E-MOSFET AS A DIGITAL SWITCH

E-MOSFET APPLICATION

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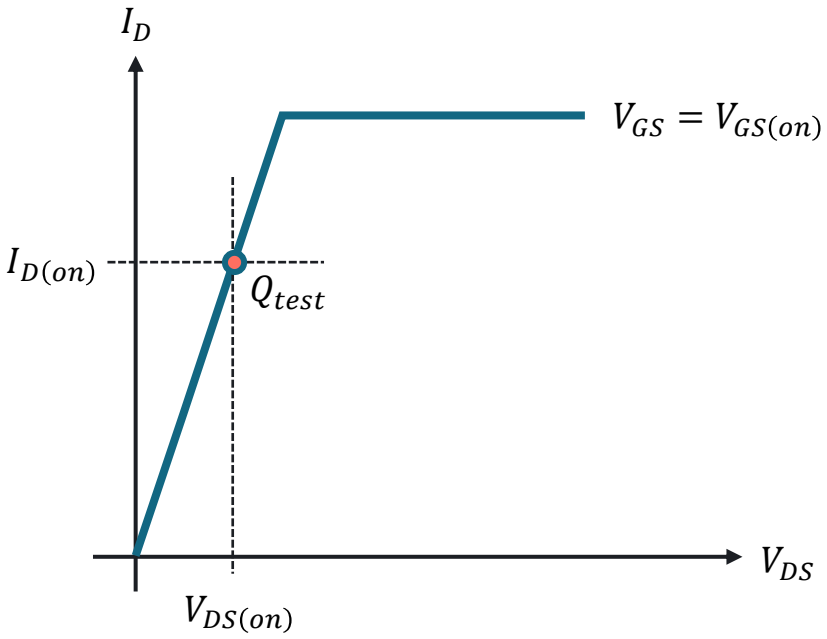
TOPIC OUTLINE

The Ohmic Region

Active-load Switching

OHMIC REGION

Measuring $R_{DS(on)}$



Drain-Source ON Resistance

$$R_{DS(on)} = \frac{V_{DS(on)}}{I_{D(on)}}$$

For instance, at the test point, a VN2406L has $V_{DS(on)} = 1\text{V}$ and $I_{D(on)} = 100mA$.

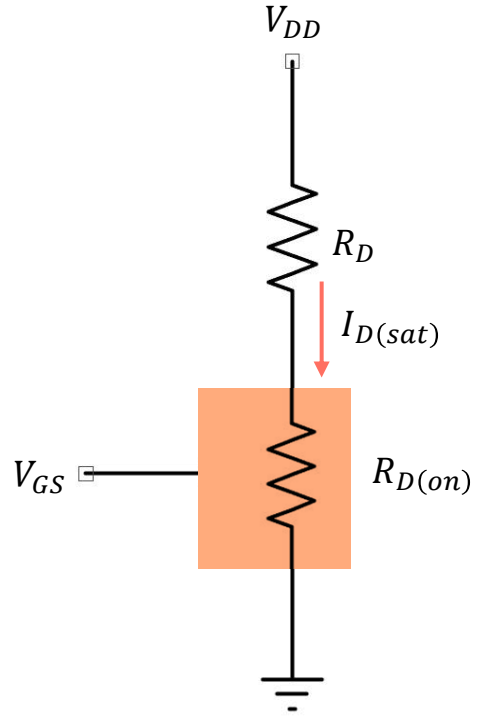
$$R_{DS(on)} = \frac{1\text{V}}{100\ mA}$$

