

2024

COMPUTATIONAL AND ALGORITHMIC THINKING

CAT.

AMT.
AUSTRALIAN
MATHS TRUST

Upper
Primary
Years 5–6

Information 考试说明

- There are 9 questions in the competition: 6 multiple choice and 3 three-part integer.
本次考试共 9 道题，分为 6 道单选题和 3 道填空题，答案为整数。
- You are allowed 60 minutes to do the questions. There is no extra reading time.
本次考试时长为 60 分钟，没有额外的读题时间。
- There are no penalties for incorrect answers. You should attempt all questions.
答错不扣分。请尝试回答所有问题。
- The questions have been checked thoroughly. Each question is clearly written and no further explanation can be given.
本场考试的所有题目已仔细核查，内容详尽，不提供更多解释。
- Diagrams are not drawn to scale. They are intended only as aids.
图形未按比例绘制，仅供参考。

Competition rules 考试规则

- You must maintain silence at all times.
考试过程中全程保持肃静，认真考试。
- Do not open the paper until told to do so.
收到监考老师指示前，请勿打开试卷。
- Mobile phones and smart watches are not allowed. If you have one, you must give it to a supervisor who will store it in a safe place.
禁止携带手机和智能手表。如有携带这些设备，请暂时交与监考老师保管。
- You may use calculators and printed language dictionaries.
允许使用计算器和纸质语言词典。
- You may not borrow equipment without a supervisor's permission.
未经监考老师许可，禁止向他人借用工具。
- You must not leave your seat during the competition. You must remain seated until the competition finishes.
考试期间禁止离开座位，直到考试结束。
- If you wish to leave the room, a supervisor must accompany you. Raise your hand and wait for a supervisor to come to you.
如需离开考场，必须举手示意并等待监考老师陪同。
- If you have any other questions or problems, raise your hand and wait for a supervisor.
如果有其他问题，请举手示意监考老师。

No student may sit the competition more than once or sit more than one division of the competition. AMT conducts integrity checks on competition results and reserves the right to withhold results or disqualify students if plagiarism or duplicate sittings are suspected.

DATE

22 May

TIME ALLOWED

60 minutes

IMPORTANT

All papers must be immediately returned to a supervisor at the end of the competition.

考试结束后，监考老师立即收回所有试卷。

This paper is not for circulation or distribution until Monday 3 June 2024.

2024 年 6 月 3 日前禁止传播或公开发布该试卷内容。

Part A: Questions 1–6

Each question should be answered by a single choice from A to E.

每题有五个选项，考生应从中选出一个正确答案。

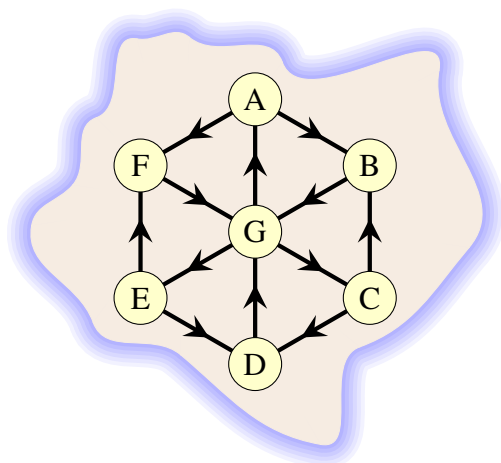
Questions are worth 3 marks each.

每题 3 分。

1. Octave Island-奥克塔夫岛

Octave Island has seven small towns labelled A to G. The towns are connected by one-way roads as shown.

岛上有七个小镇，分别用字母 A 到 G 进行标记。各小镇之间通过单行道相连，如图所示。



Mabel lives in A and needs to visit G, E and D in order, then return to A. But she can't drive directly from A to G because of the one-way roads. Each road takes 1 hour to travel on, so her return journey takes 6 hours.

住在 A 小镇的 Mabel 想按照 G、E、D 的顺序去这三个小镇旅游，然后再回到 A 小镇。但由于各小镇之间都是单行道，她无法直接从 A 小镇去到 G 小镇。每条单行道的行驶时间为 1 小时，Mabel 往返路程一共耗时 6 小时。

Mabel's friend Klara lives in C and wants to visit the towns A, F and E in order and return to C.

