The Lab
Junior Program

THE LAB
Junior

Term 1
Home Workbook
Answer Key

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Preface

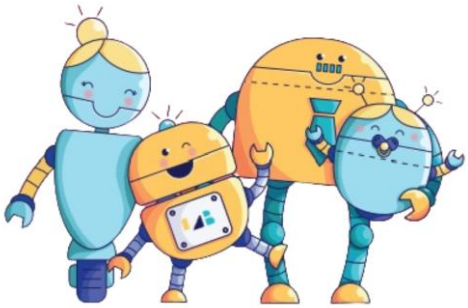
Version Oct 2025

Welcome to The Lab Singapore's workbook—a guide designed to spark creativity, nurture logical thinking, and develop essential coding skills.

At The Lab, we believe that every child can achieve remarkable things when given the right tools and guidance. Our passionate educators, driven by a love for teaching and innovation, are dedicated to empowering students to solve real-world problems through coding and computational thinking.

This workbook reflects our commitment to making learning engaging, meaningful, and fun. It is more than a collection of exercises—it's a step towards building confidence, resilience, and a lifelong love for learning.

Let's embark on this exciting journey together!



A Friendly Note to Parents & Students

This workbook is designed to help our students revise and practise the concepts taught in class. Many of these ideas are new, so it's completely normal for students to need repetition and extra practice before they fully understand them. Not getting it the first time is part of the learning journey — and absolutely okay!

Please remember that this workbook is not a test and it does not reflect how well your child is performing in class or how well we teach. It simply gives students a chance to try things on their own at home, at their own pace.

To keep things encouraging, here's how we look at the scores:

✔ Scoring (Just for Practice!)

50% and above – Great job!

Your child has understood the main ideas.

Below 50% – Keep practising!

This is not a failure. It just shows which areas are still new or need a bit more time — and we'll continue to guide them in class.

At The Lab, we believe learning should feel positive, safe, and joyful. We hope this workbook supports your child as they grow, explore, and discover new concepts!

Answer Key

Random vs Sequence

Coding Concepts

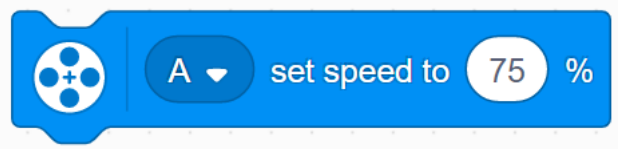
1. Answer: A, seconds. Tells the motor connected to Port A to run in a clockwise direction for 1 seconds.

2. Answer: 1, 10. Picks a random number from 1 to 10.
3. Answer: C. As the name suggests, the Single Motor block is used to control only one motor at a time. It allows you to set the mode and direction for a single motor, rather than multiple motors together.

4. Answer: A. Just like its name, the Single Motor block controls one motor at a time.

5. Answer: C. The Single Motor block makes a single motor of the robot moves clockwise and anticlockwise.

6. Answer: C. The Single Motor block does not allow you to set the speed of the motor. You will need an additional block, namely the Set Single Motor Speed block, to control the speed of a single motor.



7. Answer: D. When the Random block (the green block) is added to the value of seconds, the program will pick a random number within the specified range. In this case, the range is 1 to 10, so the motor will run clockwise for a random number of seconds between 1 and 10.

8. Answer: A. The motors run one at a time, in the order of Port A → Port B → Port C, each completing its rotation before the next starts.

9. Answer: B. When the Random block (green block) is added to the value of rotations, the program selects a random number within the specified range. Here, the range is 20 to 30, so the motor will run clockwise for a random number of rotations between 20 and 30. Therefore, the correct answer is B (25), because 25 falls within the range of 20 to 30.

10. Answer: Right. The left code spins the motor for a random number of rotations, but the right code spins it for a random amount of time. So, the correct choice is the right code.

11. Answer: Left. The left code spins the wheel (i.e., Randomness is a jackpot) a random number of rotations, but it always ends in the same position. The right code spins the wheel for a random amount of time, so the result can change each time. That's why the left code is correct.

12. Answer: Right. The left code spins the wheel (i.e., Randomness is a jackpot) a random number of rotations, but it always ends in the same position. The right code spins the wheel for a random amount of time, so the result can change each time. That's why the right code is correct.

13. Answer: Right. The left code spins the wheel (i.e., Randomness is a jackpot) a random number of rotations, but it always ends in the same position. The right code spins the wheel for a random amount of time, so the result can change each time. That's why the right code is a better code for Randomness as a jackpot machine needs to display random numbers all the time.