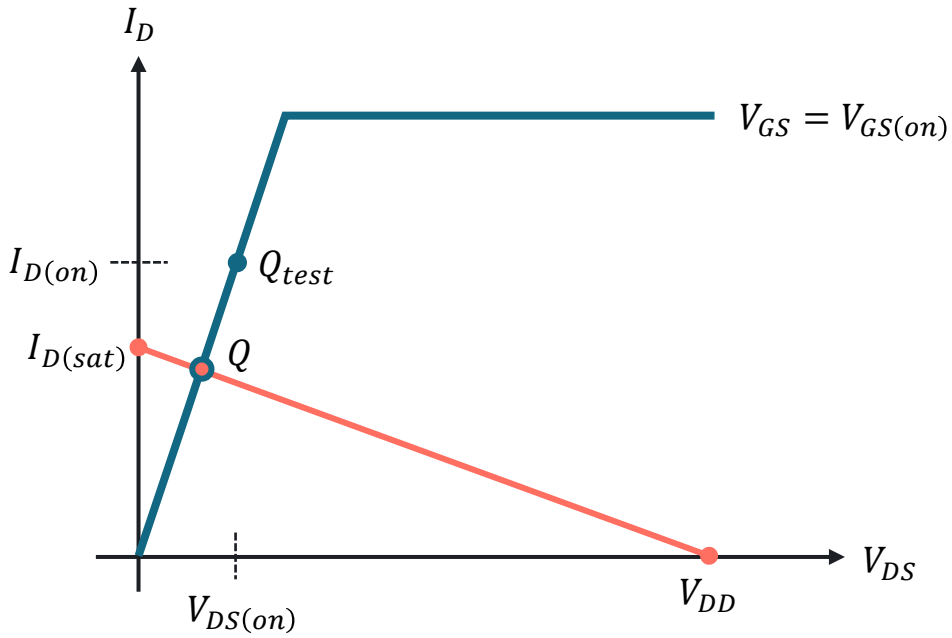
$$R_{DS(on)} = 10\Omega$$

SMALL-SIGNAL E-MOSFETs

Device	$V_{GS(th)}$	$V_{GS(on)}$	$I_{D(on)}$	$R_{DS(on)}$	$I_{D(max)}$	$P_{D(max)}$
VN2406L	1.5V	2.5V	100 mA	10Ω	200mA	350mW
BS107	1.75V	2.6V	20 mA	28Ω	250mA	350mW
2N7000	2V	4.5V	75 mA	6Ω	200mA	350mW
VN10LM	2.5V	5V	200 mA	7.5Ω	300mA	1W
MPF930	2.5V	10V	1 A	0.9Ω	2A	1W
IRFD120	3V	10V	600 mA	0.3Ω	1.3A	1W

BIASING IN OHMIC REGION





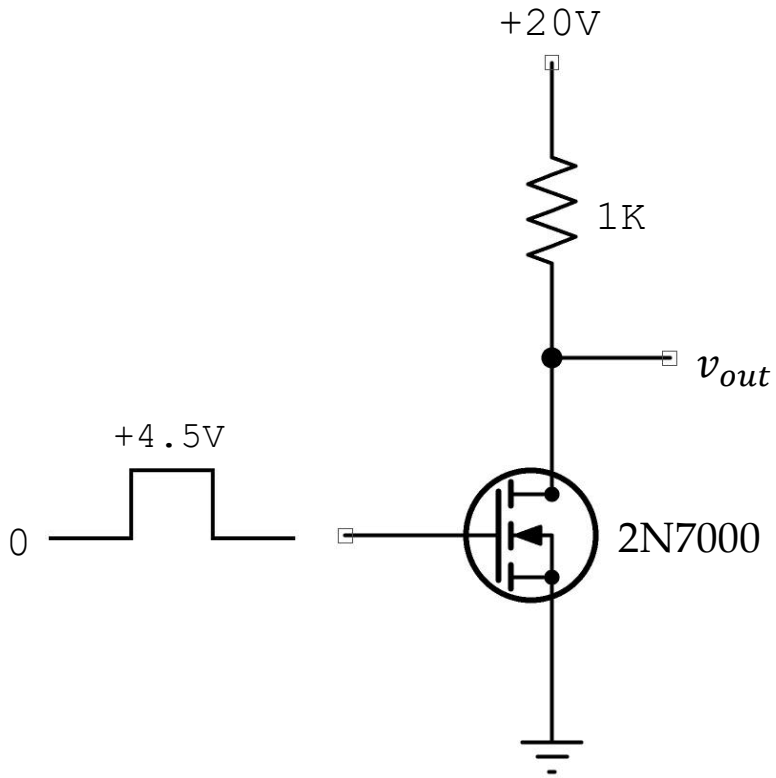
Drain saturation current

$$i_{D(sat)} = \frac{V_{DD}}{R_D}$$

$I_{D(sat)}$ less than $I_{D(on)}$ with $V_{GS} = V_{GS(on)}$ ensures saturation.

