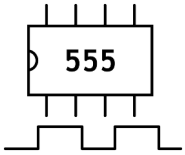
**Name:** _____ **Class:** _____

# N5 Electronics
# Timers and Comparators



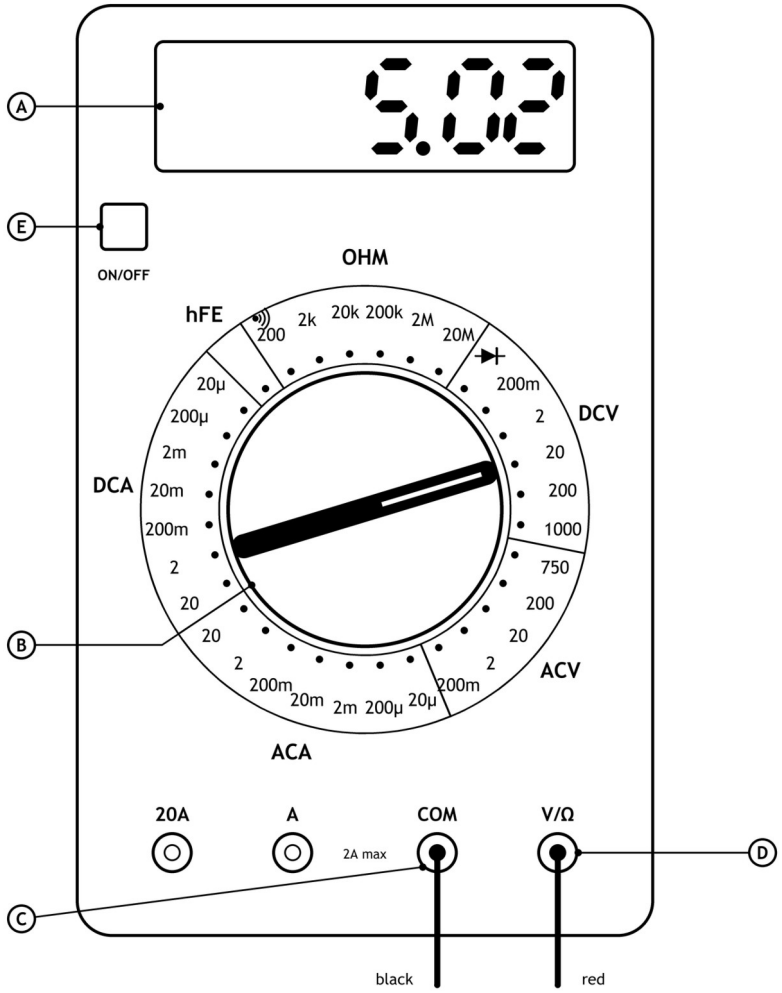

| Success Criteria | ✓ |
|---|---|
| **1. Testing with a multimeter and a logic probe** | |
| 1.1 I can choose the setting and socket on a multimeter for each test. | |
| 1.2 I can predict what a meter or a logic probe should read. | |
| 1.3 I can connect a logic probe and read logic 1, logic 0 and a pulse. | |
| 1.4 I can find a fault from meter and probe readings. | |
| **2. The op-amp comparator** | |
| 2.1 I can state when the output of a comparator is high. | |
| 2.2 I can calculate the reference voltage from a voltage divider. | |
| 2.3 I can describe how a thermistor comparator circuit works. | |
| 2.4 I can test a comparator in Yenka with voltmeters and a logic indicator. | |
| **3. The 555 monostable** | |
| 3.1 I can simulate a monostable in Yenka and time its pulse. | |
| 3.2 I can plan a monostable on the Breadboard Builder. | |
| 3.3 I can check parts, complete a pre-power-up check and test with a meter and probe. | |
| 3.4 I can draw a 555 circuit diagram from a stripboard layout. | |
| **4. The 555 astable** | |
| 4.1 I can simulate an astable in Yenka and measure how fast it flashes. | |
| 4.2 I can plan an astable on the Stripboard Builder, with track cuts and test points. | |
| 4.3 I can build and test an astable with a meter and a logic probe. | |
| 4.4 I can calculate frequency from an oscilloscope trace. | |


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# 1. Testing with a multimeter and a logic probe

**Lesson page** — notes, simulator and the answers to this section:
mrstewartphysics.co.uk/classes/electronics/testing.html

## The multimeter




| | Part | What it does |
|---|---|---|
| A | display | Shows the reading. The unit comes from the range you chose. |
| B | dial | Chooses what you measure and the biggest value it can show. |
| C | COM socket | The **black** lead. Always. |
| D | V/Ω socket | The **red** lead for volts, ohms, continuity and diode check. |
| E | ON/OFF | On before you measure. Off when you finish. |
| | 20A and A | Only for measuring current. |


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## Multimeter guide: what each setting does

| Setting | Measures | Red lead in | How to connect | Use it for |
|---|---|---|---|---|
| **DCV** (V⎓) | Voltage from a battery or power supply. | V/Ω | Across the part, circuit **on**. Black on 0 V, red on the point. | The supply and every test point. Use **20** for our 5 V and 9 V circuits. |
| **OHM** (Ω) | Resistance. | V/Ω | Across the part, circuit **off**. Start on a big range and turn down. | Checking a resistor, thermistor or LDR. |
| **Continuity** (buzzer mark, OHM block) | Is there a connection? | V/Ω | One probe on each end, circuit **off**. A beep means joined. | Switches, tracks, links and joints. No beep between the supply rails. |
| **Diode check** (▶\| , DCV block) | Which way a diode or LED conducts. | V/Ω | Red on the long leg (anode), black on the short leg. A number means it conducts; 1 means it is the wrong way round. | Which way round a diode or LED goes. An LED may glow faintly. |
| **DCA** (A⎓) | Current. | A (up to 2 A) or 20A | In series: break the circuit and put the meter in the gap. | Current through an LED. Move the red lead back to V/Ω after. |
| **ACV** and **ACA** (~) | Alternating voltage and current. | — | — | Not used in class. We never measure mains. |
| **hFE** | Transistor current gain: how many times bigger the collector current is than the base current. | no leads | Push the transistor into the small socket, NPN or PNP side, legs into E, B and C. | Checking a transistor works. A BC548 reads somewhere between 100 and 800. |


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## Testing jobs

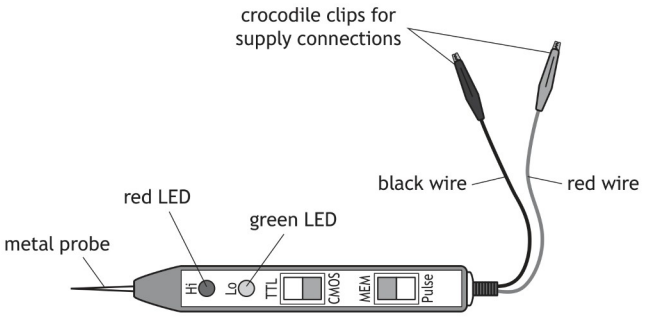
| Job | Setting | How | A good result |
|---|---|---|---|
| A resistor's value | OHM, the range just above the colour code value | Power off. The resistor out of the circuit, or one leg lifted. | Within its tolerance: a 10 kΩ ±5 % resistor reads 9.5 to 10.5 on the 20k range. |
| A slide switch | Continuity | Power off. One probe on the middle pin, the other on an outer pin. Slide the switch both ways. Then try the other outer pin. | It beeps in one position and not the other, for each outer pin. |
| A track, link or joint | Continuity | Power off. One probe on each end. | A beep. No beep between two tracks next to each other. |
| No shorts across tracks | Continuity | Power off. One probe on each of two tracks side by side. | No beep. A beep means a solder bridge or a stray strand of wire. |
| The supply voltage | DCV 20 | Power on. Black on 0 V, red on +V. | Close to the set voltage, e.g. 5.0 V. |
| A logic level on a chip | The **logic probe** only, not the meter | Power on. Red clip on +V, black clip on 0 V. Touch the tip on one pin. | Red Hi LED: logic 1. Green Lo LED: logic 0. On a 7400 chip, pin 14 is always 1, pin 7 always 0. |