14. Answer: B. If the motor spins a fixed number of rotations, the wheel always stops in the same spot. But a jackpot machine needs the wheel to stop at different numbers each time. So, using rotations is not the right code.

15. Answer: B. The image shown is a Single Motor block. As the block indicates, it will make a single motor spin clockwise (as shown in the icon) for 1 rotation.

Random and Range

Coding Concepts

1. Answer: motors. Sets which ports the motors are connected to.

2. Answer: forward, 10. Tells the motors connected to move forward for 10 rotations.

3. Answer: C. As the name suggests, the Double Motor block is used to control two motors at a time. It allows you to set the mode and direction for two motors to move at the same time.

4. Answer: B. As the name suggests, the Double Motor block is used to control two motors at a time.

5. Answer: C. You need to use the Set Movement Motors block together with the Double Motor block. The Set Movement Motors block tells the robot which ports the motors are connected to. You must identify the ports correctly so that the robot can move both motors properly.

6. Answer: C. The left code moves the motors one by one, A first, then B. The right code moves both motors together, so the robot goes straight.

7. Answer: Right. The left code moves the motors one by one, so the robot zigzags (A first, then B). The right code moves both motors together, so the robot goes straight.

8. Answer: Right. The left code will work only if the motors are connected to Port A and B, because the program defaults to these ports. Since the motors are in Port C and D, the Set Movement Motors block is needed to tell the robot the correct ports. Therefore, only the right code will work.

9. Answer: D. If the motors are connected to Port A and B, the program will work without the Set Movement Motors block, because it defaults to these ports. In this case, the left and right codes behave the same way.

10. Answer: B. If the motor ports are switched (for example, from A and B to B and A), the robot will move in the opposite direction. This means the robot will move backward instead of forward.

11. Answer: A. Setting the motor ports is required. The program will only work if the motors are connected to Port A and B, because these are the default ports. Since the motors are actually in Port C and D, the Set Movement Motors block is needed to tell the robot the correct ports.

12. Answer: A. Setting the motor ports is required to tell the program which ports the motors are to activate them.

13. Answer: A. According to the law of force, a robot will move in a straight line only when both motors run at the same speed side by side. If the speeds are different, the robot will veer or turn instead of going straight.

14. Answer: A, B, C. This is a troubleshooting question. The only incorrect option is D, which suggests the robot can move by itself. Options A, B, and C are all logical reasons why the robot may not move even if the code is correct.

15. Answer: B, C, D. This is a troubleshooting question. The only incorrect option is A, which suggests the robot can decide to dislike going somewhere. Options B, C, and D are all logical reasons why the robot may not go straight even if the code is correct.

Flowcharts in Programming

Coding Concepts

1. Answer: A. An input device is something that provides data or information to a computer or robot. These are typically sensors. For example, a touch sensor gives information to the computer about whether it has been pressed or not. Hence, option A is the answer.

2. Answer: D. An output is an action or result produced by the robot after receiving an instruction. For example, when a clockwise turning command is given, the motor turns clockwise. Hence, option D is the answer.

3. Answer: C. An input device is something that provides data or information to a computer or robot. Pressing a button on the robot sends information to the robot.

4. Answer: B. When a robot receives various signals (like button presses or sensor data), it can produce specific actions or outputs for each one based on its code.

5. Answer: C. According to the program, Motor A will move for 1 rotation when left button is pressed, while Motor B will move for 1 rotation when right button is pressed. Hence, option C is the answer.

6. Answer: A. According to the program, the program first waits for the left button to be pressed before running the motor. After that, it waits for the right button to be pressed to turn on the smiley face. So, the correct order of inputs is pressing the left button first, then the right button.

7. Answer: Left. The left code will wait until the left button is pressed before the motors start moving, while the right code will wait for 1 second before the motors start moving.

8. Answer: Right. The question asks for the motor to be reset, which means it must move in the opposite direction of the previous code. Therefore, the right code is correct, as it makes the motor move clockwise first and then anticlockwise to reset its position.

9. Answer: Right. The difference between the two codes is that one activates Motors A and B, while the other activates only Motor A. Since the question asks for the motor to be reset, which refers to a single motor, the right code is the correct answer.

10. Answer: C. The question asks what happens when the left button is pressed. From reading the code, if the left button is pressed, the block below this condition will be activated, causing Motor A to spin 1 rotation clockwise.