EXERCISE

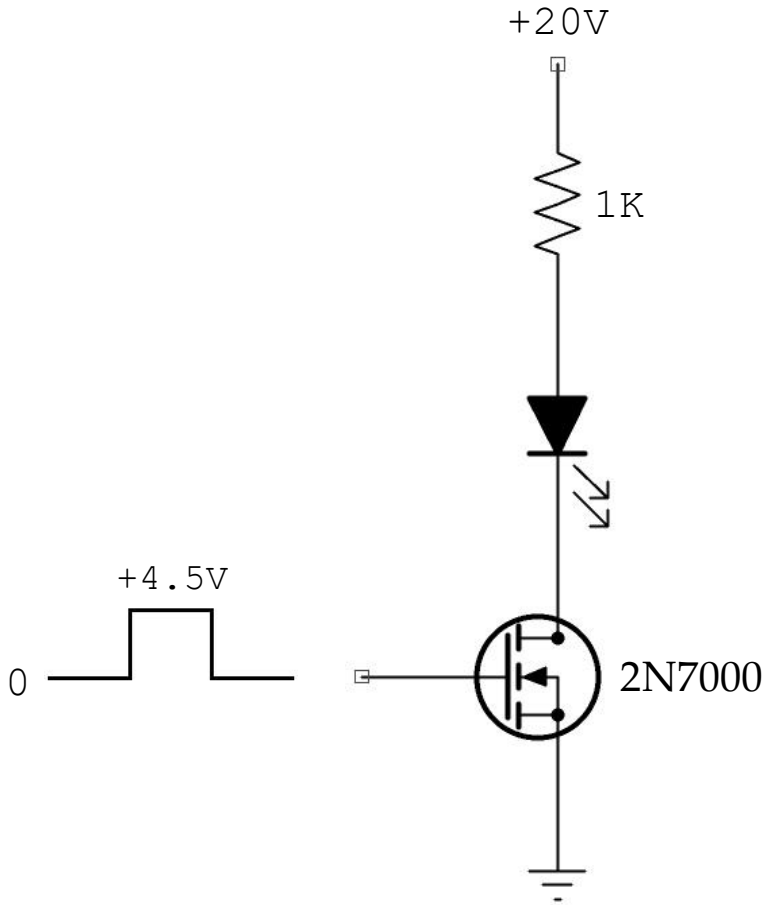
What is the output voltage in the given circuit?



Solution

EXERCISE

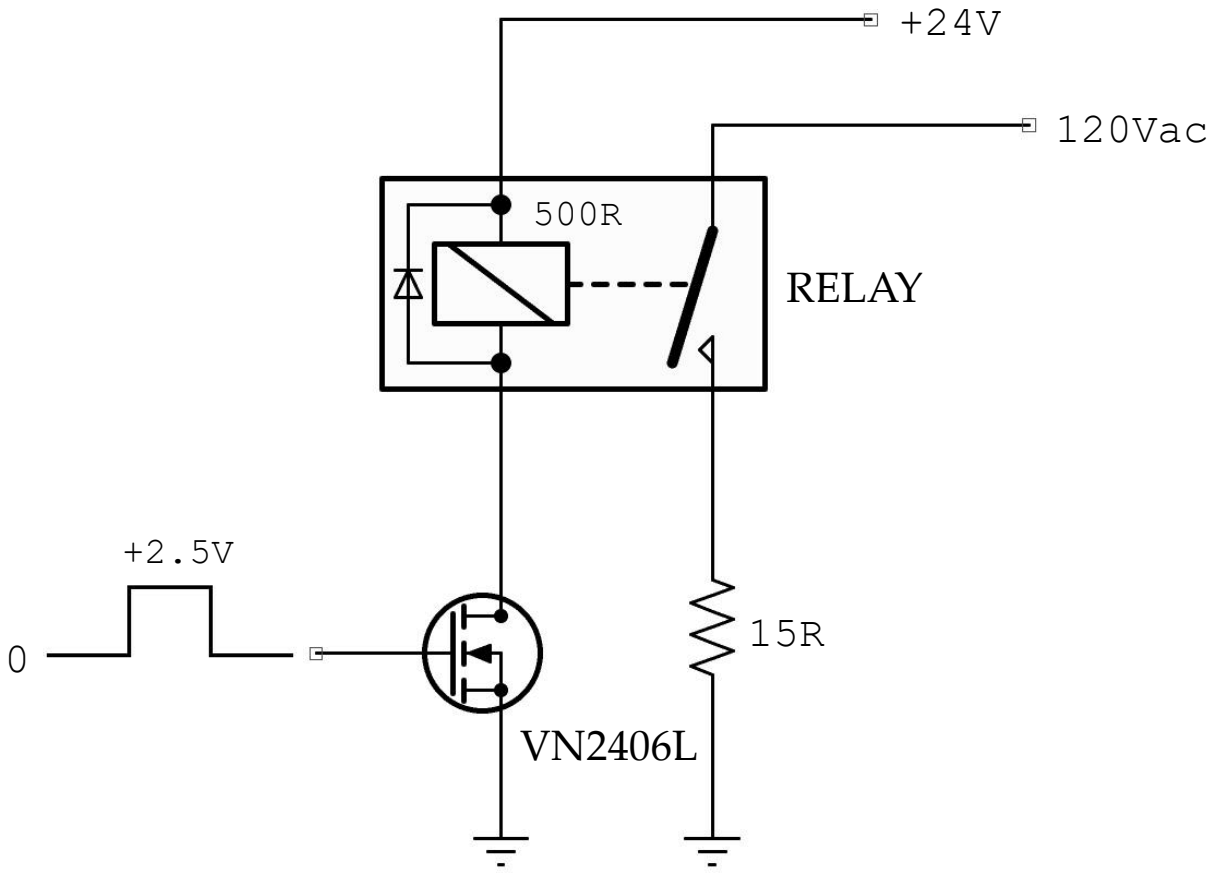
Calculate the LED current in the given circuit.