Mabel 的朋友 Klara 生活在 C 小镇，想按照 A、F、E 的顺序去这三个小镇旅游，然后再回到 C 小镇。

What is the shortest time, in hours, that Klara could take for the return journey?

请问 Klara 往返路程最少需要多少个小时？

- (A) 6 (B) 7 (C) 8 (D) 9 (E) 10

2. Wandering drone-无人机漫步

Mia and Adam were given a toy drone for Christmas. The remote control for this drone has five buttons.

Mia 和 Adam 在圣诞节当天收到了一架玩具无人机。这架无人机可以通过五个按钮进行远程操控。

U: Go up in the air 10 metres 上升 10 米

D: Go down towards the ground 10 metres 下降 10 米

L: Turn left 90° 左转 90°

R: Turn right 90° 右转 90°

F: Go forward 1 metre 前进 1 米

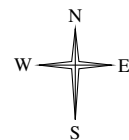
They took it to the local park and set it down on the ground facing north.

Mia 和 Adam 把无人机面朝北放在公园地上。

They then pressed the following buttons in order.

然后按顺序执行下列按钮指令。

U F R R F F L R R L F L F L F L F F R L L R F F R R F R F D



What direction is the drone facing now?

请问无人机现在面对哪个方向?

(A) north 北 (B) east 东 (C) south 南

(D) west 西 (E) it's impossible to tell 无法判断

3. Growth-野蛮生长

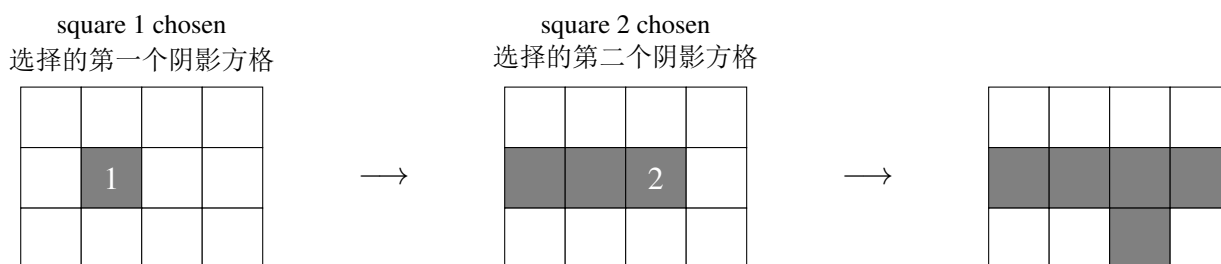
The game of *Growth* takes place on a grid of white squares.

野蛮生长 游戏采用一个由白色方格组成的网格。

- To start, a single square somewhere in the grid is chosen. It is shaded.
游戏开始时，网格中随机出现一个阴影方格。
- To make a move, a player chooses a shaded square and shades two white squares that are adjacent to it. (Adjacent means the squares have an edge in common.)
玩家每一轮需要选择一个阴影方格，然后为其两个相邻白色方格涂上阴影。(相邻方格指的是共用一条边的方格。)
- A shaded square **cannot** be chosen if it does not have two white squares adjacent to it.
如果一个阴影方格没有两个相邻的白色方格，那么它就不能被选择。
- A shaded square **can** be chosen more than once.
一个阴影方格可以被多次选择。

The example below shows the first shaded square and how the board *could* develop over two moves on a 4×3 grid.