**Five rules for every reading**

1. The black lead always goes in **COM**.
2. **Choose** the range just above what you expect: **20 V** for a 5 V circuit.
3. A **1** on the left of the display means over range. Turn up one range.
4. A minus sign means the leads are swapped. The size is still right.
5. Never measure resistance with the power on.


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## The logic probe




| Part | What to do |
|---|---|
| red wire | Clip to the **+V** rail of the circuit you are testing. |
| black wire | Clip to the **0 V** rail. |
| TTL / CMOS | Set to **TTL** for 74 series chips and our 555 circuits. |
| MEM / Pulse | Set to **Pulse** to catch a changing signal. |
| metal probe | Touch it on the point you are testing. |

| What you see | What it means |
|---|---|
| red LED (Hi) on | the point is at logic 1 (high) |
| green LED (Lo) on | the point is at logic 0 (low) |
| an LED flashing | the point is pulsing — the logic level keeps changing |
| neither LED on | the point is not connected to anything, or the probe has no supply |


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## Common mistakes with the logic probe

| Mistake | What you see | Do this |
|---|---|---|
| Clips on a different supply, not the circuit you are testing | Readings that make no sense | Clip to the **same** circuit's +V and 0 V. |
| Red and black clips swapped | No LEDs at all | Red on +V, black on 0 V. |
| A clip on the insulation, not bare metal | No LEDs at all | Clip onto a test pin or bare wire. |
| MEM switched on | An LED stays lit after you move the probe | Switch to **Pulse**. |
| Touching the chip body, or two pins at once | Wrong or flickering readings; risk of a short | Touch **one** pin. Count from pin 1 at the notch. |
| Probing an input that is not connected | Neither LED, or a flicker | That is a fault in the circuit: the input needs a pull-up or pull-down. |
| Thinking a flashing LED is a fault | Flashing on a 555 astable output | Flashing is right there. |

**TASK 1 — Predict the reading**

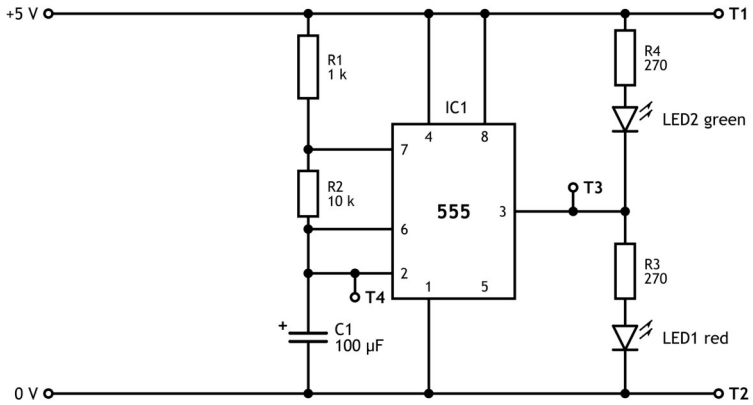
Multimeter only, no kit yet. For each job, **write** the dial setting, the socket for the red lead and what the display is likely to show. Use the guide. The first row is done for you.

| What you are measuring | Dial setting | Red lead in | Likely reading |
|---|---|---|---|
| **Example:** the supply of the 5 V astable board | **DCV 20** | **V/Ω** | **about 5.00** |
| A 9 V battery | | | |
| A 10 kΩ resistor (brown black orange), out of the circuit | | | |
| A 470 Ω resistor (yellow violet brown), out of the circuit | | | |
| A push-to-make switch, held pressed | | | |
| A red LED, red probe on the long leg | | | |
| The same LED, probes swapped | | | |
| The current through an LED (about 11 mA) | | | |


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**TASK 2 — Probe Detective**

This is the 555 astable practice board. Each reading below comes from a board with **one** fault.




**(a)** T1 reads 0 V. **State** the most likely fault. (1)

**(b)** T1 reads 5.0 V. LED1 flashes, but LED2 never lights. **Suggest one** fault. **Describe** how you would check it with the meter. (2)

**(c)** T1 reads 5.0 V. The probe on pin 3 shows red all the time and T4 reads 0 V. **Suggest** the fault. **State** what T4 should read. (2)

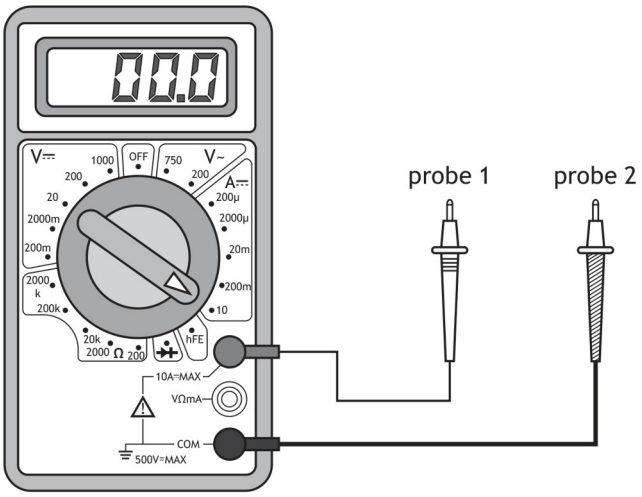
## Practise on the test bench

| | |
|---|---|
| **Learn to Test**: nine guided tasks, one for each kind of test.<br>mrstewartphysics.co.uk/classes/electronics/learn-to-test.html | |
| **Practise Testing**: find the fault on ten boards.<br>mrstewartphysics.co.uk/classes/electronics/practise-testing.html | |


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## Exam practice

**1.** A student wants to measure the voltage across a component in a circuit and sets up the multimeter as shown below.




**(a) Identify** the **two** errors the student has made. (2)

Error 1:

Error 2:

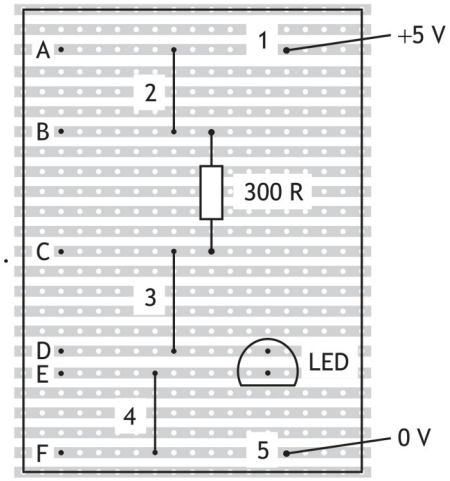
(b) The student is given a resistor with no colour markings.