Solution

EXERCISE

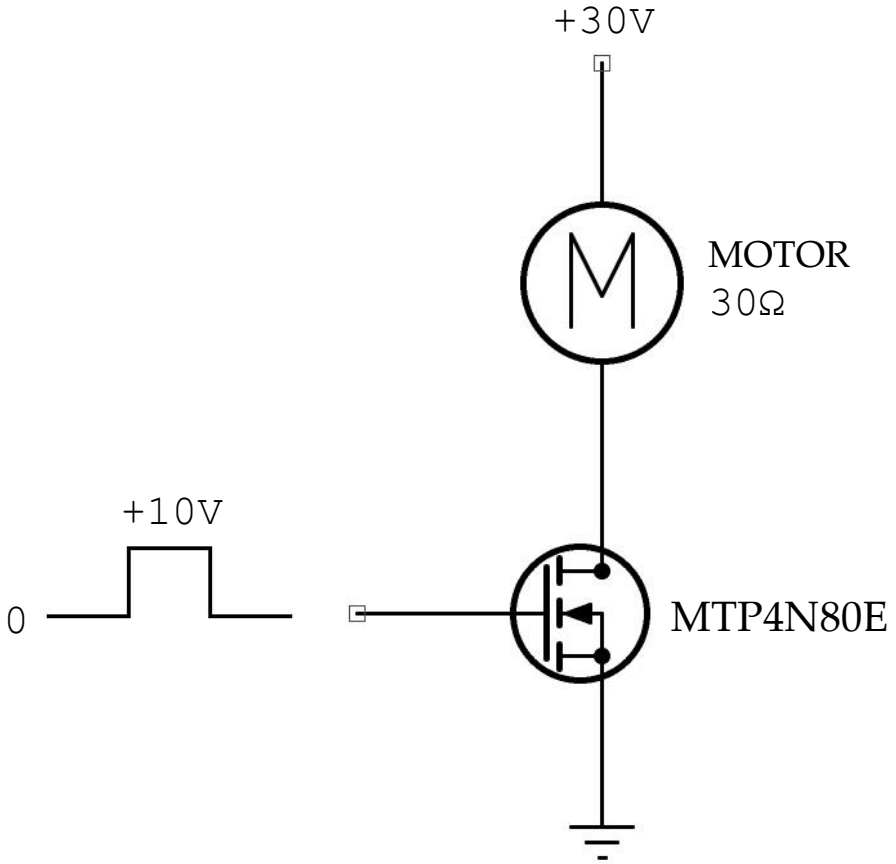
What does the given circuit do if a coil current of 30mA or more closes the relay contact?



