Grade 12 Computing

Unit 3 · Software Engineering

ANSWER KEY · FOR TEACHERS

Full marks 31

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. repository
2. commit
3. merge conflict
4. regression
5. boundary
6. breakpoint
7. pure function
8. critical path

K · 4

Each carries 0.5 mark.

2 Changing over

1. direct changeover → **f.** the old system stops and the new one starts on the same day
2. parallel running → **a.** both run side by side, and their results are compared
3. phased changeover → **b.** the new system replaces the old one a part at a time
4. pilot changeover → **c.** one group uses the whole new system first, then everyone

K · 2

Each carries 0.5 mark.

3 Multiple choice

i. **c.** Refuse marks over 100 in check_marks() — K · 1

It says exactly what this commit does, briefly, and it is one change. The second mixes three changes in one commit, and "the bug that Dawa found" means nothing to a reader next year.

ii. **a.** Git joins both changes by itself; there is no conflict, though the tests should still be run. — U · 1

Git works line by line, not file by file. Changes to different parts of a file are joined automatically; only changes to the same lines, or lines right next to each other, are a conflict. Joined text can still be a broken program, so test after every merge.

iii. **b.** a regression — K · 1

A regression is something that worked before and was broken by a later change. Running every old test after every change is how regressions are caught.

iv. **a.** observer — A · 1

Each part subscribes to new data, and the data part tells everyone on its list. New parts can subscribe without the data code changing.

v. **b.** agile, so the members can try a working version every two weeks and steer what comes next — A · 1

When needs aren't clear at the start, short rounds with working versions find out what users really want, early and cheaply. Waterfall would fix requirements nobody is sure of yet. Spiral is meant for big projects with serious risks.

4 Think

ANSWER

No. Passing tests show only that the program gives the right answer **for the inputs tested**; a bug can be in a case no test tried, in how parts work together, or in a requirement that was misunderstood, so the tests themselves check the wrong thing. A

Science Playground, Katunje, Bhaktapur
Book a class visit: https://science-playground.com/booking

direct changeover on results day would leave nothing to fall back on if such a bug appears; parallel running for an exam, comparing every grade with the old spreadsheet, would catch it safely. HA · 2

MARKING SCHEME

- ✓ Tests can show bugs, not that there are none: untested cases, integration, or wrong requirements.
- ✓ A direct changeover on results day is too risky; parallel running (or a pilot) gives something to compare with or fall back on.

5 Choosing test data

ANSWER A · 4

Test value	Kind of data	Accept or refuse?
22	normal	accept
5	boundary	accept
40	boundary	accept
41	erroneous (just outside the boundary; "boundary" also accepted)	refuse
-3	erroneous	refuse
twenty	erroneous	refuse

i. **4** is missing: just below the lowest allowed, as 41 is just above the highest. Mistakes cluster at the edges, where > and >= look so alike, so both sides of each edge must be tested.

MARKING SCHEME

- ✓ 22 normal, accepted.
- ✓ 5 and 40 boundary, accepted.
- ✓ 41, -3 and "twenty" erroneous (41 just outside the boundary), refused.
- ✓ 4 is missing, the value just below the lower boundary.

6 A merge conflict

ANSWER U · 3

i. The line between `<<<<<<< HEAD` and `=======` is `main`'s (the branch he is on); the lines between `=======` and `>>>>>>> new-fees` are the other branch's.

ii.

```
def fee_for(grade):
    if grade >= 11:
        return 5000      # the new fee from Shrawan
    return 3500
```

iii. Delete all three marker lines, run every test, then `git add fees.py` and `git commit` to finish the merge.

MARKING SCHEME

- ✓ HEAD's part is `main`'s, the part after `=======` is `new-fees`'.
- ✓ The function with the new fee only, and no marker lines left.
- ✓ Run the tests, then `git add` and `git commit`.

Science Playground, Katunje, Bhaktapur
Book a class visit: https://science-playground.com/booking

7 Find and fix the bug

ANSWER A · 3

i. Line 5 should be `elif age >= 60:`. Then all four tests pass.

ii. **Boundary** data: 60 is where the price changes. Mistakes cluster at boundaries because > and >= look so alike; a normal value such as 70 would have passed.

MARKING SCHEME

✓ Line 5 found, from the failing test and its message.

✓ `elif age >= 60:`.

✓ Boundary data: at an edge, > and >= are easily mixed up.

8 Planning with a Gantt chart

ANSWER A · 4

Task	First week	Last week
A	1	2
B	3	4
C	3	3
D	5	7
E	5	5
F	8	9
G	10	10

i. The critical path is **A → B → D → F → G**, 2 + 2 + 3 + 2 + 1 = **10 weeks.** D waits for B, which ends a week after C. E ends in week 5, but G can't start until F ends in week 9, so E has **4 weeks** of float. (C has 1.)

MARKING SCHEME

✓ B and C in weeks 3–4 and 3; D in weeks 5–7, after the later of them.

✓ E in week 5, F in weeks 8–9, G in week 10.

✓ Critical path A → B → D → F → G, 10 weeks.

✓ E's float is 4 weeks.

9 Write a program

ANSWER

```
def late_fee(fee, days_late):
    """The fee plus Rs 10 a day late, with at most Rs 200 added."""
    if days_late < 0:
        raise ValueError("days late can't be negative")
    return fee + min(10 * days_late, 200)

def test_normal():
    assert late_fee(4500, 3) == 4530

def test_boundary():
    assert late_fee(4500, 0) == 4500
    assert late_fee(4500, 20) == 4700
    assert late_fee(4500, 21) == 4700

def test_erroneous():
    try:
        late_fee(4500, -2)
        assert False, "-2 days was not refused"
    except ValueError:
        pass
```


Science Playground, Katunje, Bhaktapur
Book a class visit: https://science-playground.com/booking

- ✓ Rs 10 a day added, with at most Rs 200 (`min`, or an `if`).
- ✓ A `ValueError` for negative days; the function changes and prints nothing (pure).
- ✓ Normal and boundary tests with answers worked out by hand (0 days, and 20 or 21 days where the cap starts).
- ✓ An erroneous test that passes only if the `ValueError` is raised.

10 Activity: Find the bug with a debugger

(not marked)

WHAT STUDENTS SHOULD FIND

- `total` is 0, then 4.0, then 3.6, and 3.2 at the end: each grade point **replaces** total instead of being added to it.
- `gpa()` gives back 1.07, only the last subject's 3.2 divided by 3, instead of 3.6.
- Line 15 should be `total = total + POINTS[grade_for(marks)]`.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	8	4	17	2	**31**

Science Playground, Katunje, Bhaktapur
Book a class visit: https://science-playground.com/booking