**Describe** how the student would set up and use a multimeter to accurately measure the resistance of the resistor. (3)


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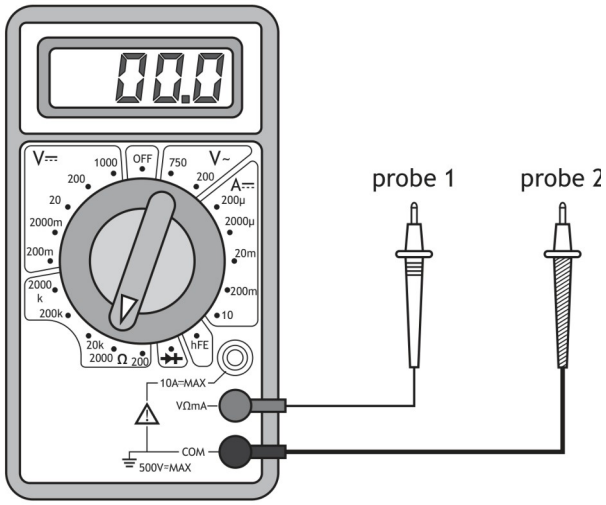
**2.** A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.




The student now constructs the circuit. Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

The multimeter used is shown below and will sound a 'beep' to indicate continuity.




**Describe** how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. (3)


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## Key words

Complete the sentences. Use each word from the box once.

**COM V/Ω across series continuity pulsing**

1. The black lead always goes in the _____ socket.
2. To measure voltage, the red lead goes in the _____ socket.
3. A meter measuring voltage is connected _____ the part.
4. A meter measuring current is connected in _____ with the part.
5. A beep on the buzzer setting shows _____.
6. A flashing LED on the logic probe means the point is _____.


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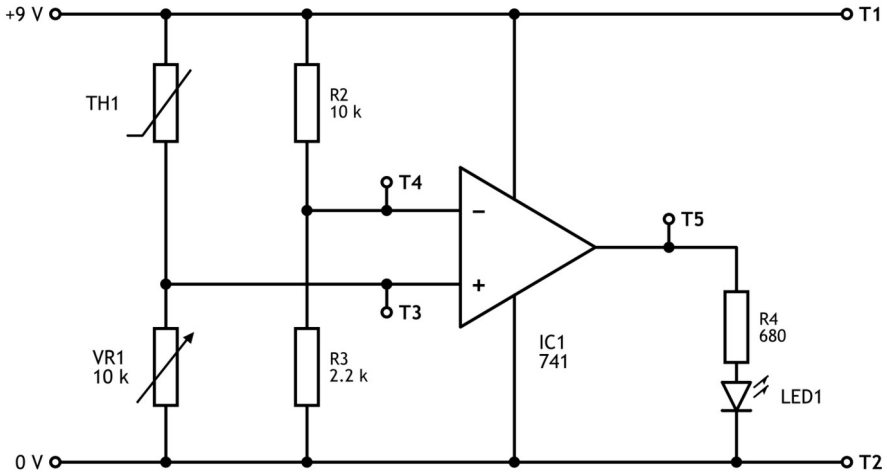
# 2. The op-amp comparator

**Lesson page** — notes, simulator and the answers to this section:
mrstewartphysics.co.uk/classes/electronics/op-amp-comparator.html

**Remember**

A comparator compares two voltages. If the voltage at the + input (pin 3) is bigger than the voltage at the − input (pin 2), the output is **high**. If not, it is **low**.

**TASK 1 — Read the diagram**




1. **Name** the input sensor. (1)

2. **State** which test point measures $V_{in}$ and which measures $V_{ref}$. (2)

3. **Calculate** $V_{ref}$. (3)

*Space for working and answer*

4. TH1 warms up and its resistance falls. **State** what happens to $V_{in}$. (1)

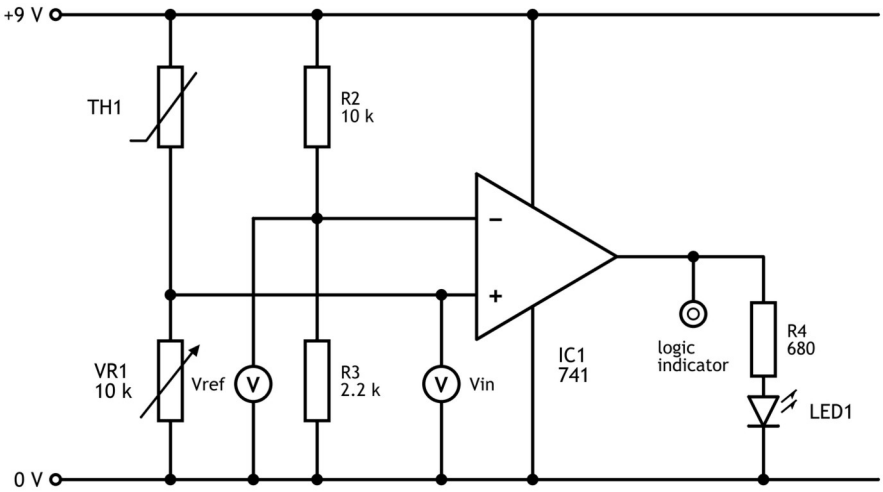

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5. **State** when LED1 comes on. (1)

---

**TASK 2 — Yenka: build and test**

1. **Open** Yenka (Electronics). **Build** the circuit above.
2. Parts: 9 V supply, thermistor TH1, variable resistor VR1 (10 kΩ), R2 10 kΩ, R3 2.2 kΩ, a 741 op-amp, R4 680 Ω and LED1.
3. **Add** the two voltmeters and the logic indicator, as in the diagram below.
4. **Set** TH1 to each temperature in the table. **Record** the readings.




In Yenka the logic indicator is **red for high** and **white for low**.

| TH1 (°C) | $V_{in}$ (V) | $V_{ref}$ (V) | $V_{in} > V_{ref}$? | Logic indicator (red or white) | LED1 on? |
|---|---|---|---|---|---|
| 0 | | | | | |
| 10 | | | | | |
| 20 | | | | | |
| 30 | | | | | |
| 40 | | | | | |
| 50 | | | | | |

At what temperature does LED1 come on?

---


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**TASK 3 — Threshold Hunter**

Change VR1 until LED1 comes on at **30 °C**.

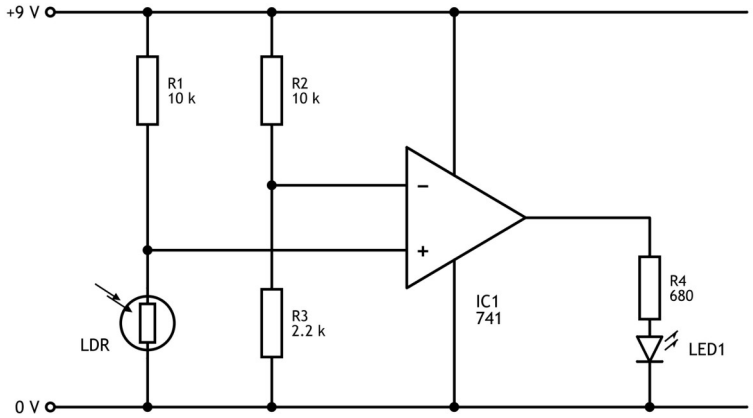
| VR1 resistance (kΩ) | $V_{in}$ at 30 °C (V) | $V_{ref}$ (V) |
|---|---|---|
| | | |

**State** the purpose of VR1 in this circuit. (1)

---

## Another way to build it (for interest)

Swap TH1 for a fixed resistor and VR1 for an LDR. Now the LED comes on when it gets **dark**, as in a night light.