11. Answer: C. The question asks what happens when the right button is pressed. From reading the code, if the right button is pressed, the block below this condition will be activated, causing Motor A to spin 1 rotation anticlockwise.

12. Answer: C. The question asks for an input. Therefore, Option A is incorrect because it is an output. From reading the code, the action “move Motor A clockwise” is the output that happens when the left button is pressed, which is the input. Hence the answer is C.

13. Answer: D. The question asks for an input. Therefore, Option A is incorrect because it is an output. From reading the code, the action “move Motor A anticlockwise” is the output that happens when the right button is pressed, which is the input. Hence the answer is D.

14. Answer: C. The question asks what needs to be done for the robot to spin its umbrella. To find out, we look at the instructions before the umbrella spins. From the flowchart, the robot spins its umbrella when the left button is pressed.

15. Answer: D. The question asks what needs to be done for the robot to adjust its spectacles. To find out, we look at the instructions before the spectacles are adjusted. From the flowchart, the robot adjusts its spectacles when the right button is pressed.

Wait Until with Positive and Negative Numbers

Coding Concepts

1. Answer: wait, true. The program will wait at this block until the condition in the hexagonal gap is true, at which point the program will move on to the next sequential block of code.

2. Answer: 1. Tells the code to wait 1 second before carrying out the next sequential block of code.

3. Answer: left, pressed. This block checks whether the left button has been pressed.

4. Answer: Cat Meow 1. Plays the sound Cat Meow 1 once.

5. Answer: Left. The grabber needs to open and close. In the left code, the motor first spins clockwise, then anticlockwise (the second block reverses direction because the number is negative). The second block on the right is meant to spin the motor anticlockwise based on the icon, but because the rotation value is negative, it cancels out the anticlockwise command, making the motor spin clockwise again. Hence the left code is the correct answer.

6. Answer: Right. The grabber needs to open and close. In the left code, the second block is meant to spin the motor anticlockwise based on the icon, but because the rotation value is negative, it cancels out the anticlockwise command, making the motor spin clockwise again. Hence the right code is the correct answer.

7. Answer: Right. Time can never be negative. Other motor modes, like rotations or degrees, can have negative values, similar to physics. Therefore, the correct choice is the right code, which uses a valid mode for the action.

8. Answer: Left. Since the grabber is required to move slowly, a wait block is needed to slow down the action. Therefore, the left code is correct.

9. Answer: A. In a typical grabbing action, it's useful to have a short pause between opening and closing the grabber's claws. A wait block is ideal for creating this pause, ensuring the movement is smooth and controlled.

10. Answer: Left. The sample code makes the motor turn clockwise. In both the left and right codes, the negative rotation value is used to make the motor turn anticlockwise, so an anticlockwise turn icon is needed to reverse the action and make the motor turn clockwise.

11. Answer: Right. The sample code makes the motor turn clockwise. Since the turn icon shows anticlockwise, a negative rotation value is used to reverse the action and make the motor turn clockwise. Therefore, the correct answer is the code on the right.

12. Answer: C. Time can never be negative. Other motor modes, like rotations or degrees, can have negative values, similar to physics. Therefore, the correct choice is the right code, which uses a valid mode for the action.

13. Answer: B. The code will open the grabber when the left button is pressed at the 5-second mark. Since the question states the button is pressed for more than 5 seconds, the condition becomes true, and the code below the "wait until" block will be executed. Therefore, the program will wait for another 5 seconds before activating the motor, making it 10 seconds.

14. Answer: C, D. The “wait until” block makes the motor activate only when the left button is pressed twice, with a 1-second interval between the presses. Therefore, only Options C and D are correct.

15. Answer: D. Since the question states that the left button is released when the program runs, the condition will be false because no button press is detected. As a result, nothing will happen.

Angles and Turns

Coding Concepts

1. Answer: clockwise, anticlockwise. Starts the motor turning in clockwise or anticlockwise direction.

2. Answer: number. Tells the motor(s) to run in a clockwise or counterclockwise direction for a number of rotations, seconds or degrees.

3. Answer: C. The "Wait Until" block in LEGO Spike programming pauses the program until a specific condition is met. Once the condition becomes true, the program continues to the next block.

4. Answer: C. Since a clap is a sound, the appropriate sensor to use is a sound sensor. Therefore, the correct answer is C.

5. Answer: A. Since a press is related to touch, the appropriate sensor to use is a touch sensor. Therefore, the correct answer is A.

