Grade 8 Computing

Unit 7 · Physical Computing

ANSWER KEY · FOR TEACHERS

Full marks 30

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. physical computing
2. microcontroller
3. sensor
4. relay
5. polling
6. digital
7. analog
8. threshold

Each carries 0.5 mark. **K · 4**

2 Label the diagram

1. Inputs
2. Program
3. Outputs
4. (switched by a relay)

Each carries 0.5 mark. **K · 2**

3 Multiple choice

i. **c.** the loud beeper **K · 1**

The sensor (input) notices smoke, the program decides that there is too much, and the beeper (output) warns people.

ii. **b.** `display.set_pixel(4, 4, 9)` **U · 1**

x and y go from 0 to 4, so the bottom-right corner is (4, 4), and the brightest is 9. 5 and 10 are out of range and stop the program with a ValueError; (0, 4) is the bottom-left.

iii. **b.** waits a quarter of a second **U · 1**

250 ms is 250 thousandths of a second: 0.25 s, a quarter of a second.

iv. **b.** how much water is in a tank **U · 1**

The water can be at any level from empty to full: a quantity in a range is analog. The others have just two states, so they are digital.

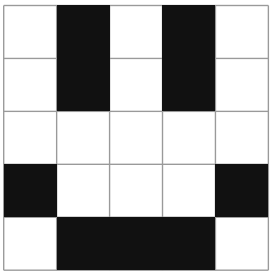
v. **c.** 880 Hz **A · 1**

Going up one octave doubles the frequency: 2 × 440 = 880 Hz. (220 Hz is one octave lower, `"a3"`.)

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4 Draw the LEDs

ANSWER **A · 2**



A happy face: two eyes, and a smiling mouth.

MARKING SCHEME

- ✓ Rows from the top: 01010 · 01010 · 00000 · 10001 · 01110 (each 9 lit, each 0 off).
- ✓ A happy (smiling) face.

5 What does it print?

MARKING SCHEME **A · 2**

- ✓ The count goes up only when the drawer is open now and was shut before: at 150 and at 200, not at 160 (it was already open).
- ✓ `Opened 2 times`, printed once, after the loop.

6 Trace the program

ANSWER **A · 4**

`light`	`on`	**Output**
55	False	55 False
38	True	38 True
45	True	45 True
52	True	52 True
61	False	61 False
50	False	50 False

MARKING SCHEME

- ✓ 55: neither below 40 nor above 60, so `on` stays `False`.
- ✓ 38: below 40, so `on` becomes `True`.
- ✓ 45 and 52: between the thresholds, so `on` stays `True`.
- ✓ 61: above 60, so `False`; 50 then leaves it `False`. Each line printed as the value and `on`.

7 Find and fix the bug

MARKING SCHEME **A · 3**

- ✓ While the drawer stays open, the condition is `True` each time round the loop (every 100 ms or so), so one opening is counted many times.
- ✓ It must remember whether the drawer was open last time round (a variable like **was_open**).
- ✓ Count only when it is open now and was not before (`if is_open and not was_open:`), and set `was_open = is_open` each time round.

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8 Write a program

ANSWER A · 3

```
from microbit import *

while True:
    if button_a.is_pressed():
        display.show(Image.YES)
    elif button_b.is_pressed():
        display.show(Image.NO)
    else:
        display.clear()
```

`is_pressed()` is right here, not `was_pressed()`: the picture must stay for as long as the button is held.

MARKING SCHEME

- ✓ `from microbit import *` and a `while True:` loop round the rest.
- ✓ `if button_a.is_pressed():` shows `Image.YES`, and `elif button_b.is_pressed():` shows `Image.NO`.
- ✓ `else: display.clear()`, so nothing shows when neither is pressed.

9 Short answers

MARKING SCHEME U · 3

- ✓ `is_pressed()`: `True` all the time A is held; `was_pressed()`: one `True` for each press since the program last asked, then it forgets it.
- ✓ `is_pressed()` for something that lasts while the button is held, such as a doorbell or a torch.
- ✓ `was_pressed()` for something that must count each press once, such as a counter for guests or a game's score.

10 Think

ANSWER HA · 2

A sensor's number is a measurement of that place, not a unit like a meter: his grandmother's room may be darker by day (small windows, thick walls), so the board reads under 50 in the afternoon. The board's LEDs measure light only roughly, too. Ram should measure first: print the readings in the real place, by day, at dusk and at night, then choose a threshold between the day and night readings, and test it there.

MARKING SCHEME

- ✓ A reading depends on the place: the room there may read under 50 by day (the light level is not a fixed unit, and the board measures roughly).
- ✓ Measure first in the real place (print the readings by day, at dusk and at night), choose a threshold between them, then test.

11 Activity: Inputs → program → outputs at home

(not marked)

WHAT STUDENTS SHOULD FIND

Almost every device fits the pattern. A rice cooker: inputs the buttons and a temperature sensor under the pot; rules, heat hard, then gently, then keep warm; outputs the heater and the lights. A phone: inputs the touch screen, microphone, camera and accelerometer; outputs the screen, speaker and vibration. A traffic light with a button: inputs the button (and sometimes car sensors); outputs the lamps. Students often forget that a button is an input too, and that the program is the part that decides.

Marks by level	Knowledge	Understanding	Application	Higher ability	**Total**
Marks	7	6	15	2	**30**

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