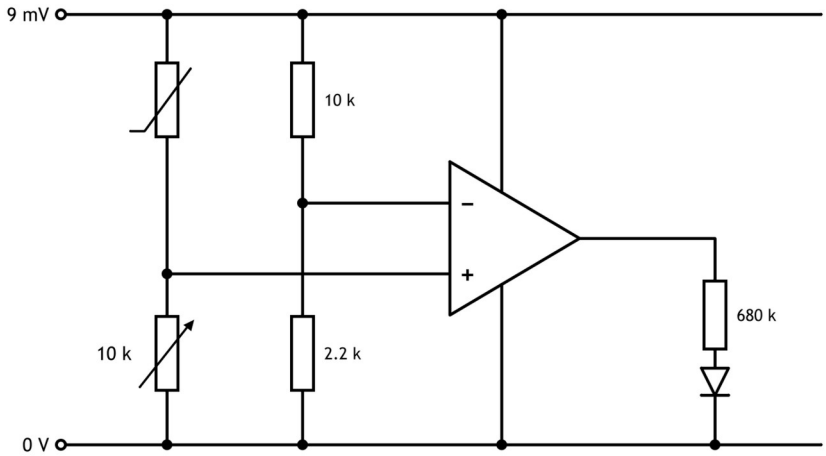


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## Exam practice

**1.** A student simulates a circuit that should switch on an LED when it gets hot. The simulation does not work as specified.

**Identify three** errors in the student's simulation. (3)




Error 1:

---

Error 2:

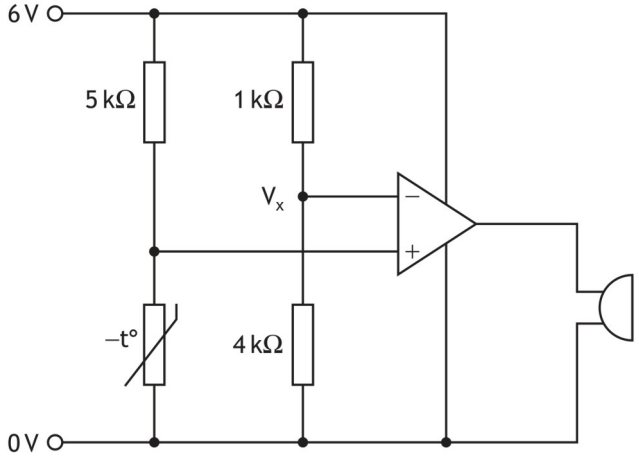
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Error 3:

---


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**2.** A low temperature warning system is controlled using a LM741 comparator circuit as shown in the simulation below.




**(a) Calculate** the reference voltage $V_x$. (3)

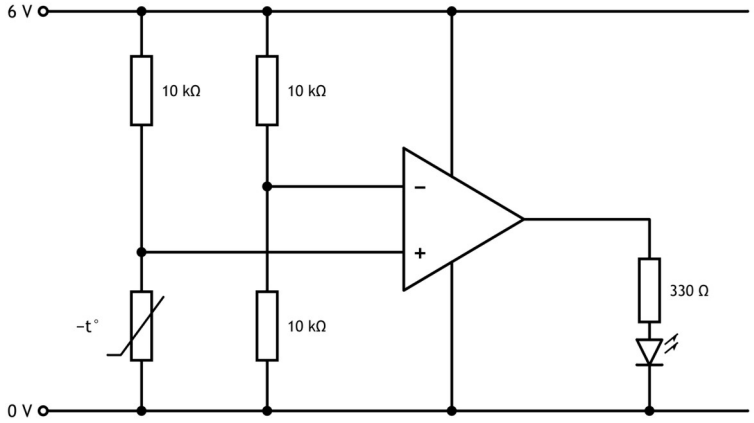
*Space for working and answer*

**(b) State** the resistance of the thermistor when the voltage across it is equal to the reference voltage $V_x$. (1)

**(c) Describe** how this circuit works. (3)


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**3.** A student simulated the circuit shown below. It should light the LED when it gets cold.




**Complete** the following table by giving **three** pre-power up checks for this circuit. (3)

| **Pre-power up checklist** |
|---|
| Correct power supply voltage |
| |
| |
| |

## Key words

Complete the sentences. Use each word from the box once.

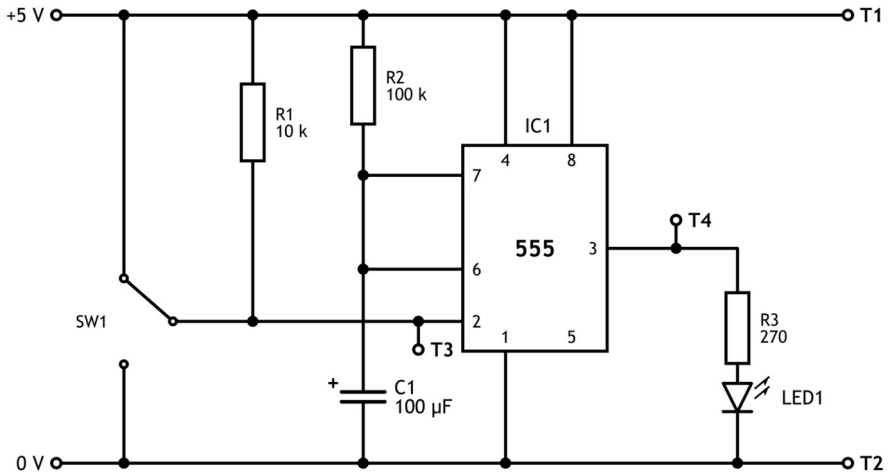
**comparator** **divider** **reference** **high** **thermistor** **variable resistor**

1. A _____ compares two voltages.
2. R2 and R3 form a voltage _____.
3. $V_{ref}$ is the _____ voltage.
4. When $V_{in}$ is bigger than $V_{ref}$, the output goes _____.
5. As a _____ warms up, its resistance falls.
6. The _____ sets the temperature at which the LED comes on.


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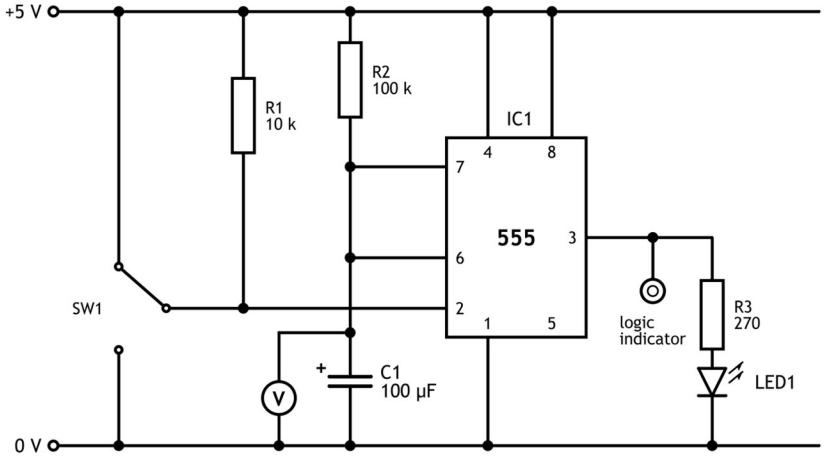
# 3. The 555 monostable

**Lesson page** — notes, simulator and the answers to this section:
mrstewartphysics.co.uk/classes/electronics/555-monostable.html




**TASK 1 — Yenka: simulate it first**

1. **Open** Yenka (Electronics). **Build** the circuit above.
2. **Add** a voltmeter across C1 and a logic indicator on pin 3, as in the diagram below.
3. **Slide** SW1 to 0 V and straight back. **Time** how long the logic indicator stays red.
4. Watch the voltmeter. **Record** C1's voltage when the logic indicator turns white.

