The Lab
Junior Program

Term 3
Home Workbook
Answer Key

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Preface

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!
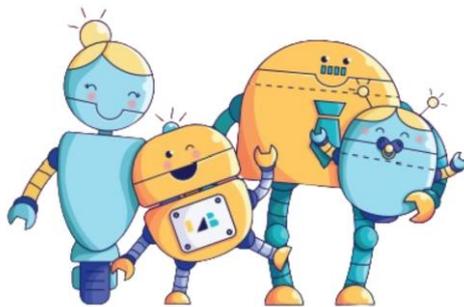
A Friendly Note to Parents & Students

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!

Angles with Conditionals

Coding Concepts

1. Answer: yaw, 0. Sets the current yaw angle to 0. Any yaw angle measured from this point onwards will consider the current orientation as having a yaw angle of 0.

2. Answer: yaw, angle. A variable containing the current yaw angle of the Spike hub detected by the gyro sensor inside. The angle that is contained in the variable can be changed between pitch, roll or yaw.

3. Answer: A. a gyro sensor measures the three main tilt angles of an object: yaw (left-right rotation), pitch (up-down tilt), and roll (side-to-side tilt).

4. Answer: B. Yaw describes rotation left and right around a vertical axis, meaning the robot is turning left or right

5. Answer: C. Pitch refers to the robot tilting forward and backward, like nodding its head.

6. Answer: A. Rolling refers to the robot tilting or leaning left and right, which matches side-to-side movement. It does not mean turning left and right (that is yaw), jumping up and down, or tilting forward and backward (that is pitch).

7. Answer: A. Yaw refers to a robot turning left and right, just like when its head rotates from side to side. Pitch is tilting forward and backward, roll is leaning side to side, and somersault is flipping over.

8. Answer: A. Yaw measures how much the robot turns left or right, and this rotation is typically expressed from –180˚ (full left turn) to +180˚ (full right turn).

9. Answer: A. In LEGO Spike, the gyro sensor can detect orientation changes across a full –180˚ to +180˚ range for pitch. The gyro tracks rotation around the pitch axis continuously, not just the amount a robot can physically lean. So even though the robot cannot physically tilt a full 180˚, the sensor reading itself can still report values anywhere between –180˚ and 180˚.

10. Answer: A. In LEGO Spike, the gyro sensor measures roll (tilting side to side) using the same angle range as yaw and pitch. All three orientation axes can report values from –180˚ to +180˚, because the sensor tracks full rotational position around each axis.

11. Answer: D. The code tells the robot to continuously write the current yaw angle on the screen. Since the yaw angle changes depending on how the robot is rotated, we cannot know the exact number just by looking at the code.

12. Answer: B. Because the yaw is constantly reset to 0 inside the forever loop, the robot never reaches a yaw angle greater than 90°, even if you physically tilt it to 100°. Since the condition yaw angle > 90 is never true, the robot will not run its motors and will stay still.

13. Answer: C. The code checks if the yaw angle is greater than 90°. When you tilt the robot to 100°, the yaw angle becomes more than 90, so the condition becomes true. herefore, the robot moves its motors.

14. Answer: C. The code only runs the motor when the yaw angle is greater than −90. If you tilt the robot 100° anti-clockwise, the yaw angle becomes −100°, which is less than −90. Since −100 is not greater than −90, the condition is false and the robot will not move.

15. Answer: Right. The right code is better because it sets the yaw angle to 0 only once at the start, which is correct. After that, the robot simply checks the yaw angle continuously inside the forever loop. In the left code, the yaw is reset to 0 every single time the loop repeats, so the angle never changes, and the robot can never detect a real tilt.

Range with Conditionals

Coding Concepts

1. Answer: C. Yaw, pitch, and roll are terms used to describe how an object rotates in 3D space, exactly what the robot's gyro sensor measures.

2. Answer: D. Spike's gyro sensor measures how much the robot rotates or turns, not the size of geometric angles like acute, obtuse, or right angles.

