

# Computational and Algorithmic Thinking

CAT Sample Problems  
Intermediate

# Part A: Question 1

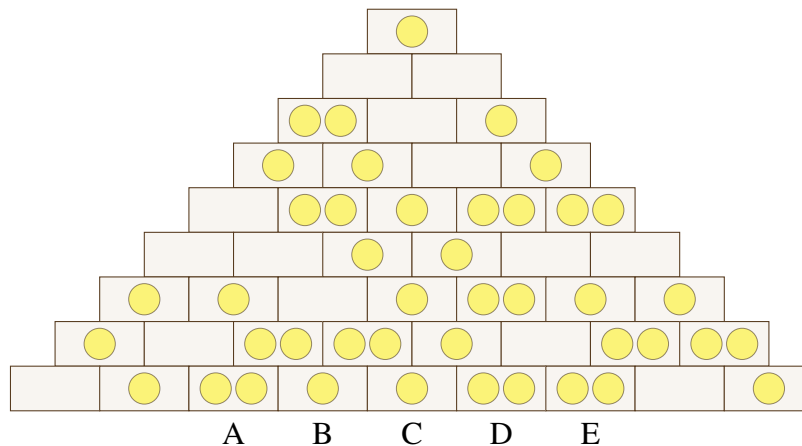
This question should be answered by a single choice from A to E.

This question is worth 3 marks.

## 1. Pyramid Climb

Starting at one of the bricks on the bottom row, your job is to climb from one row to the next until you reach the top of the pyramid. From each brick you must go up to the left or up to the right. You cannot move sideways along the same row of bricks and you cannot move down to the row below.

Along the way, you can collect any coins you find. Some bricks have no coins, some have one coin and some have two coins.



You want to collect as many coins as possible. Of the bricks labelled A to E, which one is the **worst** place to start?

(A) A

(B) B

(C) C

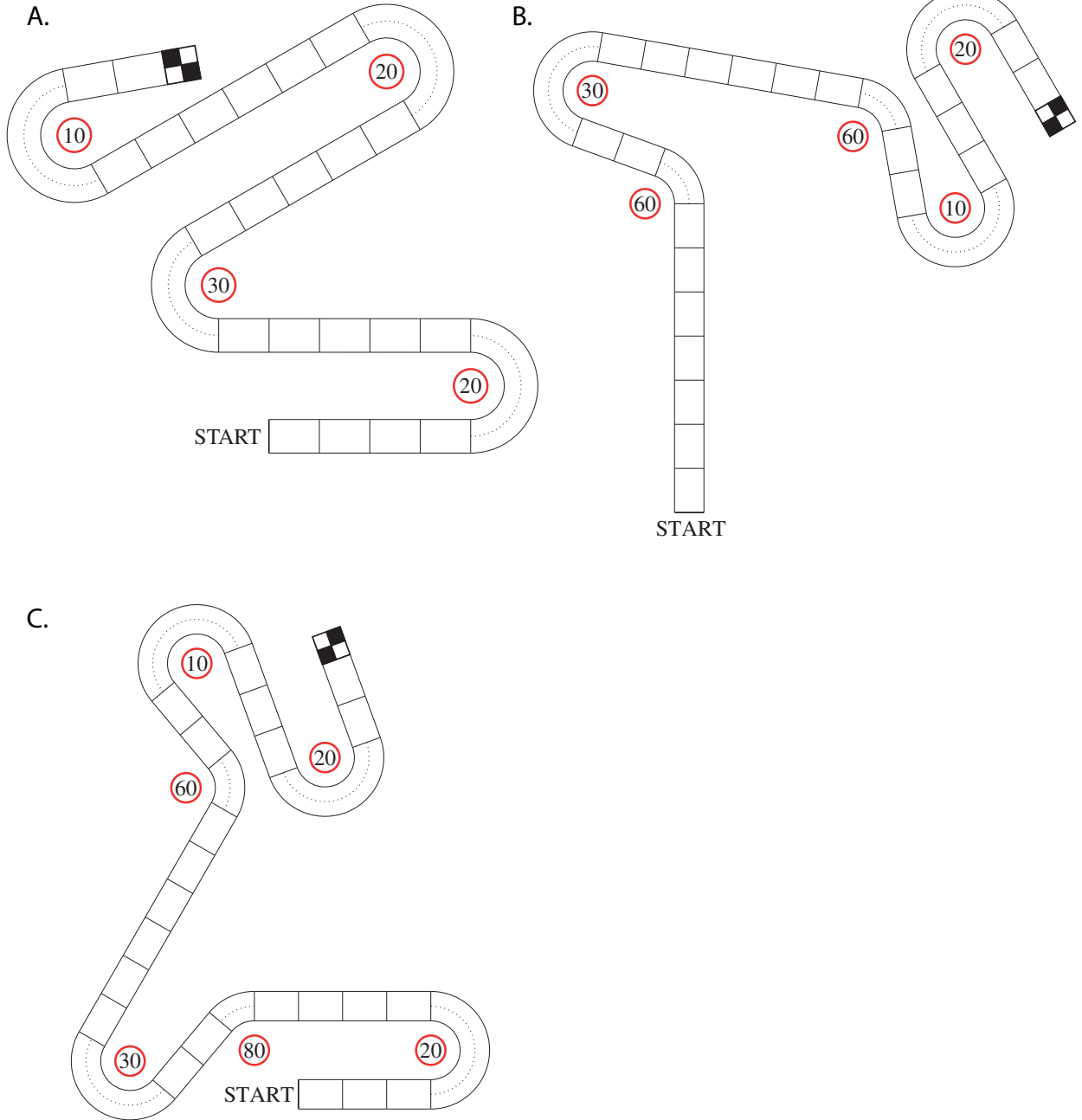
(D) D

(E) E



In the competition time trials, *Alain always drives as fast as he possibly can on each segment without crashing.*

On each of the following courses, what is the total cost his team incurs when Alain races once?



# Part C: Prize Question 1

This is an optional prize question. It's not part of the core competition. Each prize question has two parts and has the same rules as a core question in the paper.

**Note: the full introductory text is copied below but the examples are omitted.**

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## Prize 1. Race Track

Alain races his car in time trials on race tracks made up of straights and corners. Each corner has a speed limit, and if he enters the corner any faster than the limit, he crashes.

The straights are laid out in segments, marked by lines across the track.

On each straight segment he can do one of the following:

- accelerate to increase his speed by 10km/h
- brake to decrease his speed by 10km/h
- coast, which keeps his speed the same.

In corners, his car cannot accelerate or brake, and so exits the corner at the same speed that it enters – unless he is over the corner's speed limit, when he will crash.

His car always starts at the start line and has zero speed when the time trial starts. It can safely cross the finish line at any speed.

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### *Prize Extensions*

In these questions we represent a racetrack by  $s_1 (C_1) s_2 \dots$

The racetrack in the example would be represented by 6 (20) 2 (50) 2.

Alain is racing several laps on a racetrack where the end point is the same as the starting point. Alain still drives as fast as he possibly can on each segment without crashing.

In these questions, when Alain accelerates his speed only increases by 1 (one) on each segment.

- A.** The race track is 4 (61) 4 (61) 4 (60) 4 (54) 4.  
Alain drives 4 times around the track. On how many segments did he brake?
- B.** The race track is 8 (55) 4 (49) 4 (52) 9 (55) 5.  
Alain drives 3 times around the track. On how many segments did he brake?