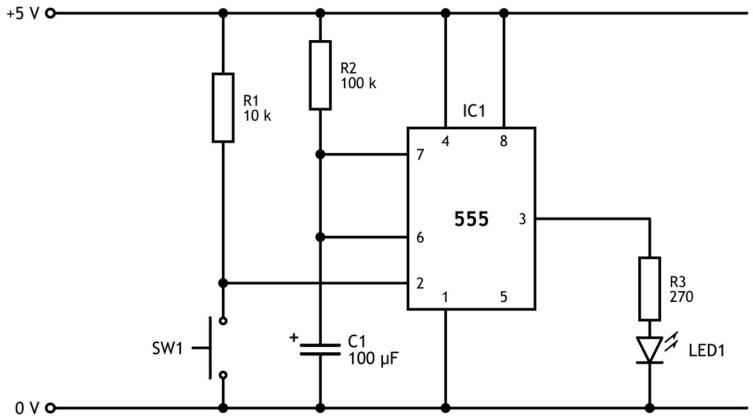



| | Pulse time (s) | C1 voltage when it ends (V) |
|---|---|---|
| R2 = 100 kΩ | | |
| R2 = 47 kΩ (predict first, then measure) | | |


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## Another way to build it (for interest)

A push-to-make switch from pin 2 to 0 V, with R1 holding pin 2 high. Press it to start the pulse. Exam papers often draw it this way.




| Item ID | Part | Value |
|---|---|---|
| IC1 | 555 timer | — |
| R1 | resistor | 10 kΩ (brown black orange) |
| R2 | resistor | 100 kΩ (brown black yellow) |
| C1 | electrolytic capacitor | 100 µF |
| R3 | resistor | 270 Ω (red violet brown) |
| LED1 | red LED | 5 mm |
| SW1 | slide switch (changeover) | — |


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**TASK 2 — Plan it on the Breadboard Builder**

Plan your layout on the website's Breadboard Builder, following the worked guide on the lesson page. Print it and stick it in. Number and colour every wire in the wiring schedule.

**Stick your Breadboard Builder printout here.**

mrstewartphysics.co.uk/classes/electronics/breadboard-builder.html

| No. | Colour | From | To | What it carries |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |



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**TASK 3 — Check the parts**

Check every part **before** it goes in. Use the Testing jobs table in section 1.

| Part | Setting | Expected | Measured | OK? |
|---|---|---|---|---|
| R1 | OHM 20k | 10 kΩ: reads 9.5 to 10.5 | | |
| R2 | OHM 200k | 100 kΩ: reads 95 to 105 | | |
| R3 | OHM 2k | 270 Ω: reads about 0.27 | | |
| LED1 | diode check | a number one way round, 1 the other | | |
| SW1 | continuity | middle pin beeps to one outer pin, then the other | | |

**TASK 4 — Pre-power-up check**

Fill this in **before** the supply is connected. Power on only when every row is done.

| Date | Test point | Description of test | Result | Changes made |
|---|---|---|---|---|
| | T1 to T2 | No short between the supply rails: continuity setting, no beep. | | |
| | — | IC1 straddles the centre gap, notch and pin 1 on the left. | | |
| | — | C1 the right way round: + leg to pins 6 and 7, − leg to 0 V. | | |
| | — | LED1 the right way round: long leg to R3, short leg to 0 V. | | |
| | — | Every wire matches the wiring schedule. | | |
| | — | Supply set to 5 V before it is connected. | | |


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**TASK 5 — Test it**

Meter on DCV 20, black probe on T2. Slide SW1 to 0 V and straight back to start a pulse.

| Test point | What it is | Waiting: expected | Measured | During the pulse: expected | Measured |
|---|---|---|---|---|---|
| T1 | +5 V supply | 5 V | | 5 V | |
| T2 | 0 V | 0 V | | 0 V | |
| T3 | pin 2, trigger | 5 V | | 0 V while SW1 is at 0 V | |
| T4 | pin 3, output | about 0 V | | 3.5 V to 5 V | |

Now the logic probe, on TTL and Pulse. Clip it to this board's +5 V and 0 V.

| Point | Waiting: expected | Seen | During the pulse: expected | Seen |
|---|---|---|---|---|
| pin 2 | high (red) | | low (green) while SW1 is at 0 V | |
| pin 3 | low (green) | | high (red) | |

Time the pulse three times.

| Try 1 (s) | Try 2 (s) | Try 3 (s) | Average (s) | Predicted (s) |
|---|---|---|---|---|
| | | | | $T \approx 1.1 \times R2 \times C1 = 11$ |

**Give** one reason your average might not be exactly 11 s. (1)

---

**TASK 6 — Fault from readings**

**(a)** The LED never lights. T1 reads 5.0 V and T3 stays at 5 V, even when SW1 is slid to 0 V. **Suggest** the fault. (1)

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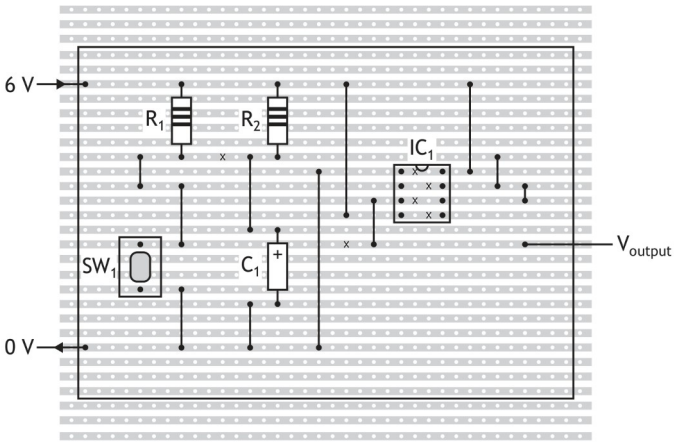
**(b)** The LED is on all the time. T3 reads 0 V all the time. **Suggest two** possible faults. (2)

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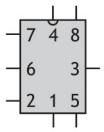
## Exam practice

**1.** The stripboard plan below shows a **component (top) view** of a circuit with the following layout.




| Component data | |
|---|---|
| $IC_1$ — NE555 | |
| $R_1$ and $R_2$ — carbon film 10 KΩ 0.25 W | |
| $C_1$ — 1000 μF 16 V **electrolytic** capacitor | |
| $SW_1$ — push-to-make switch | |
| X shows where a track has been cut. | |