下图显示了在这个 4×3 网格中选择的第一个阴影方格以及经过两轮操作后网格可能的变化情况。

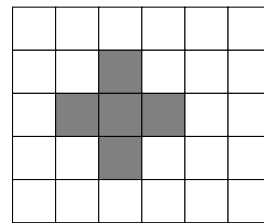
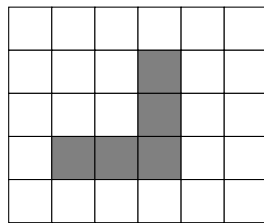
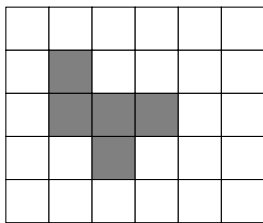
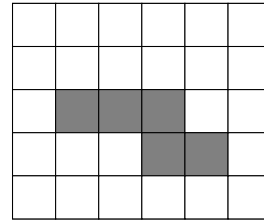
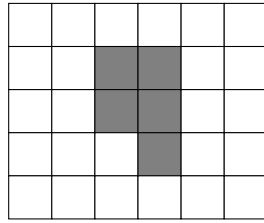
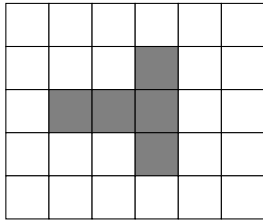


A game is played on a 6×5 grid.

如果该游戏采用的是一个 6×5 的网格。

How many of the following diagrams are possible after two moves?

请问在下列图片中，有多少张图片可能显示的是两轮操作之后的结果？



(A) 0

(B) 1

(C) 2

(D) 3

(E) 4

4. Heads up-翻面

You have a line of coins, some with the head side up and some with the tail side up. You want all of the coins to have the head side up. The only move you are allowed is to flip two adjacent coins. You will apply this move repeatedly until all the coins have their head sides up.

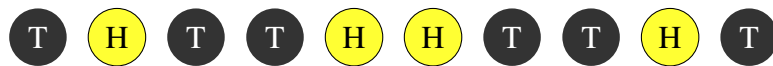
一排硬币中，有些正面（H）朝上，有些背面（T）朝上。此时，你想让一排硬币全部正面（H）朝上。操作过程中，每轮只能同时翻转两个相邻硬币，一直翻转直到所有硬币都正面（H）朝上为止。

Example 举例



You are given the following line:

给定如下一排硬币：



What is the smallest number of moves you need so that all the coins have their head sides up?

请问至少需要翻转几轮才能使所有硬币正面（H）朝上？

(A) 4

(B) 5

(C) 6

(D) 7

(E) 8

5. Garry's moves-Garry 的棋局

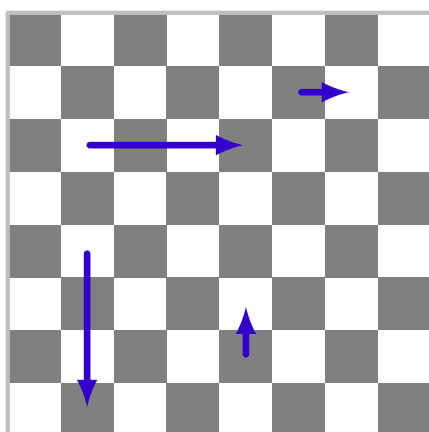
Garry is playing a game on an 8 by 8 chessboard. Here are the rules:

Garry 正在一个 8×8 的棋牌上玩游戏。游戏规则如下：

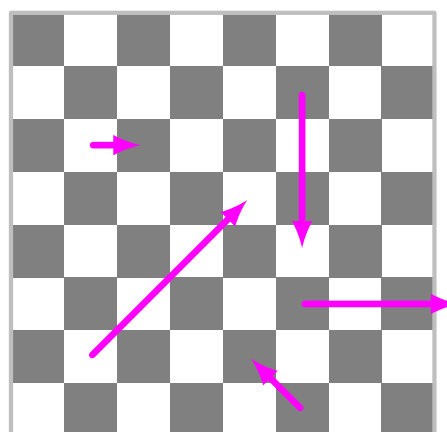
- On each turn he can move his playing piece up, down, left or right.
每一轮操作，Garry 可以在上、下、左、右四个方向上移动自己的棋子。
Diagonal moves are *not* allowed.
但 禁止 在对角线方向上移动。
- If his piece is on a dark square, on his next turn he must move exactly 1 square.
如果棋子落在黑色方格内，下一轮操作时必须恰好移动一个方格。
- If his piece is on a white square, on his next turn he must move exactly 3 squares, all in the same direction.
如果棋子落在白色方格内，下一轮操作时就必须在同一方向上恰好移动 3 个方格。

