

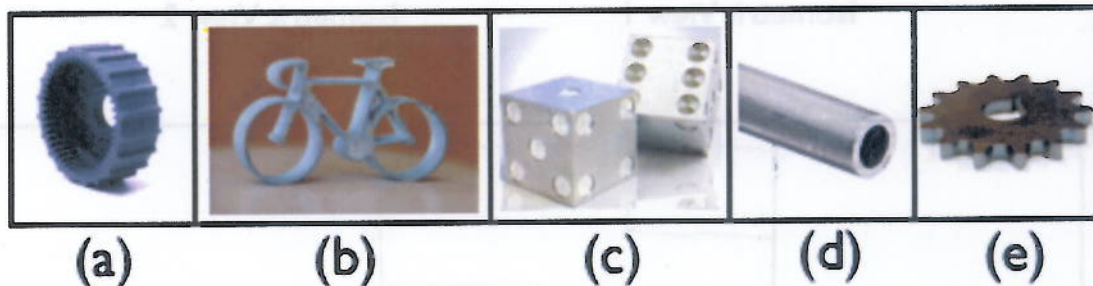
Robotics Quiz 1

Instructions: Work through sections I, II, III, and IV in any order. Complete required questions first, and if you have time remaining, you may work on optional questions.

Section I. MANUFACTURING [7 points]

Instructions: In the table below, write a description of each part (a) through (e), the material you think each is made of, and name of the machine that was **most likely** used to produce each part.

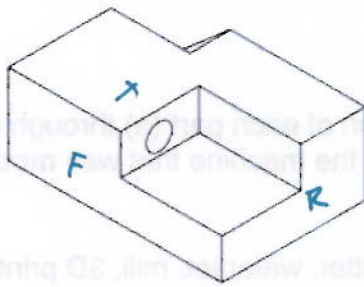
List of Machines (in no particular order): laser cutter, water jet, mill, 3D printer, extruder



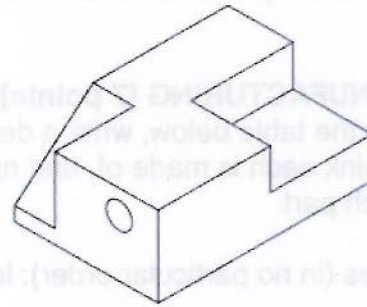
	(i) Description	(ii) Material	(iii) Machine
(ex)	DriveBot chassis	acrylic	laser cutter
(a)	GEAR, WHEEL	PLASTIC, METAL, FOAM	3D, MILL
(b)	CUT OUT OF BICYCLE	stone	WATERJET, MILL
(c)	PTE / OCE	ALUMINUM	MILL
(d)	PIPE	METAL	EXTRUDER, WATERJET, MILL
(e)	GEAR	wood	LASER CUT, MILL, WATERJET

Section II. SKETCHING [9 points]

Instructions: Draw three sketches: one for each view listed. You will draw a top view, front view, and right view. *Note: draw all hidden lines as dotted lines (- - -) and all visible lines as solid lines (—).*