3. Answer: C. Angles of rotation tell you how much the robot has turned or rotated. So it directly represents the amount of rotational movement.

4. Answer: C. The gyro sensor's job in LEGO Spike is to measure how much the robot rotates or tilts. Its only function is to sense rotational movement and changes in orientation.

5. Answer: C. The gyro sensor measures how much the robot has rotated

6. Answer: C. The gyro sensor is the only sensor that measures rotation and turning.

7. Answer: B. The gyro sensor measures how much the robot has rotated, and rotation is always measured in degrees

8. Answer: Left. In the left code, it checks if the yaw angle is greater than 2, which means the car is turning right, and then tells it to move left. The right code checks if the yaw angle is less than 2, which does not detect right-veering.

9. Answer: Left. In the left code, it checks if the yaw angle is less than –2, which means the car is veering to the left, and then tells it to move right. The right code checks if the yaw angle is more than -2, which does not detect left-veering.

10. Answer: A. A value like 2 is realistic and sensitive enough for detecting a right-veering The other numbers (2000 or -2000) are impossible yaw angles, and –2 would detect a left-veering.

11. Answer: B. Using "> 5" is better because it reacts only when the car is clearly veering to the right, while values like > 0.5 or > 0 are too sensitive and trigger corrections from tiny movements. "> –5" is incorrect because the yaw angle is almost always above –5, so the robot would constantly try to correct itself.

12. Answer: C. Using "< –5" is better because it reacts only when the car is clearly veering to the left, while "< 0" is too sensitive and trigger corrections from tiny movements. "< 0.5" or "< 5" is incorrect because the yaw angle is almost always less than 5 or 0.5, so the robot would constantly try to correct itself.

13. Answer: D. A value like -2 is realistic and sensitive enough for detecting a left-veering The other numbers (2000 or -2000) are impossible yaw angles, and 2 would detect a right-veering.

14. Answer: Right. The ">" operator is correct because the yaw angle becomes greater than 0 when the car starts veering to the right.

15. Answer: Left. The left code is better because it only corrects the car when the yaw angle passes -5 or +5. The right code is too sensitive and trigger corrections from tiny movements.

Range with AND/OR Operators

Coding Concepts

1. Answer: current, timer. A variable containing the current value of the timer.

2. Answer: C. Timer block in LEGO Spike is used to reports the time, in seconds, since the program started, just like a stopwatch.

3. Answer: C. The Timer block in LEGO Spike measures time in seconds.

4. Answer: C. The Timer block keeps counting as long as the program is running. It simply stops counting the moment the program ends.

5. Answer: C. The Timer block is used to control how long the robot does something.

6. Answer: Right. The "wait 1 seconds" block is the only one that makes the robot pause for a specific amount of time before continuing to the next action.

7. Answer: Bottom. The bottom code is correct because one colour sensor can only detect one colour at a time, so it cannot check for red and blue together. The bottom code uses OR, which correctly checks whether the sensor sees either red or blue.

8. Answer: B. The "Or" operator checks two conditions and returns true if either one is true.

9. Answer: C. The "Or" operator checks two conditions and returns true if either one is true. So you must provide two conditions for it to check.

10. Answer: D. The "Or" operator becomes true if any one of the conditions is true. So if the day is sunny or rainy, the condition will be true

11. Answer: A. The "Or" operator becomes true if any one of the conditions is true.

12. Answer: D. The meow sound will play only when the timer is less than 3 or greater than 5. Among the options, the only value that satisfies this condition is 6.

13. Answer: C. The meow sound will play only when the timer is greater than 5 and lesser than 7. Among the options, the only value that satisfies this condition is 6.

14. Answer: A. The meow sound will play only when the timer is less than 3 or greater than 5. Among the options, the only value that satisfies this condition is 2.

