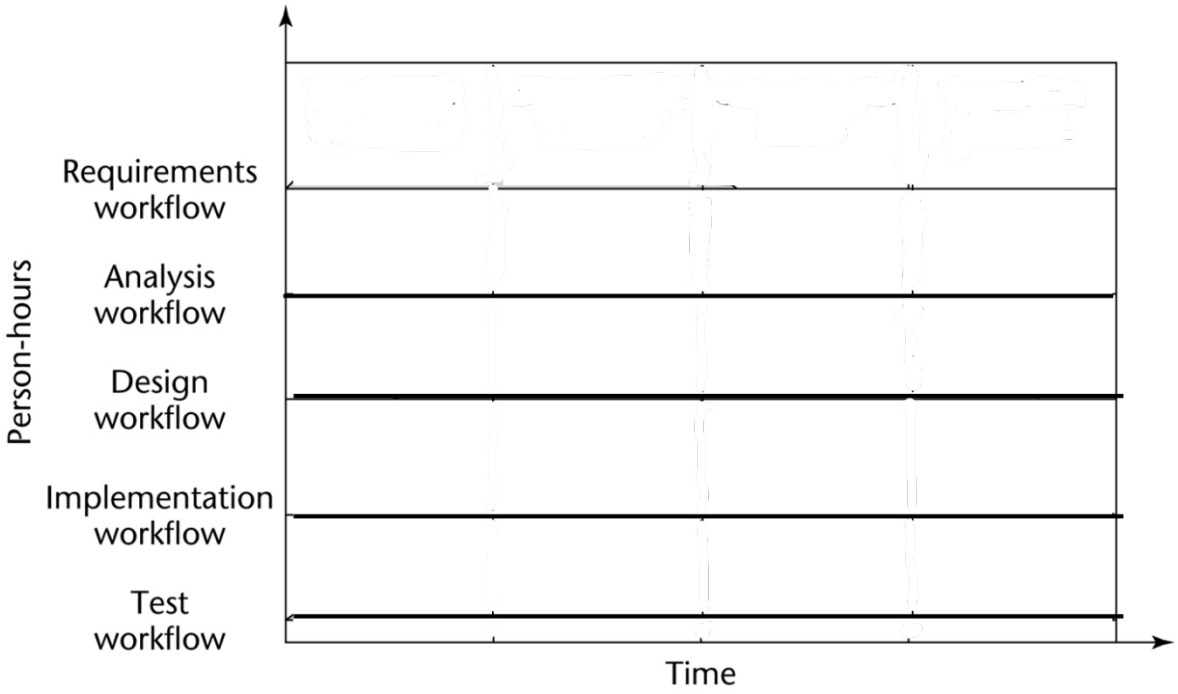
Question 1 (5 marks)

The SmartSolutions software company had a contract with a transportation company, TransCo, to add a new component to their existing scheduling tool. The new component was to be a smart reasoning component for recommending routes to drivers. After the first version was implemented, TransCo decided that the new component would have to contain more features to allow maximum flexibility for users ("event 1"). After incorporating these, SmartSolutions found out that the company producing the constraint solver library that it was using had gone broke, so it needed to change the design to use a different library("event 2"). Then SmartSolutions realized its own analysts had misunderstood one of TransCo's requirements, so they had to re-do some of the analysis ("event 3").

Below is an "empty" depiction of the Unified Process. Extend the figure to represent (roughly) the relative effort given to the different workflows during this project. Indicate on the x (time) axis roughly when "event 1", "event 2" and "event 3" occurred. (5 marks)



Question 2 (20 marks)

Your software development organization has been engaged to build software for a company that helps medical patients to record and manage their pain medication. They have a paper-based system for doing this, that allows patients to record which part of their body is in pain, how severe the pain is, what medication they took, and when. They think an app on a touch-screen device, such as a smartphone or tablet, would be easier for the patients to use, and would allow them to collect patient data in real-time. They don't have any clear ideas beyond this. They want to work with you to understand the capabilities of the touch-screen devices and the possibilities for such a system.

Your new boss doesn't have much technical experience, but is familiar with the Waterfall software lifecycle model.

(a) Write an explanation for your boss of the weaknesses of the Waterfall model. Explain the problems that are likely to arise if it is applied to the project described above.

[10 marks]

The classic waterfall software lifecycle model has stages named "Requirements", "Analysis", "Design", "Implementation" (code and test), "Maintenance", and "Retirement". The Rational Unified Process has workflows with very similar names: "Requirements", "Analysis", "Design", "Implementation", and "Test". This has led your boss to think that they are basically the same.

(b) Explain how the Rational Unified Process actually differs from the Waterfall model, and in particular, how it addresses the problems with the Waterfall model you have described above. Indicate how this could mean that the Rational Unified Process would be a better fit for the pain management system project.

[10 marks]

Question 3 (20 marks)

You are a software engineer working on an online shopping application. Web customers can browse items, but has to register the first time they make a purchase. When making a purchase, the customer can go back at any time and view the items in their shopping basket. When they proceed to the "checkout" phase, the system allows them the option of paying by credit card (which means the system has to connect to a credit payment service), or by PayPal. A separate database system will store all the customer registration information.