Solution

EXERCISE

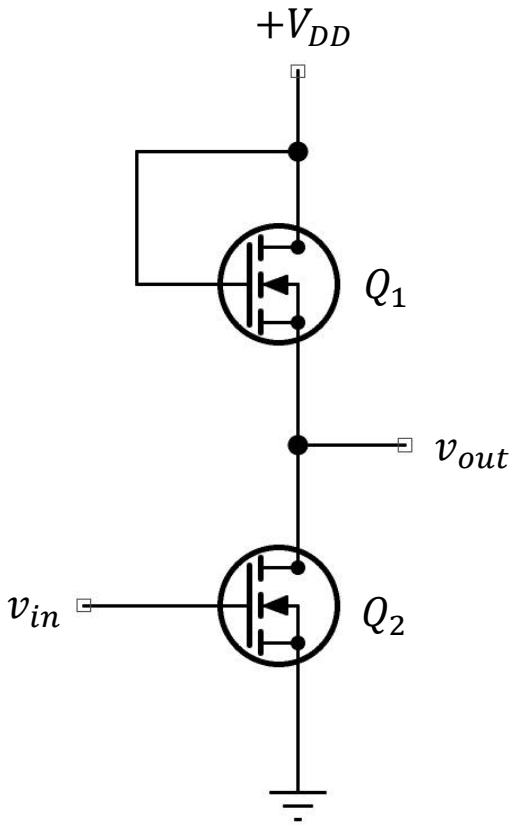
What is the current through the motor winding? For an MTP4N80E: $V_{GS(on)} = 10$ V, $I_{D(on)} = 2$A, and $R_{DS(on)} = 1.95\Omega$.