Examples 举例：

Allowed 允许

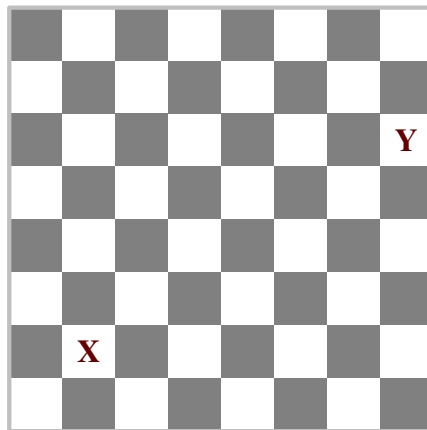


Not allowed 禁止



On the chessboard below, Garry wants to get his piece from **X** to **Y** in the smallest possible number of turns.

在下图所示棋盘中，Garry 想通过尽可能少的操作次数将自己的棋子从 **X** 方格移动到 **Y** 方格。



How many turns will he take?

请问他最少需要经过几轮才能将棋子从 **X** 方格移动到 **Y** 方格?

(A) 4

(B) 5

(C) 6

(D) 7

(E) 8

6. Pancakes-煎饼

There are three plates in front of you: two sorting plates (grey) and one serving plate (orange).

面前有三个盘子：两个灰色的分拣盘和一个橘色的餐盘。

You can move pancakes between the sorting plates *however you wish*, but:

你可以按照自己的喜好，在两个分拣盘之间移动煎饼，但是：

- you can only move a pancake from the top of one pile to the top of another pile (or to an empty plate); **and**
只能将其中一个分拣盘最上方的煎饼移到另一个分拣盘的最上方（或者移到一个空盘子里）；**并且**
- once you move a pancake to the serving plate, *you cannot move it again*.
一旦煎饼被放到餐盘中，就不能再次移动该煎饼。

Example 举例:

You can move the 4-pancake to the other sorting plate or to the serving plate.

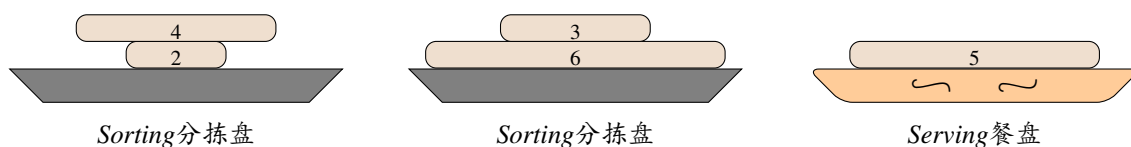
你可以将 4 号煎饼移动到另一个分拣盘或者餐盘中。

You can move the 3-pancake to the other sorting plate or to the serving plate.

你可以将 3 号煎饼移动到另一个分拣盘或者餐盘中。

You cannot move the 5-pancake since it is on the serving plate.

不能移动 5 号煎饼，因为 5 号煎饼已经放在餐盘中了。



At the start, the leftmost sorting plate contains a pile of pancakes in a random size order.

The other two plates are empty.

游戏开始时，最左边的分拣盘中摆放着这一叠煎饼，这些煎饼并未按照尺寸大小顺序排列。与此同时，其他两个盘子为空。

Your goal is to move all pancakes to the serving plate, in sorted order, with the smallest on the top and the largest on the bottom.

你需要将所有煎饼移动到餐盘中，并按数字顺序摆放：数字最大的煎饼放在最下面；数字最小的煎饼放在最上面。

Initial: All pancakes on the left plate, in order 4 2 5 3 6 1 (with 4 on the top).

游戏开始时：所有煎饼按照 4 2 5 3 6 1 的顺序摆放在左边的分拣盘中（4 号煎饼摆放在最上面）。



Final: All pancakes on the serving plate, in order 1 2 3 4 5 6 (with 1 on the top).

游戏结束时：所有煎饼按照 1 2 3 4 5 6 的顺序摆放在餐盘中（1 号煎饼摆放在最上面）。



How many moves would it take to arrange them in sorted order on the serving plate, with the smallest on the top and the largest on the bottom?