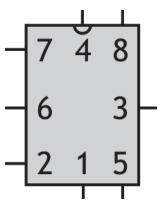
Circuit symbol for $IC_1$




Circuit symbol for $SW_1$



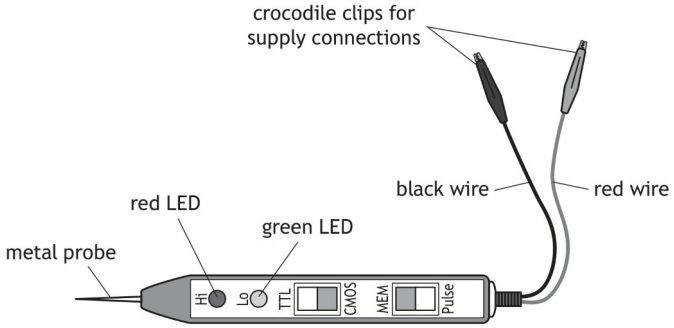
For the stripboard layout diagram, complete the circuit diagram below. Each component must be labelled. (6)





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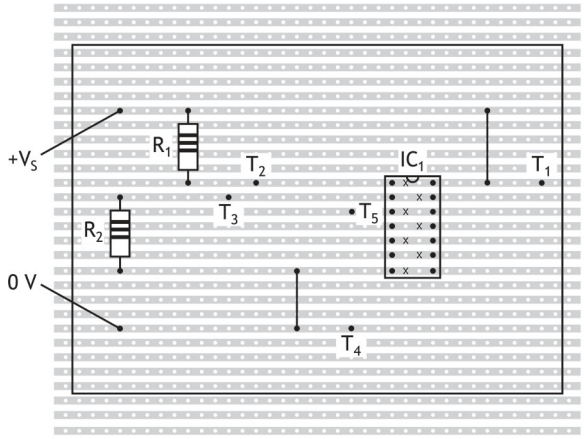
**2.** A logic probe, shown below, is used to test the inputs and outputs of a 74 series logic chip. The logic probe is set to TTL and pulse.




**(a)** (i) State where the red and black wires should be connected. (1)

**(ii)** Describe how a logic 1 would be detected. (2)

(b) A student sets up a circuit on stripboard as shown below. $IC_1$ is a 74 series logic chip.




Test points $T_1$ to $T_5$ are marked on the stripboard.

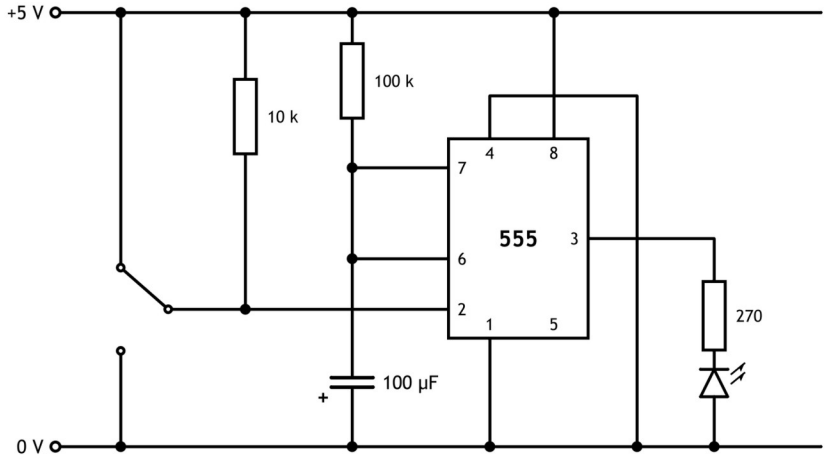
**(i)** Identify **two** test points that are used to measure the voltage across $R_2$. (1)

**(ii)** The logic probe is placed at pin 7 of the logic chip, $IC_1$. **Explain** why the LED on the logic probe flashes green. (1)


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**3.** A student simulates a monostable that should light the LED for about 11 s when the switch is slid to 0 V and back. The simulation does not work.

**Identify three** errors in the student's simulation. (3)




Error 1:

---

Error 2:

---

Error 3:

---

## Key words

Complete the sentences. Use each word from the box once.

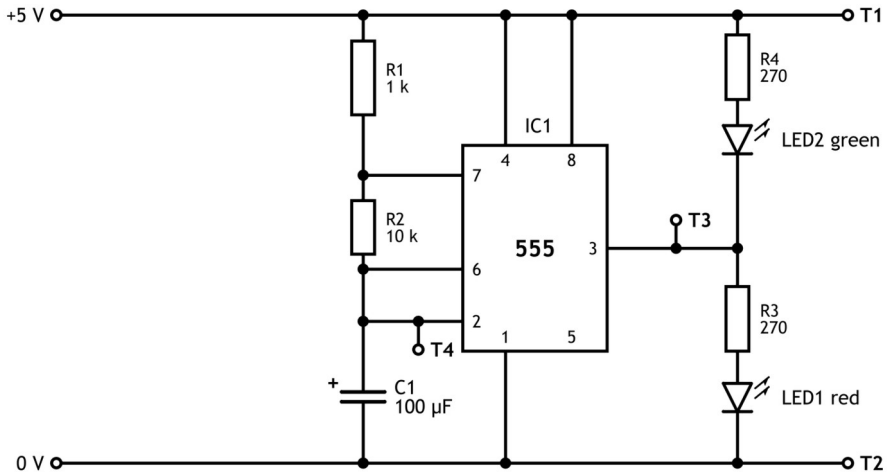
**monostable trigger low length longer pre-power-up**

1. A _____ gives one pulse each time it is triggered.
2. Pin 2 is the _____ input.
3. The pulse starts when pin 2 goes _____.
4. R2 and C1 set the _____ of the pulse.
5. A bigger R2 or C1 gives a _____ pulse.
6. A _____ check is done before the supply is connected.


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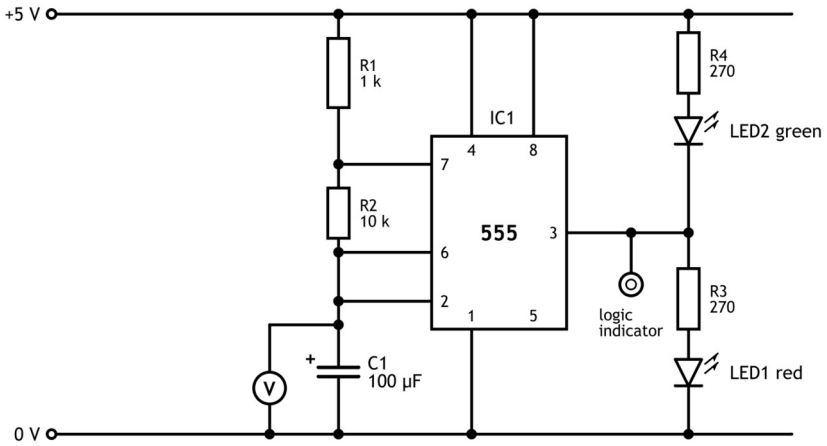
# 4. The 555 astable

**Lesson page** — notes, simulator and the answers to this section:
mrstewartphysics.co.uk/classes/electronics/555-astable.html




**TASK 1 — Yenka: simulate it first**

1. **Open** Yenka (Electronics). **Build** the circuit above.
2. **Add** a voltmeter across C1 and a logic indicator on pin 3, as in the diagram below.
3. **Count** how many times the logic indicator turns red in 30 seconds.
4. Watch the voltmeter. **Record** C1's lowest and highest voltage.