15. Answer: D. The meow sound will play only when the timer is lesser than 10 and greater than 5. Among the options, the only value that satisfies this condition is 6

Logic with Nested Ifs

Coding Concepts

1. Answer: B. "Nested" If statements mean placing one If statement inside another.

2. Answer: B. In LEGO Spike, you create nested If statements by placing one If block inside another If block.

3. Answer: C. The inner "If" statement will only be checked after the outer "If" condition is true. If the outer condition is false, the robot will skip the inner condition.

4. Answer: B. Nested "If" statements let the robot make more complex decisions by checking multiple conditions in a specific order. This means the robot can behave differently depending on several factors at once, which is much more powerful than a single simple check.

5. Answer: C. If the first two conditions in nested "If" statements are true, the robot will still check the third condition to decide whether to run the inside code.

6. Answer: Yes. the two codes perform the same because both require two conditions to be true before running the sound and motor blocks.

7. Answer: No. The two codes are not the same because the first code has two separate "If" statements, so the robot will react when either Button B is pressed or the distance is less than 30 cm. In the second code, the distance check is nested inside the Button B check, so the robot will only react when both conditions are true at the same time.

8. Answer: No. the two codes will not perform the same. In the first code, the robot will run the sound and motor if either Button B is pressed or the distance is less than 30 cm, because the two conditions are checked separately. In the second code, both conditions must be true at the same time for the robot to react.

9. Answer: Yes. The two codes perform the same because both versions trigger the same actions when either Button B is pressed or the distance sensor detects an object closer than 30 cm.

10. Answer: Yes. The two codes perform the same because both versions trigger the same actions when either Button B is pressed or the distance sensor detects an object closer than 30 cm.

11. Answer: B. A condition is used to check whether something is True or False.

12. Answer: B. A Nested "If" checks the second condition only if the first condition is True. The "and" operator requires both conditions to be True at the same time before the robot performs the action.

13. Answer: D. You can have as many Nested "If" statements as needed. Programming does not limit how many layers of "If" statements you can stack, as long as the logic remains clear and the robot can understand it.

14. Answer: C. In an "If Else If" structure, the second "If" condition is checked only when the first condition is False. If the first condition is True, the program runs that block and skips checking the rest.

15. Answer: Left. The "and" operator only becomes True when both conditions are True at the same time

Logic with Nested Ifs and AND Operators

Coding concepts

1. Answer: B. An "If-Else" statement helps the computer choose between two different actions based on whether a condition is true or false.

2. Answer: B. The "Else" part is only executed when the If condition is false. If the condition is true, the program runs the "If" block and ignores the "Else" block.

3. Answer: D. If the condition "Is it raining?" is false, that means it's not raining, so you would take an action appropriate, such as wearing sunglasses.

4. Answer: A. When the If condition is true, the program executes the "If "block and skips the "Else" block entirely.

5. Answer: C. "If-Else" logic is used to help a program make decisions based on conditions, allowing the code to choose different actions depending on whether something is true or false.

6. Answer: A. The rule says you only eat the candy if it is red, so if it is not red, the one thing you should not do is eat it.

7. Answer: B. The condition states that if it is sunny, you need sunglasses, so the correct action when it is sunny is to wear sunglasses.

8. Answer: B. The rule says the robot turns on its lights at night and turns them off during the daytime, so if it is daytime, the robot must turn off its lights.

9. Answer: C. The condition says you must finish your vegetables first, so you should eat the vegetables and then have the ice cream afterward.

10. Answer: C. If your friend likes soccer, the most suitable and related gift choice is a soccer ball.

11. Answer: C. Option C stops the motor for 10 seconds. Option A only creates a delay but doesn't stop the motor, option B stops the motor immediately but not for a set duration, and option D sets the speed to 0 but does not ensure the bike remains stopped for 10 seconds.

12. Answer: C. In LEGO Spike, when you use the run for rotations block without setting a speed, the motor automatically runs at its default speed, which is 75%.