(a) Here are 3 of the requirements, written in English language. Each of these is not well-written (well-written requirements should be precise, unambiguous, complete and consistent.) For each

(i) indicate whether this is a functional or non-functional requirement (1 mark)

(ii) re-write the requirement (2 marks)

1. *"When customers register they have to provide a password, which must be a 'strong' one."*

2. *"The shopping website has to work on all the main web browsers."*

3. *"Customers will be able to search for items"*

(b) As part of the business modelling process, you have to develop a use-case diagram. Draw a UML use-case diagram for this problem in the space provided. (10 marks)

Question 4 (20 marks)

FaceSpace is a social networking site that lets users control who can see their personal information. Users can post text and images to their FaceSpace page, maintain a list of FaceSpace contacts, and use FaceSpace to publicize events. When you add a contact on FaceSpace, you choose whether the new contact is a family member, friend, or co-worker. When you post new material, you can restrict its availability to one of these contact types. That means that you can prevent your boss from seeing those embarrassing party photos! If users want finer-grained control over visibility, they can create groups for sharing information. The groups can be open to public signup or invitation- only. Any registered user can sign up to an open group, but an invitation-only group is only visible to a user who has received an invitation. Users can also create and manage events. These can be open or invitation-only. They can also be restricted to a particular group or to a particular kind of contact (family, friends or co-workers). Overall though, users will spend most of their time on FaceSpace reading and making comments on posts from contacts. Note: the database behind FaceSpace is being developed as a separate software product that FaceSpace will interact with.

(a) Perform **noun extraction** on the problem description above. Use it to decide on your candidate entity classes by assessing each noun and considering whether it:

(i) lies outside the problem boundary and may therefore be ignored,

(ii) is an abstract noun (i.e. is not going to be a "thing" within the system), and if so might it be an attribute of an entity class, or

(iii) is a candidate entity class.

(b) Develop an **initial UML class diagram** for the system described above, with the relevant classes and attributes resulting from your noun extraction.

Make sure you:

(i) include appropriate attributes for the classes
(ii) describe the relationship between classes using generalization, association, aggregation and composition (as appropriate)
(iii) represent the multiplicity (cardinality) of the relationships properly.

Question 5 (15 marks)

Develop a **UML statechart diagram** as a precise statement of the following informal specification of the states of an old fashioned landline telephone, of the kind shown in this picture.

First the telephone has to be connected to the telephone network. If the receiver is in place, the phone is silent. When you lift up the receiver to make a call, first you hear the dialtone. After dialling the number, if the number is not connected to any phone account, you hear a message from the telephone company. If the number is a valid one, but is already part of a call, you will hear the busy tone. If the number is valid and not busy, you will hear a ring tone. If someone picks up the phone, you are connected and can talk. If no-one picks it up, after a certain number of rings, the tone will switch to an annoying series of beeps, as the call attempt is aborted, until you hang up. When you are talking to someone, if you hang up (put the receiver back), the call is disconnected. If the callee disconnects, you go back to hearing a dialtone. You can hang up at any stage

Question 6 (15 marks)

Consider the following scenario.

"A company that manages a very popular social networking site is in the middle of "buy-out" negotiations. The maintenance programmers (members of the Australian Computing Society) looking after the software have just discovered a bug that allows anyone to view photos of users with private profiles, including users under the age of 16. This is a violation of local child safety laws. Some of these photos have made their way to inappropriate sites. If the sale of the company is successful every employee will profit financially from the deal. However, if the system bug becomes public it will significantly decrease the financial value of the deal. The programmers bring this to the attention of their manager, who says to leave it to him, but then does nothing."

What are the ethical and professional issues that arise with the behaviour of the people involved in this situation? How would you evaluate their behaviours? In your answer, you must refer to the applicable parts of the Software Engineering code of ethics.

Question 7 (10 marks)

Suppose that you are a software engineer working on a car simulation system. You are given the pseudocode for the drive method in the Driver class.

```
Class CarSim:Driver
    Instance variables
        name: String
        instructions:  Array of Strings
        car: Car

begin method drive(instructions: Array of Strings)
// "s" – start car; "x" – stop car; "a" – accelerate;  "b" – break;
// "l" – turn left; "r" – turn right; "f" – continue forward
Local variables
instruction: String

foreach instruction in instructions
    if (instruction == "s")
        if (car.getStatus() != "stopped")
            Display message "Car is already started!"
        else
            if (startCar())
                Display message "Brmmm! Car started"
            else
                Display message "Hmm, the car won't start."
            end if
        end if
    else if (instruction == "x")
        if (car.getStatus() == "stopped")
            Display message "Car is already stopped!"
        else
            if (car.getSpeed() > 0)
                Display message "Don't turn off the engine while driving!"
            else
                if (stopCar())
                    Display message "Car stopped"
                else
                    Display message "Hmm the engine won't turn off."
                end if
            end if
        end if
    else if (instruction == "a")
        if (car.getStatus() != "stopped" and accelerate())
            Display message "You are now moving at car.getSpeed()"
        else
            Display message "Couldn't accelerate, is something wrong?"
        end if
    else if (instruction == "b")
        if (car.getStatus() != "stopped"  and brake())
            Display message "You are now moving at car.getSpeed()"
        else
            Display message "Couldn't brake! Is something wrong?"
        end if
    else if (instruction == "l")
        if (car.getStatus() != "stopped"  and turnLeft())
            Display message "You are now heading car.getHeading()"
        else
            Display message "Couldn't turn left"
        end if
    else if (instruction == "r")
        if (car.getStatus() != "stopped"  and turnRight())
            Display message "You are now heading car.getHeading()"
        else
            Display message "Couldn't turn right"
        end if
    else if (car.getStatus() != "stopped"  and instruction == "f")
        if (car.move())
            Display message "You continue heading  car.getHeading()"
        else
            Display message "Couldn't continue"
        end if
    else
        Display message "Invalid instruction"
    end if

    if (car.getStatus() == "broken")
        if (car.getVelocity > 150)
            Display message "Driving too fast when car broke down. You died."
        else
            Display message "Oh no, the car has broken down"
        end if
    end if
end foreach  instruction

end method  drive
```

Question 7 (cont.)

Write a set of 10 test cases for **glass box unit testing** of the drive() method.

Test No and brief description	instructions	Car status	Car speed	Expected output/behaviour
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				