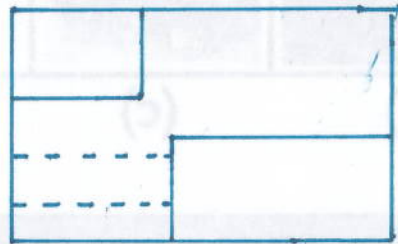


Isometric View 1

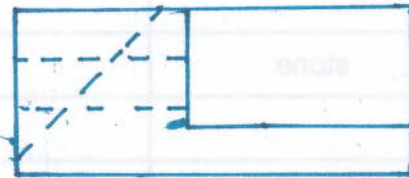


Isometric View 2

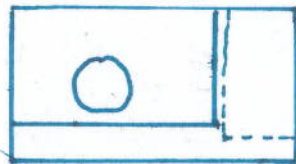
Top View



Front View



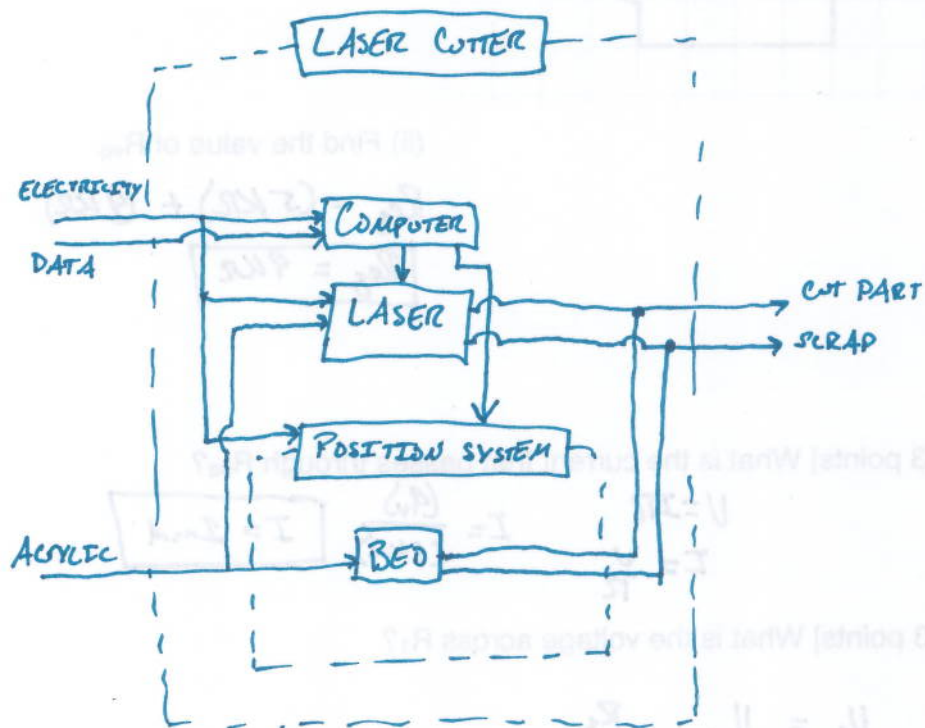
Right View



Section III. SYSTEM DIAGRAMS [10 points]

Instructions: Draw a system diagram for a laser cutter, using the following word bank. Each item in the word bank can be: an input, an output, or a module.

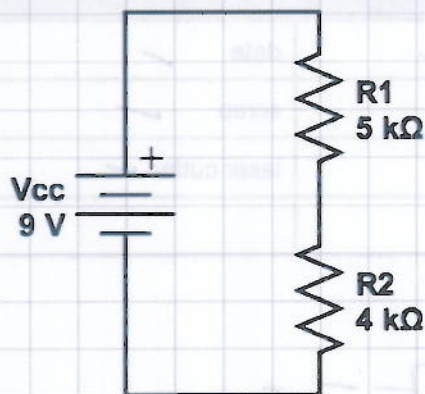
Word Bank		
cut part ✓	position system ✓	data ✓
bed (of laser cutter) ✓	acrylic ✓	scrap ✓
electricity ✓	laser ✓	laser cutter ✓
computer ✓		



Section IV. ELECTRONICS

Instructions: Label all units and show your work! Partial credit will be given.

1.



(a) [2 points] (i) Draw the equivalent 1 resistor circuit.



(ii) Find the value of R_{eq} .

$$R_{eq} = (5 \text{ k}\Omega) + (4 \text{ k}\Omega)$$

$$R_{eq} = 9 \text{ k}\Omega$$

(b) [3 points] What is the current that passes through R_{eq} ?

$$V = IR$$

$$I = \frac{V}{R}$$

$$I = \frac{(9\text{V})}{(9\text{k}\Omega)}$$

$$I = 1 \text{ mA}$$

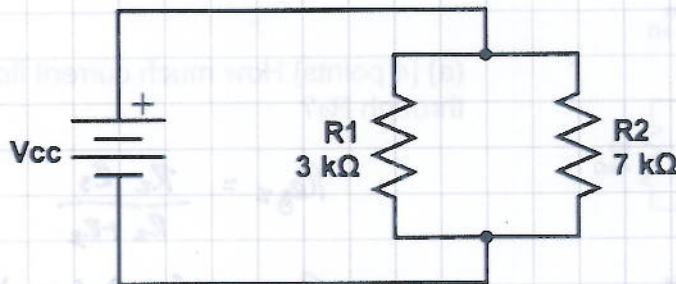
(c) [3 points] What is the voltage across R_1 ?