13. Answer: Left. The left code is correct because it stops the motorcycle when the colour sensor detects red, and otherwise starts the motor continuously to make it move in a circle. The right code is wrong because its "ELSE" block stops the motor, which does not match the requirement for continuous circular motion.

14. Answer: Left. The left code is correct because it checks both conditions together before stopping the motorbike. If either condition is not met, the "ELSE" block makes the bike continue moving. The right code is incorrect because it checks the left button only in the "ELSE "section, so it would not properly stop the motor when both required conditions are true.

15. Answer: Right. The right code is correct because it makes the motorcycle start the motor continuously when the colour sensor detects green, which matches the requirement for circular motion. When the light is not green, the else block correctly stops the motor. The left code is incorrect because "run for 1 rotation" moves the bike only briefly, not continuously, so it doesn't match the description.

Range with Reflected Light Intensity

Coding Concepts

1. Answer: D. Since the rule only specifies what to do when it's sunny (go to the park) or raining (stay home), cloudy weather is an in-between situation. Bringing an umbrella prepares you for either outcome without cancelling your plans

2. Answer: C. If Max barks when hungry and yawns when sleepy, and he is doing neither, then he must not be hungry or sleepy. The most reasonable remaining option is that Max is playing.

3. Answer: C. Because the forecast is unclear, you don't know if it will be hot or cold, so packing both outfits prepares you for either kind of weather.

4. Answer: C. You're only allowed to play once homework is done, so if it isn't finished yet, the correct action is to complete it before gaming.

5. Answer: C. Since you like peanut butter and jelly equally, there's no reason to choose just one, so using both spreads fits the rule.

6. Answer: D. The rules tell you to sort toys into boxes that match what they are, so when you find a book, it belongs in a "Books" box.

7. Answer: D. The rules cover what to do if someone wants cheese, ham, or both, so if they want neither, you choose a different filling, like salad, instead of adding cheese or ham.

8. Answer: B. The rule given only tells you what to do in two situations: clap if the answer is correct, and shake your head if the answer is wrong. If your friend doesn't guess at all, they are not correct, which means you treat it like a wrong answer and shake your head.

9. Answer: D. Since it is both sunny and rainy, you must follow both rules: sunny means wearing shorts, and rainy means wearing a raincoat. So you wear both items together.

10. Answer: C. You only act when it's too cold or too warm. If the water is already at the right temperature, you don't need to heat it or cool it.

11. Answer: Bottom code. The bottom code is correct because it opens the safe and then waits 5 seconds before locking again. The top code is incorrect because it opens the safe but never locks it afterward.

12. Answer: Bottom code. In the bottom code, it uses "nested ifs". This ensures the second password is only tested after the first one is correct. If both passwords are correct, the box opens and then locks itself again after 5 seconds. In contrast, the top code separates the two "if" statements, meaning the second password (blue or yellow) could open the box even if the first password was never entered, which does not meet the requirement..

13. Answer: Top code. The top code is correct because the smiling face is shown when the first password is correct and when the second password is correct. In the bottom code, no smiling face is shown even if the second password is correct

14. Answer: Right. If the first password is wrong, the program should go to the "else" section and display "Wrong." So the correct missing block is "write wrong" block not the "smiling face" block.

15. Answer: No. This code is not correct because the "Wrong" message is attached to the first password check, so it only appears when the first password fails. To show "Wrong" when the second password is wrong too, the "else" block must also be attached to the second password check.

Light Intensity with Proportional Integral Derivative

Coding Concepts

1. Answer: C. The colour sensor can detect how much light is reflected from the surface.

2. Answer: B. "Reflected light intensity" describes how much light returns to the sensor after hitting a surface.

3. Answer: C. When light hits a mirror, it reflects almost all the light back in the same intensity.

4. Answer: C. Turning on a lamp adds more light to the room, so more light bounces off objects and returns to the sensor. This makes the reflected light intensity go up.

5. Answer: A. White surfaces reflect a lot of light, while black surfaces absorb most of it. Since reflected light intensity measures bounced-back light, white paper will show a much higher reading than black paper.