请问要经过多少次移动才能将所有煎饼按顺序放在餐盘中：数字最小的煎饼放在最上面，数字最大的煎饼放在最下面？

(A) 9

(B) 10

(C) 11

(D) 13

(E) 15

Part B: Questions 7–9

Each question has three parts, each of which is worth 2 marks.

每题有三个部分，每部分 2 分。

Each part should be answered by a number in the range 0–999.

每部分答案应为一个介于 0–999 之间的数字。

7. Restricted swapping-限制交换

You are given a number with several digits. You are allowed to make several swaps. Each swap is of two adjacent digits. Your aim is to form the largest number possible.

给定一个多位数。玩家需要对这个多位数的各位数字进行多次顺序交换，最终得到一个可能的最大数字。玩家每次只能对两位相邻数字进行交换。

For example, suppose you start with 8 5 3 7 9 2 and are allowed to make three swaps.

You might choose

假设给定的多位数是 8 5 3 7 9 2，且玩家仅允许进行 3 次交换。你可以选择

$8 \underline{5} 3 7 9 2 \rightarrow 8 3 5 \underline{7} 9 2 \rightarrow 8 3 5 \underline{7} 2 9 \rightarrow 8 3 5 2 7 9$

Note that with these choices you have made the number *smaller*, not larger!

注意，以上三次交换是让数字变小了，而不是变大！

You are presented with 2 9 1 7 8 6 5.

现在给定一个多位数 2 9 1 7 8 6 5。

What are the **middle three digits** of the largest number you can make with:

请问对于以下三种不同的交换次数，分别得到的最大数字的中间三位数字是多少？

- A. 3 swaps? 3 次交换？
- B. 4 swaps? 4 次交换？
- C. 7 swaps? 7 次交换？

For instance, if the largest number you can make is 1 2 6 9 7 5 8, your answer will be 6 9 7.

例如，如果得到的最大数字是 1 2 6 9 7 5 8，那么你的答案应该为 6 9 7。

8. Plantings-苗床种植

Elle wants to plant her rural block with banksias (B), grevilleas (G) and waratahs (W). She has marked out several rectangular garden beds. She wants to plant out her garden beds so that:

Elle 想要在农村种植山茂櫟 (B)、银桦木 (G)、瓦松 (W)。她已经将土地规划成多块矩形苗床，并且计划按照以下模式在苗床中栽种：

- each garden bed will be planted with only one type of plant – banksias or grevilleas or waratahs

每块苗床只栽种一种植物——山茂櫟 (B)、银桦木 (G) 或瓦松 (W)

- neighbouring garden beds will not be planted with the same type of plant (neighbouring garden beds are those that have an edge or part of an edge in common, but not just a corner).

相邻苗床中栽种的植物类型不同（相邻苗床指的是共用一条边或者共用一部分边的苗床。注意，仅共用一个角落的苗床不是相邻苗床。）

Just as she is pondering the possibilities, her mother announces that she has just put some plants in! Luckily the rules Elle set have been obeyed, and now there is no decision to make: there is only one possible way to plant the rest of the beds.

正当 Elle 考虑计划可行性时，她的妈妈说她已经在一些苗床里面种了一些植物了！不过，幸好妈妈遵循了 Elle 设定的栽种规则，现在 Elle 只能在剩下未种植的苗床中栽种植物了。

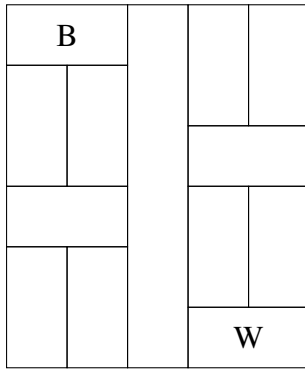
For each of the rural blocks below, find the number of beds that are planted with each type of plant. *This includes the beds Elle's mother has planted.*

对于下列各块农村土地，求每种植物的苗床数量。其中包含 Elle 妈妈栽种的苗床。

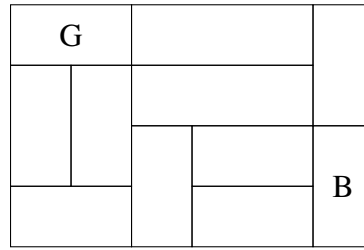
Your answer will be a 3-digit number, giving the number of beds planted with banksias, grevilleas and waratahs. For instance 123 would mean 1 bed planted with banksias, 2 with grevilleas and 3 with waratahs.