6. Answer: A. In the Wait Until block, if the specified condition is never true, the program will wait indefinitely until the condition becomes true.

7. Answer: Left. A full circle is 360 degrees. Hence the code on the left is correct.

8. Answer: Right. The question asks the robot to turn anticlockwise first and then clockwise. By examining the directional arrows on the motor blocks in both codes, the right code correctly follows this sequence.

9. Answer: Left. Both codes include a move motor output. However, only the left code has an input, where the robot will wait until the left button is pressed before moving the motor.

10. Answer: A. In the given code, the motor will first move in a clockwise direction. It will then wait until the left button is pressed to change direction and move anticlockwise. Hence the answer is A.

11. Answer: D. There is a wait until left button is pressed above the Cat Meow sound block. That means that the condition must be true (i.e. left button is pressed) first before the Cat Meow sound block is executed. Hence the answer is D.

12. Answer: B. There are two "Wait Until" blocks before the Basketball Bounce sound block. This means both conditions must be true — the left button is pressed and then the right button is pressed — before the Basketball Bounce sound block executes. Therefore, the correct answer is B.

13. Answer: B. There is a "Wait Until Left Button is Released" block above the Basketball Bounce sound block. This means the condition — the left button is released — must be true before the Basketball Bounce sound block is executed. Since released means the button is not pressed, the correct answer is B.

14. Answer: A. There are two "Wait Until" blocks before the Basketball Bounce sound block. This means both conditions — the left button is released and then the right button is released — must be true before the sound block executes. If the program is run and neither button is pressed, both conditions are already true. Therefore, the correct answer is A.

15. Answer: A. Since there is only one action/output tied to the condition, the Basketball Bounce sound block will be executed only once when the condition becomes true.

Geometry and Loops

Coding Concepts

1. Answer: Forever. Forever repeats all code inside the gap in sequential order

2. Answer: 10. Executes all code inside the gap in sequential order 10 times.

3. Answer: A. Since the block is described as "forever", any instructions placed inside this block will repeat indefinitely.

4. Answer: C. The repeat block lets you input a number to control how many times the instructions inside will run. For example, if you enter 2, the instructions will execute twice. Therefore, the correct answer is C.

5. Answer: B. When you use the forever block, any instructions placed inside this block will repeat indefinitely. In this case, the instruction is to make the robot move forward. As such, will keep moving forward until you stop the program, i.e. Answer is B.

6. Answer: C. The repeat block lets you input a number to control how many times the instructions inside will run.

7. Answer: B. If you put a forever block inside a repeat block, the instructions inside the forever block will be repeated forever.

8. Answer: Right. The left code will just make the robot go forward and backward. The right code makes the robot go straight and then turn to make a square.

9. Answer: Left. A square has 4 sides. There are 2 turning in the repeat block, hence the value of the repeat block must be 2 and not 4.

10. Answer: Left. Comparing the duration of the single motor block movement. The left code is likely to spin the motor less than one full turn. The right code spins it for 8 rotations, which is likely more than one full turn. Since none of the angles of a parallelogram is more than a full circle, the left code is the correct choice.

11. Answer: D. You need to use the Set Movement Motors block together with the Double Motor block. The Set Movement Motors block tells the robot which ports the motors are connected to. You must identify the ports correctly so that the robot can move both motors properly.

12. Answer: B. 5 x 4 cm = 20.

13. Answer: A. (5 - 2) cm x 4 = 12cm

14. Answer: D. (5 + 2) cm x 4 = 28cm

15. Answer: B. (5 – 5 + 10) cm x 5 = 50cm

Logic and Conditionals

Coding Concepts

1. Answer: true, false. If the specified condition placed inside the hexagonal gap is true, execute the code inside the first white space. If the specified condition inside the hexagonal gap is false, execute the code inside the second white space.

2. Answer: red. Sets the centre button on the Spike hub to light up in red.

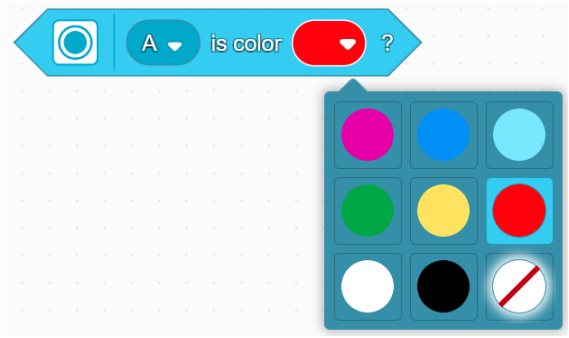
3. Answer: A, red, true. Checks if the colour sensor, connected to port A, detects the colour red. If it does, the block returns true, if not it returns False.