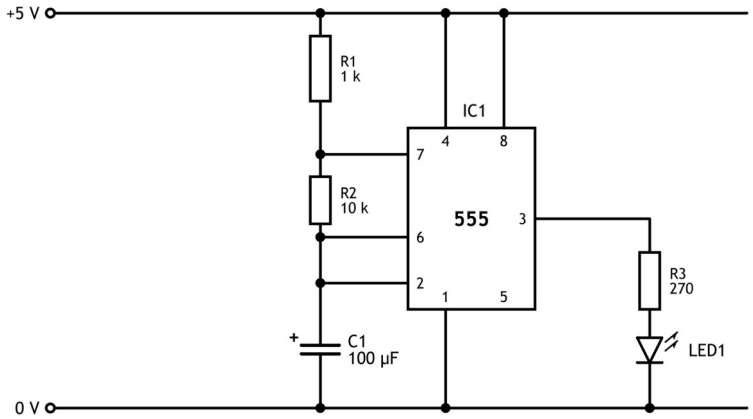



| Flashes in 30 s | Frequency = flashes ÷ 30 (Hz) | C1 lowest (V) | C1 highest (V) |
|---|---|---|---|
| | | | |


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## Another way to build it (for interest)

One LED from pin 3 to 0 V. It flashes at the same rate. Most exam papers draw the astable this way.




| Item ID | Part | Value |
|---|---|---|
| IC1 | 555 timer, in an 8-pin DIL socket | — |
| R1 | resistor | 1 kΩ (brown black red) |
| R2 | resistor | 10 kΩ (brown black orange) |
| C1 | electrolytic capacitor | 100 µF |
| R3, R4 | resistors | 270 Ω (red violet brown) |
| LED1, LED2 | LEDs | red, green |
| T1–T4 | test pins | — |


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**TASK 2 — Plan it on the Stripboard Builder**

Plan your layout on the website's Stripboard Builder. Follow the guide on the lesson page; where it says **your turn**, plan that step yourself. Print it and stick it in.

**Stick your Stripboard Builder printout here.**

mrstewartphysics.co.uk/classes/electronics/stripboard-builder.html

| No. | Colour | From | To | What it carries |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| Before you build: check | ✓ |
|---|---|
| Every track under the chip is cut, drawn as an X. | |
| Every leg is in the track its net was given. | |
| Every link is numbered and coloured; red and black only for the supply. | |
| C1, LED1 and LED2 are the right way round. | |
| Test points T1 to T4 are marked, each with its expected reading. | |


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**TASK 3 — Check the parts**

Check every part **before** it goes in. Use the Testing jobs table in section 1.

| Part | Setting | Expected | Measured | OK? |
|---|---|---|---|---|
| R1 | OHM 2k | 1 kΩ: reads 0.95 to 1.05 | | |
| R2 | OHM 20k | 10 kΩ: reads 9.5 to 10.5 | | |
| R3, R4 | OHM 2k | 270 Ω: reads about 0.27 | | |
| LED1, LED2 | diode check | a number one way round, 1 the other | | |

**TASK 4 — Pre-power-up check**

Fill this in **before** the supply is connected. Power on only when every row is done.

| Date | Test point | Description of test | Result | Changes made |
|---|---|---|---|---|
| | T1 to T2 | No short between the supply rails: continuity setting, no beep. | | |
| | — | No solder bridges between tracks. Track cuts under IC1 are clean (continuity: no beep). | | |
| | — | IC1 in its socket the right way round: notch and pin 1 at the marked end. | | |
| | — | C1, LED1 and LED2 the right way round. | | |
| | — | Every link matches the wiring schedule. | | |
| | — | Supply set to 5 V before it is connected. | | |

**TASK 5 — Test it**

| Test point | What it is | Expected | Measured |
|---|---|---|---|
| T1 | +5 V supply | 5 V | |
| T2 | 0 V | 0 V | |
| T3 | pin 3, output | keeps changing: about 0 V, then 3.5 V to 5 V | |
| T4 | C1, pins 2 and 6 | rises and falls between about 1.7 V and 3.3 V | |


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Logic probe on pin 3, set to TTL and Pulse. Expected: red and green flash in turn.
Seen: _____

Count LED1's flashes in 30 seconds, three times.

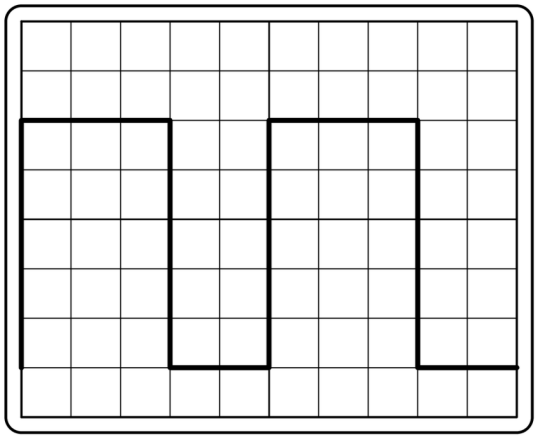
| Try 1 | Try 2 | Try 3 | Average | Frequency = average ÷ 30 (Hz) |
|---|---|---|---|---|
| | | | | |

**Compare** your board with Yenka (about 20 flashes in 30 s). **Give** one reason they might differ. (1)

---

## Exam practice

**1.** The output from pin 3 of a 555 astable is connected to an oscilloscope. The trace is shown below.



Y-gain: 1 V/div  Timebase: 100 ms/div

**(a) State** the peak voltage of the signal. (1)

---

**(b) Calculate** the frequency of the signal. (3)

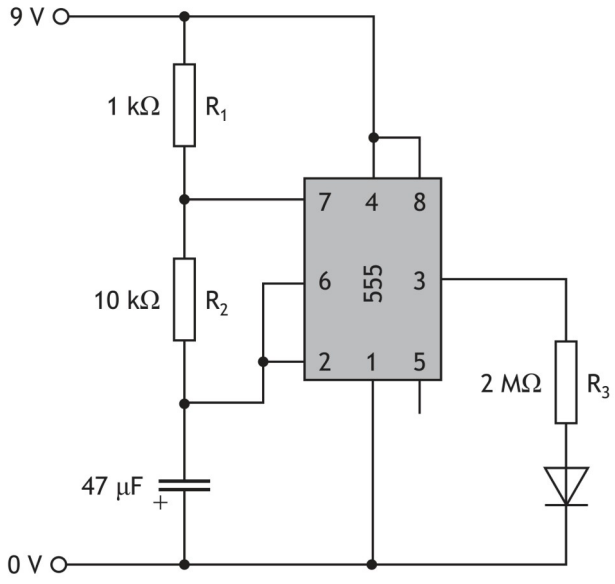
*Space for working and answer*

**2. Look** at the astable circuit diagram at the start of this section.
**Identify** the **two** test points used to measure the voltage across C1. (1)

---


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**3.** A student simulated the flashing LED circuit shown below.