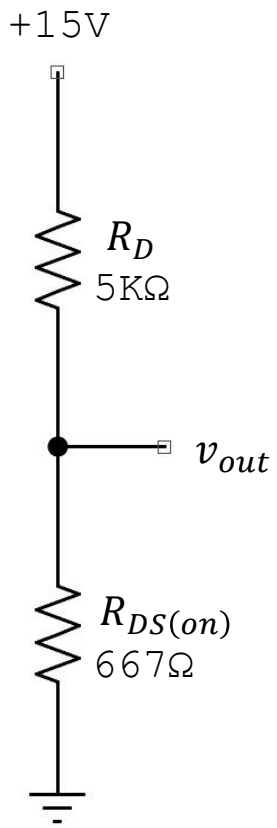
Solution

ACTIVE-LOAD SWITCHING

ACTIVE-LOAD SWITCHING

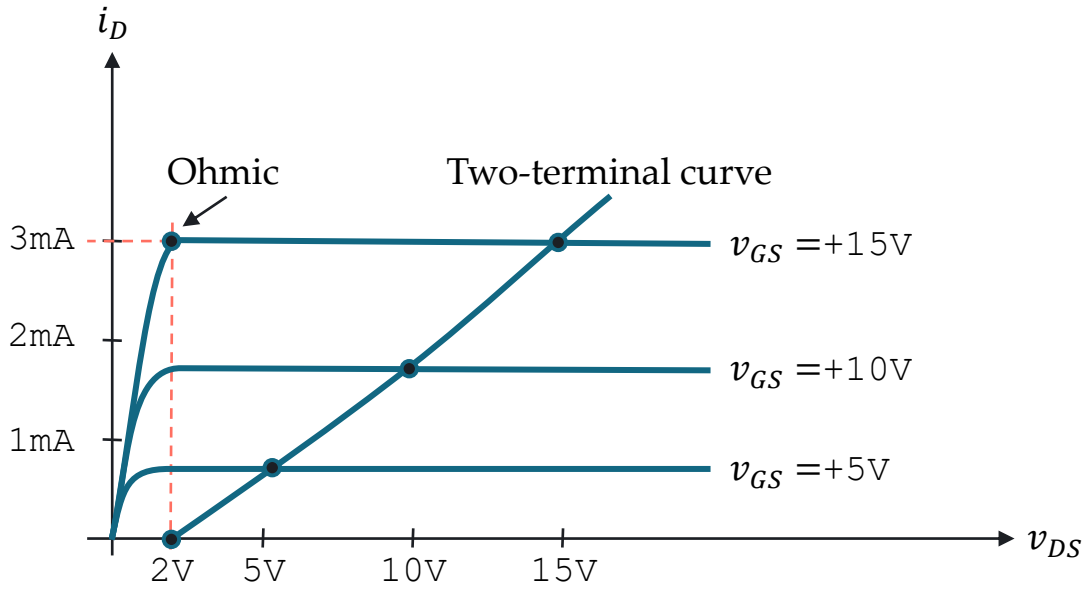


Active Load



Equivalent Circuit

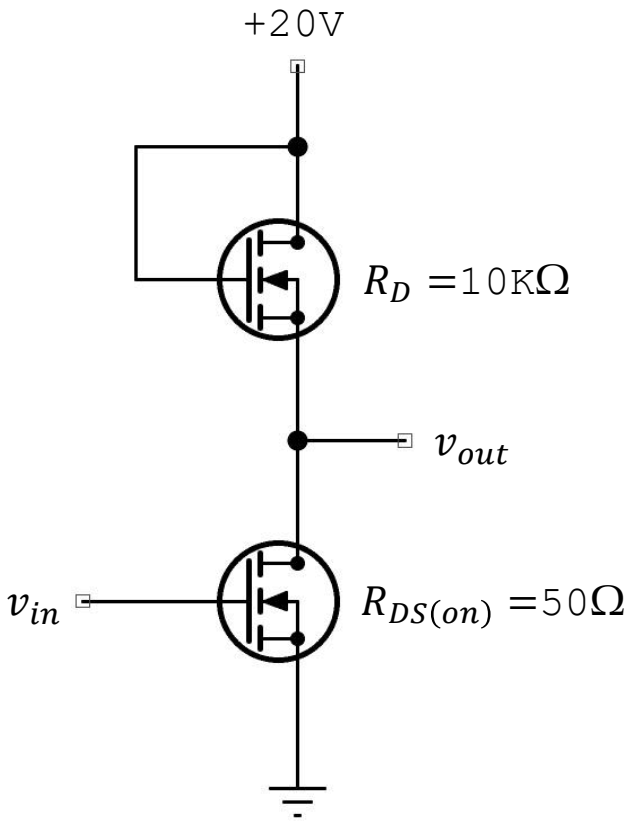
$V_{GS} = V_{DS}$ produces a two-terminal curve



EXERCISE

What is the output voltage when the input is low?

When the it is high?



Solution

EXERCISE

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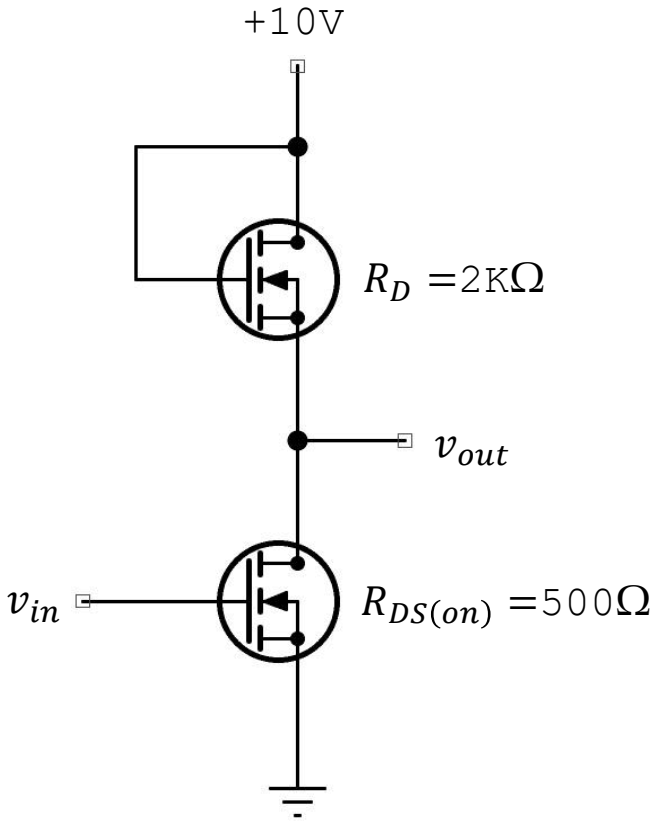

Solution

LABORATORY