

الاسم:

رقم التسجيل:

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Instructions: Time 20 minutes. