

12.2 Program Design

Name: _____ Class: _____ Date: _____

Total: 28 marks

KEY WORDS structure chart 结构图 • state-transition diagram 状态转换图 • parameters 参数
 • states 状态 • program design 程序设计

Objective

Build the skills to answer exam questions on **program design** 程序设计 tools — structure charts and state-transition diagrams.

You must be able to:

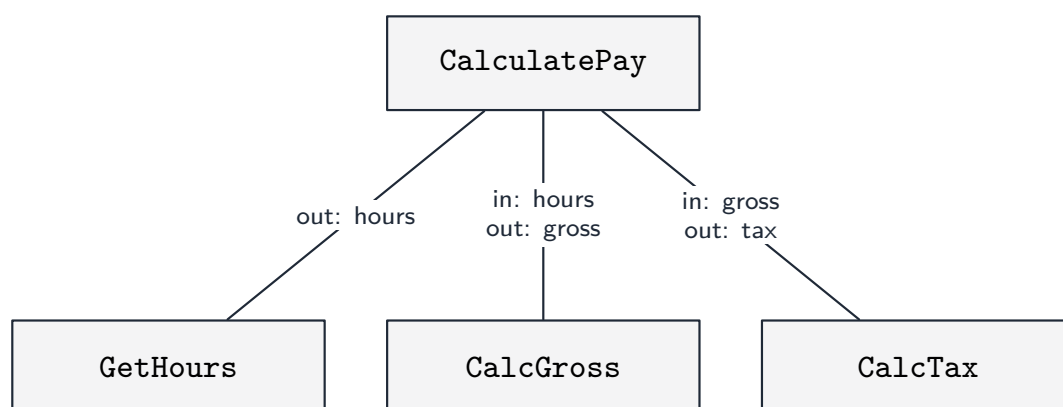
- read and draw a **structure chart** showing modules and the **parameters** between them
- read and draw a **state-transition diagram** showing states and events

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Structure chart

A **structure chart** shows how a program is **decomposed** into modules, and the **parameters** passed between them. Each module is a box; a line joins a caller (above) to a module it calls (below); the labels show data going **in** (down) and results coming **out** (up).

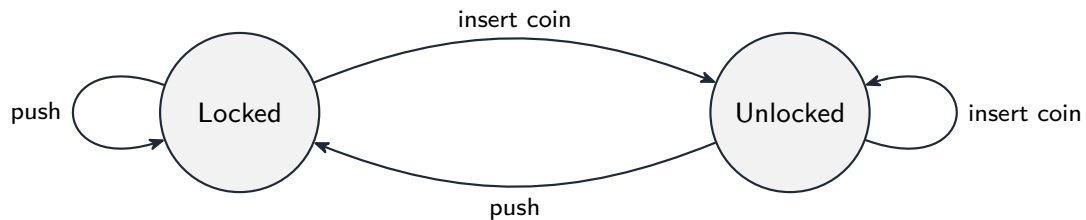


You can read each module's **signature** (its parameters and return) off the chart. Two extra symbols may appear: a **curved arrow** over the links means those modules are

called repeatedly in a **loop** (iteration); a small **diamond** on a link means the module is called only **sometimes** (selection).

■ State-transition diagram

A **state-transition diagram** shows the **states** a system can be in (circles) and the **events** (labelled arrows) that move between them. Below is a turnstile:



It makes **missing transitions** easy to spot — “*what happens if I push while Locked?*”

2 Practice

Now apply the methods above.

