assume** that the rest of the numbers remain the same, this has a **positive impact** as the Defect Removal Effectiveness of Coding phase has increased from 50% to 51% (defect removal rate has increased from 5.00 to 5.62).

8. **If the number of defects originated in design phase increased by 30% and defects (defects escaped from prior phases and injected in current) detected in code inspections increased by 20%, do you think that will have a positive or negative impact on defect removal effectiveness for the testing phases? Explain your answer in detail (present data to support your answer).**

The new Matrix will look as given below.

	Requirement	Analysis	Design	Coding	Unit Testing	Integration Testing	System Testing	Field	Total
Requirement	102								102
Analysis	13	21							34
Design	45	17	**160**						222
Coding	**41**	**16**	**72**	**256**					385
Unit Testing	12	20	**10**	178	12				232
Integration Testing	7	15	**9**	27	0	17			75
System Testing	4	12	**7**	12	0	0	11		46
Field	2	1	**1**	1	0	0	0	5	10
Total	226	102	**259**	474	12	17	11	5	1106

The cells indicating the increase in the number of defects injected in design phase (but detected across different phases) and the number of defects detected in code inspections are highlighted. The new Defect Removal Effectiveness values based on the above data are mentioned below.

Defect Removal Effectiveness		
Phase	**Old Value**	**New Value**
Unit Testing	64	64
Integration Testing	57	57
System Testing	81	82

Except for **System Testing** (which has a **positive impact**) there is no impact on the defect removal effectiveness of other testing phases.

If we consider the decimal points of the DRE values also, there is **negative impact** on **Unit Testing phase** (old value 64.42; new value 63.91), **negative impact** on **Integration Testing phase** (old value 57.46; new value 57.25) and **positive impact** on **System Testing phase** (old value 81.48; new value 82.14).