你的答案应该为一个 3 位数，分别表示山茂櫟苗床、银桦木苗床、瓦松苗床的数量。例如数字 123 表示 1 个山茂櫟苗床、2 个银桦木苗床和 3 个瓦松苗床。

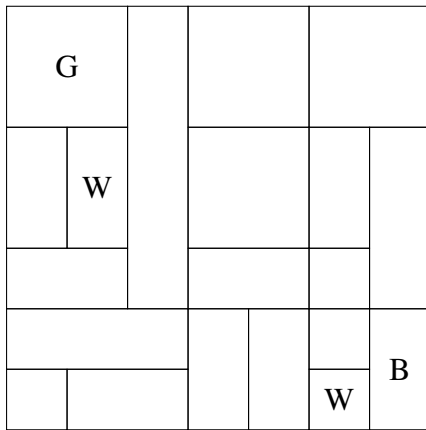
A.



C.



B.



9. Sami the sales rep-销冠 Sami

Sami has clients in several towns along a road.

Sami 的客户分布在沿路的几个小镇中。

On her outward journey her expenses are covered and she can keep all the money she makes from sales. On her return home, however, she must pay her travel expenses.

外出拜访客户时，Sami 的花费都可以报销，因此她的销售收入可以完全存下来。但在返程途中，她只能自己支付路费。

Sami does not have to visit all of the towns. She can choose where she turns back.

Sami 可以选择从任意一个小镇返程，不必去到所有小镇。

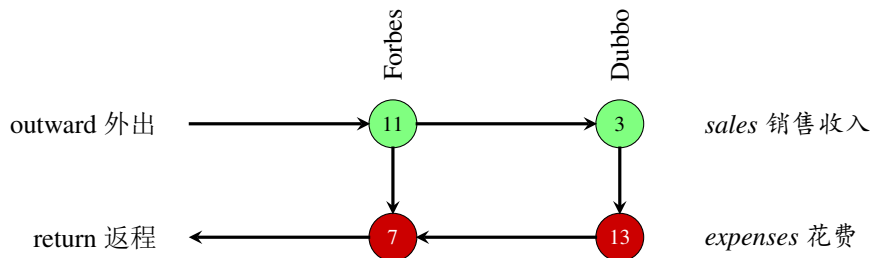
Example 举例:

Along this road, if she turns back at Forbes she makes \$11 in sales but it costs her \$7 in expenses.

如果她从 Forbes 返程，她的销售收入为 \$11，但需要自行支付路费 \$7。

If she goes on to Dubbo she makes $\$11 + \$3 = \$14$ in sales but it costs her $\$7 + \$13 = \$20$ in expenses.

如果她从 Dubbo 返程，她的销售收入为 $\$11 + \$3 = \$14$ ，但需要自行支付路费 $\$7 + \$13 = \$20$ 。



In this case there is only one travel option where her sales are greater than her expenses – turning back at Forbes.

在这种情况下，Sami 只有从 Forbes 返程，才能保证销售收入比路费多。

For each of the following roads, how many travel options are there where her sales are **greater than** her expenses?

请问在下列三条路线中，分别有多少种返程点的选择能使 Sami 的销售收入比路费多？

A.		A	B	C	D	E	F										
	outward 外出	8	7	4	6	3	5										
	return 返程	5	8	7	4	1	8										
B.		A	B	C	D	E	F	G	H	I							
	outward 外出	9	6	5	6	5	3	5	4	6							
	return 返程	8	8	3	7	6	1	4	7	4							
C.		A	B	C	D	E	F	G	H	I	J	K	L	M	N		
	outward 外出	5	4	2	6	5	3	3	7	5	1	4	2	3	6		
	return 返程	6	3	1	5	6	6	5	2	6	0	3	3	5	4		