2.1 State what a **structure chart** shows. [1]

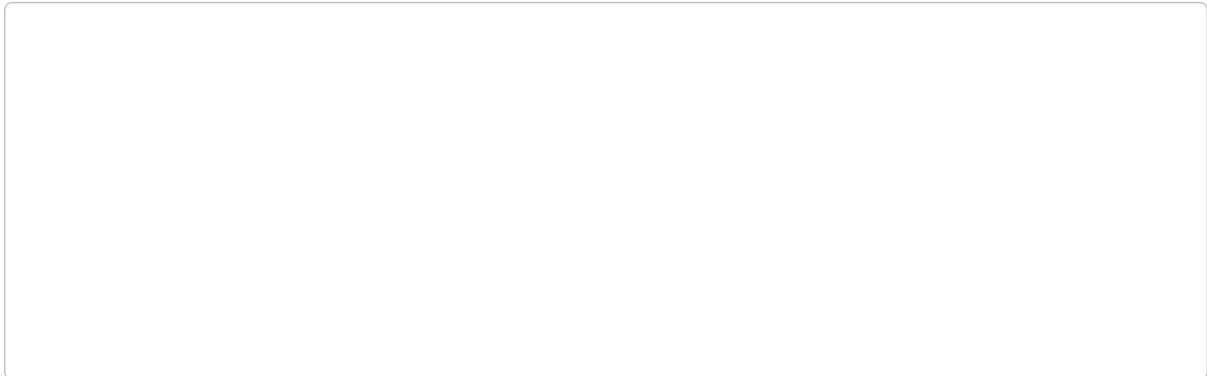
2.2 In a structure chart, what do the **labels on the links** represent? [1]

2.3 State what a **state-transition diagram** shows. [1]

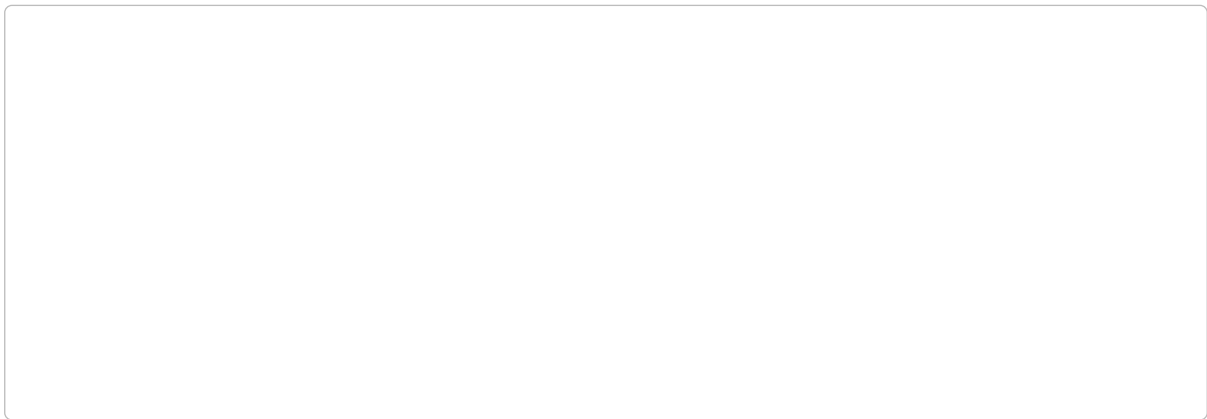
2.4 In the turnstile diagram, which **event** moves it from Locked to Unlocked? [1]

3 Exam-style questions

3.1 Draw a **structure chart** for a program `MakeTea` that calls `BoilWater` and `AddMilk`. `AddMilk` is passed the number of `Cups`. Show the parameter on the link. [4]



3.2 A vending machine has states `Idle`, `Paid` and `Dispensing`. Draw a **state-transition diagram** with these events: `coin` (`Idle`→`Paid`), `select` (`Paid`→`Dispensing`), `done` (`Dispensing`→`Idle`). [4]



3.3 State **one** benefit of drawing a state-transition diagram. [1]

3.4 In a structure chart, state what a **curved arrow** drawn over the links to two modules means. [1]

3.5 A vending machine program is documented with a **state-transition diagram** and a **structure chart**.

(a) The machine has states `Idle`, `Collecting`, `Dispensing` and `OutOfStock`. **Complete** the state-transition table for the events shown. [4]

current state	event	next state
Idle	coin inserted	_____
Collecting	enough money and item available	_____
Collecting	enough money, item sold out	_____
Dispensing	item delivered	_____

(b) **State** what a state-transition diagram shows that a structure chart does **not**. [2]

(c) **Explain** the meaning of the **curved arrow** symbol in a structure chart. [2]

(d) In the chart, `ProcessSale` calls `CheckStock`, which returns a Boolean. **Describe** how the parameter and its return value are drawn. [3]

(e) The team also produces a **program flowchart** for one module. **Explain** why all three documents are produced, rather than choosing whichever one the team prefers. [3]