6. Answer: Left. Using "< 100" is better because the sensor is unlikely to read exactly 100. By using "< 100", you allow the robot to respond to all values below 100 instead of waiting for a perfect match, which makes detection much more accurate and consistent.

7. Answer: Right. Using "> 100" is better because the sensor is unlikely to read exactly 100. By using "> 100", you allow the robot to respond to all values above 100 instead of waiting for a perfect match, which makes detection much more accurate and consistent.

8. Answer: Yes. Both codes check whether reflected light is lower than 50%.

9. Answer: Top code. The top code correctly checks if the value is between 55 and 60 by using both conditions together: "less than 60" AND "greater than 55."

10. Answer: Bottom code. The bottom code checks the range you want: the value must be less than 55 and greater than 50. The top code is incorrect because it checks for values less than 60, which is too wide, and greater than 55, which excludes the lower part of the range.

11. Answer: A. White reflects a lot of light, so its reflected light intensity will be higher than blue.

12. Answer: B. Black absorbs most light, so it gives a much lower reflected light intensity.

13. Answer: A. Yellow is a bright colour and reflects more light, so the reading will be higher than blue.

14. Answer: B. Grey reflects less light than blue, so its reflected light intensity will be lower than 55.

15. Answer: C. 40 is not greater than 55 and not greater than 40, so the both "if" conditions are false. With no matching condition, the program does nothing, so the Center Button remains unlit.

16. Answer: C. 20 is not greater than 55 and not greater than 40, so the both "if" conditions are false. With no matching condition, the program does nothing, so the Center Button remains unlit.

17. Answer: A. 100 is greater than 55, so the first "if" condition is true. That means the code will immediately set the Center Button light to red.

String and Integer with Sensor

Coding Concepts

1. Answer: A. White surfaces reflect a lot of light, so the reflected light intensity sensor will detect a high value.

2. Answer: B. Dark surfaces absorb light instead of reflecting it, so the sensor reads a low value, which is the signal for the robot to stop.

3. Answer: C. When the robot detects black, it should stay on the path and continue moving forward. Speeding up or turning around would make it lose the path, and playing a song does nothing to help it follow the line.

4. Answer: B. A high reading means a lot of light is bouncing back, which only happens on bright or reflective surfaces.

5. Answer: C. The reflected light sensor measures how much light returns to it, allowing the robot to determine color shades and brightness levels.

6. Answer: D. Reflected light intensity is measured in percent, showing how much light is reflected back.

7. Answer: D. White reflects the most light, so the sensor gives a very high value close to 100. The other options are wrong because 0 is too low for white, and negative values like –1 or –100 are impossible for reflected light readings.

8. Answer: A. 60 is greater than 50, so the first "if" condition is true. The program immediately sets the light to red, and the other conditions are skipped.

9. Answer: B. 50 is not greater than 50, so the first "if" is false. Next, the "if" checks whether 50 is greater than 40, which is true. So the light becomes green, and the yellow condition is skipped.

10. Answer: C. 40 is not greater than 50 and not greater than 40, so the first two conditions are false. But 40 is greater than 30, so the light becomes yellow.

11. Answer: D. 30 is not greater than 50, not greater than 40 and not greater than 30. All conditions are false. So the light remains unlit.

12. Answer: B. The repeat block is incorrect because it only checks the sensor conditions 10 times. A "forever" loop should be used instead, otherwise, the robot will stop correcting its path after 10 checks and will not follow the curved line properly.

13. Answer: A. The sensor block is incorrect because ports A and B are already used for the motors, so the colour sensor cannot also be connected to port A.

14. Answer: A. The movement block is incorrect because using "move for 1 rotation" makes the robot turn too far each time, so it cannot follow a curved black line smoothly or accurately. Continuous line following requires very small, quick adjustments, not large rotation movements.

15. Answer: B. Reflected light intensity is never a fixed value. This means the sensor reads a range of values, not one exact number.