4. Answer: Stops, A. Stops the motor connected to port A.

5. Answer: A. A colour sensor can only sense one colour at any point in time.

6. Answer: B. As the name suggests, the colour sensor is designed to detect colours.

7. Answer: D. The LEGO colour sensor is preprogramed to sense multiple colours as per the image below. It cannot sense all the colours in the world but it can reasonably sense at least 8 colours.



8. Answer: B. A LEGO Colour Sensor shines a light onto an object and measures the amount of light reflected back. It uses this information to determine the colour of the object.

9. Answer: A. A black line is a form of colour. As such, the most appropriate sensor to use is the colour sensor.

10. Answer: C.

11. Answer: Right. To rock back and forth, the motor needs to be clockwise then anticlockwise or vice versa.

12. Answer: Left. The forever block is needed when programming a sensor because you usually want the sensor to keep sensing continuously and be ready to trigger an action whenever its condition is met.

13. Answer: Left. Stationary means the motor needs to stop moving. To make this happen, the instruction/block should be in the else condition. In the left code, the logic reads: If the robot senses red, it will start moving. Else, it will stop moving. Since the robot senses blue, which is not red, it will stop moving. Therefore, the left code is correct.

14. Answer: Left. The left code uses a forever block, which allows the sensor to keep sensing continuously. Since the code identifies red and blue as true conditions, the

motors will be activated whenever these colours are detected.The right code, however, only has two “Wait Until” blocks, which are sequential conditions. This means that once the robot executes the motor after both conditions are met, the program ends and does not continue sensing.

15. Answer: A. This code uses an if–else if condition. That means the program will only check the next condition if the first condition is false. In this question, the first condition is true (the colour sensor is sensing red), so the program will not check the next condition.

Introduction to Algorithm

Coding Concepts

1. Answer: C. In the question, there is no mention of what the robot will do if the button is not pressed. Hence, the default will be it will not do anything.

2. Answer: B. In the question, if the robot senses red, it will turn left. As this condition is true, the robot will turn left.

3. Answer: B. The forever block increases efficiency because it allows the same set of instructions to run continuously without needing to write multiple lines of code. Instead of repeating the same commands again and again, the forever block repeats them automatically for as long as the program runs.

4. Answer: B. When the value of rotation has a negative sign, the motor will do in the reverse direction of the directional arrow on the block.

5. Answer: B. In the question, if the robot senses green, it will move forward 2 unit. As this condition is true, the robot will move forward.

6. Answer: B. When a robot moves forward, turn into the right direction and go straight again, it forms an angle, like a square corner.

7. Answer: A. Assuming that the turns are right angles, the following sequence will make the robot go back to its original position.

8. Answer: Left. It is always more efficient to use a repeat block when you have multiple identical instructions for the robot. Instead of writing the same commands over and over, the repeat block executes them automatically the specified number of times, saving time and reducing errors.

9. Answer: Right. Since it is not necessary for the robot to move forward and then backward to reach a specific position, the right code is more efficient. It achieves the same result using only one movement block, reducing complexity and saving time.

10. Answer: Left. The question requires the robot to move only when it senses red. The right code does not satisfy this requirement because it makes the robot move when it senses any colour except blue, which includes colours other than red. Therefore, it does not meet the condition of moving only for red.

11. Answer: Right. The right code is more efficient because it uses an if-else structure instead of two separate if statements. This allows the program to handle both conditions with fewer lines of code, making it simpler and easier to read.

12. Answer: A. The first code is more efficient because it combines the two conditions using the or operator. Since both conditions produce the same output, this avoids writing separate instructions for each condition, reducing repetition and simplifying the code.

13. Answer: Right. The left code only sets the ports for the double motors on the robot. It does not include any instructions to actually move the motors, so no motion will occur until additional movement blocks are added.

14. Answer: Left. When movement speed is set to a higher speed, the robot will turn more sharply. This is because the faster motor increases the difference in distance travelled between the two sides, making the turn shaper instead of smoother.

15. Answer: Right. When movement speed is set to a lower speed, the robot will turn more gradually. This is because the slower motor reduces the difference in distance travelled between the two sides, making the turn smoother instead of sharp.