

Name _____

Class _____

Date _____

By the end of this worksheet I can...

- ☐ describe how a transistor works as a switch (about 0.7 V base-emitter)
- ☐ explain the purpose of a relay and a protection diode
- ☐ calculate base current, collector current and current gain (h_{FE})
- ☐ describe MOSFET threshold voltage and an advantage of a MOSFET over a BJT
- ☐ use a MOSFET graph to find drain-source current

I DO**Worked example** Read how a full-mark answer is built

A BJT has a $2.2\text{ k}\Omega$ base resistor. The input voltage is 5 V and $V_{be} = 0.7\text{ V}$. $h_{FE} = 150$.

1 Calculate the base current and collector current. (3 marks)**Full-mark answer** each ✓ is one mark

$V_{Rb} = 5 - 0.7 = 4.3\text{ V}$ ✓. $I_b = 4.3 \div 2200 = 1.95 \times 10^{-3}\text{ A}$ ✓. $I_c = h_{FE} \times I_b = 150 \times 1.95 \times 10^{-3} = 0.29\text{ A}$ ✓.

Why marks are not awarded

" $I_b = 5 \div 2200 = 2.27\text{ mA}$, $I_c = 150 \times 2.27\text{ mA} = 0.34\text{ A}$ "

1 mark (follow-on for I_c): the 0.7 V drop was missed.

WE DO**Guided practice** Use the starters and word bank to help you

An engineer replaces a BJT with a MOSFET.

2 Describe one advantage of the MOSFET over the BJT. (1 mark)**Sentence starters**

One ... is ..., which means ...
Another ... is ..., so ...

Word bank

controller · higher · almost · little · current ·
resistance · switch · currents

Tip: 1 marks = 1 separate, developed points.

YOU DO**On your own** No notes. Check your answers afterwards.**3 Quick check: tick one box for each.****a)** Why is a diode placed across a relay coil?

- ☐ To light up when the relay is on ☐ To increase the current through the coil ☐ To protect the transistor from reverse voltage ☐ To switch the relay on and off faster

b) A MOSFET is controlled by...

- ☐ Base current ☐ Gate voltage ☐ Collector current ☐ Light

c) $I_B = 2 \text{ mA}$ and $h_{FE} = 150$. I_C is...

- ☐ 300 mA ☐ 75 mA ☐ 152 mA ☐ 0.3 mA

d) Which component lets a 5 V circuit switch a 230 V heater?

- ☐ LDR ☐ Buzzer ☐ Diode ☐ Relay

4 Key terms: write the letter of the matching description next to each term.

1. Vce	_____	A $V_{CC} - V_L$ (Kirchhoff's second law)
2. MOSFET saturation	_____	B Lets a low-current circuit switch a separate high-current circuit.
3. Transistor switch-on voltage	_____	C Limits base current to protect the transistor.
4. Base resistor	_____	D $V_{DS} = V_{GS} - V_T$
5. Relay	_____	E About 0.7 V at the base.
6. Protection diode	_____	F Across the relay coil; protects the transistor from reverse voltage when the coil switches off.

A MOSFET has a threshold voltage of 2.1 V.

5 Describe what is meant by threshold voltage. (1 mark)

A transistor drives a relay coil. A diode is connected across the coil.

6 Explain the purpose of the diode. (2 marks)

A relay is used between a transistor and a mains lamp.

7 Explain why a relay is used. (2 marks)

Check and reflect

Mark your answers with the answer sheet. Go back to the checklist on the site and re-rate each “I can” statement above. Which one still needs work?