**Identify three** errors in the student's circuit. (3)

Error 1:

---

Error 2:

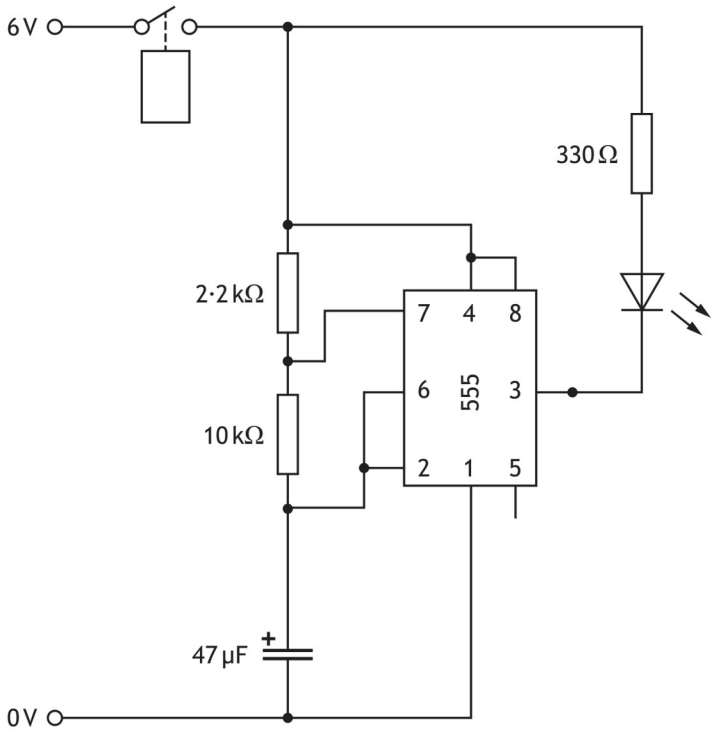
---

Error 3:

---


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**4.** A student simulated the 555 timer circuit shown below.

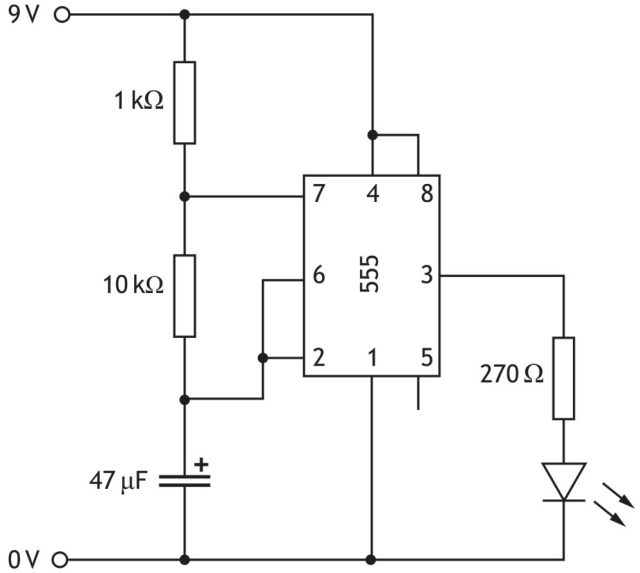



**Complete** the following table by giving **three** pre-power up checks for this circuit. (3)

| **Pre-power up checklist** |
|---|
| Check IC orientation |
| |
| |
| |


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**5.** A student builds the circuit shown.




Using the information from the two suppliers' catalogues shown below, complete the costings sheet to produce the **lowest** cost for the circuit. (5)

**Supplier — SWIFT**

| Component | Description | Product code | Cost |
|---|---|---|---|
| Integrated circuits | LM555CM timers | IC-0283 | 45p |
| | NE555 timers | IC-0254 | 32p |
| | NE556 timers | IC-0216 | 25p |
| | 8 way dil ic socket | SK-0080 | 10p |
| Semi-conductors | LED 5 mm std red | SC-0155 | 4p |
| | LED 10 mm std red | SC-0177 | 10p |
| Electrolytic capacitors | 10 µF 16 V | CP-0555 | 10p |
| | 47 µF 16 V | CP-0566 | 18p |
| | 47 µF 6 V | CP-0588 | 10p |
| | 47 µF 5 V | CP-0599 | 8p |
| Resistors | 220R 0·25 W carbon film 5% | EC-0159 | 0·5p |
| | 270R 0·25 W carbon film 5% | EC-0161 | 0·5p |
| | 1K 0·25 W carbon film 5% | EC-0175 | 0·5p |
| | 10K 0·25 W carbon film 5% | EC-0182 | 1·5p |
| | 100K 0·25 W carbon film 5% | EC-0198 | 3p |


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## Supplier — JIMSON

| Component | Description | Product code | Cost |
|---|---|---|---|
| Integrated circuits | LM555CM timers | TC 123 | 90p |
| | NE555 timers | TC 124 | 20p |
| | NE556 timers | TC 125 | 80p |
| | 8 way dil ic socket | SK 099 | 50p |
| Semi-conductors | LED 5 mm std red | LD345 | 12p |
| | LED 10 mm std red | LD346 | 20p |
| Electrolytic capacitors | 10 µF 16 V | EC 798 | 10p |
| | 47 µF 16 V | EC 799 | 14p |
| | 47 µF 6 V | EC 800 | 10p |
| | 47 µF 5 V | EC 801 | 8p |
| Resistors | 220R 0·25 W carbon film 5% | FR 921 | 0·25p |
| | 270R 0·25 W carbon film 5% | FR 922 | 0·25p |
| | 1K 0·25 W carbon film 5% | FR 923 | 0·25p |
| | 10K 0·25 W carbon film 5% | FR 924 | 2p |
| | 100K 0·25 W carbon film 5% | FR 925 | 5p |

## Costings sheet

| Supplier | Component | Product code | Cost (p) |
|---|---|---|---|
| JIMSON | NE555 | TC124 | 20 |
| SWIFT | 8 way DIL socket | SK-0080 | 10 |
| | LED 5 mm std | | |
| | 47 µF electrolytic capacitor | | |
| | 270R | | |
| | 1K | | |
| | 10K | | |


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## Key words

Complete the sentences. Use each word from the box once.

**astable** **period** **frequency** **track** **socket** **pulsing**

1. An _____ switches its output on and off again and again.
2. The time for one on-off cycle is the _____.
3. The number of cycles each second is the _____.
4. On stripboard, cut every _____ under the chip.
5. Solder a DIL _____, not the chip itself.
6. On Pulse, the logic probe flashes when pin 3 is _____.


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# Sources and credits

Exam questions from the National 5 Practical Electronics papers, © Qualifications Scotland (SQA), reproduced for educational use:

- Section 1, logic probe guide: question paper 2025, question 7 (logic probe picture).
- Section 1, exam question 1: question paper 2019, question 5.
- Section 1, exam question 2: question paper 2026, question 5(b)(iii).
- Section 2, exam question 2: question paper 2019, question 7.
- Section 3, exam question 1: question paper 2025, question 11.
- Section 3, exam question 2: question paper 2025, question 7.
- Section 4, exam question 3: question paper 2024, question 5(b).
- Section 4, exam question 4: specimen question paper, question 6(c).
- Section 4, exam question 5: question paper 2018, question 9.

The 2018 and 2019 papers were found through J Keegan's National 5 Practical Electronics Past Papers compilation (November 2025).

Questions not listed above are written in the same style by R Stewart.

Circuit diagrams, the multimeter, the oscilloscope trace and the Block 6 mark are drawn by R Stewart, with the Block 5 Logic booklet's drawing kit. The multimeter is drawn from the class meters.

Answers to every question are on the lesson pages.

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