$$V_1 = V_{cc} \cdot \frac{R_1}{R_1 + R_2}$$

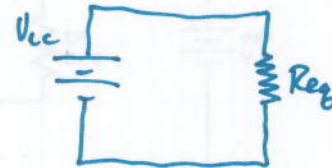
$$V_1 = (9\text{V}) \cdot \frac{(5\text{k}\Omega)}{(5\text{k}\Omega) + (4\text{k}\Omega)}$$

$$V_1 = 5\text{V}$$

2.



(a) [2 points] (i) Draw the equivalent 1 resistor circuit.



(ii) Find the value of R_{eq} .

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_{eq} = \frac{(3k\Omega)(7k\Omega)}{(3k\Omega) + (7k\Omega)}$$

$$R_{eq} = \frac{21}{10} k\Omega$$

(b) [4 points] What is the value of V_{cc} if the current that passes through R_2 is 14mA ($i_2 = 14 \text{ mA}$)?

$$i_2 = I \frac{R_1}{R_1 + R_2}$$

$$I = \frac{i_2 (R_1 + R_2)}{R_1}$$

$$V = R_{eq} I$$

$$V = \frac{R_1 R_2}{R_1 + R_2} \cdot i_2 \frac{(R_1 + R_2)}{R_1}$$

$$V_{cc} = i_2 R_2$$

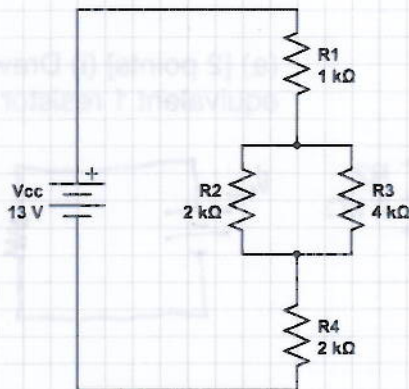
$$V = IR$$

$$V_{cc} = i_2 R_2$$

$$V_{cc} = (14 \text{ mA})(7k\Omega)$$

$$V_{cc} = 98 \text{ V}$$

3.

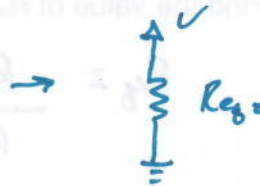
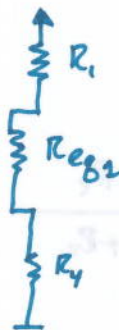
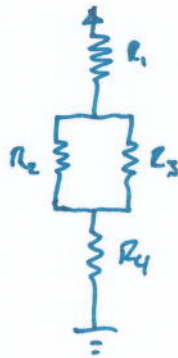


(a) [4 points] How much current flows through R_2 ?

$$R_{eq2} = \frac{R_2 R_3}{R_2 + R_3}$$

$$R_{eq2} = \frac{(2k\Omega)(4k\Omega)}{(2k\Omega) + (4k\Omega)}$$

$$R_{eq2} = \frac{8}{6} k\Omega = \boxed{\frac{4}{3} k\Omega}$$



$$R_{eq2} = R_1 + R_{eq2} + R_4$$

$$R_{eq2} = (1k\Omega) + (\frac{4}{3}k\Omega) + (2k\Omega)$$

$$\boxed{R_{eq2} = \frac{13}{3} k\Omega}$$

$$V = IR$$

$$\frac{V_{cc}}{R} = I = (13V) \cdot \left(\frac{3}{13}\right) \frac{1}{k\Omega}$$

$$I = 3mA$$

$$i_2 = I \frac{R_3}{R_2 + R_3}$$

$$i_2 = (3mA) \cdot \frac{(4k\Omega)}{(2k\Omega) + (4k\Omega)}$$

$$i_2 = \frac{2}{3} \cdot 3mA$$

$$\boxed{i_2 = 2mA}$$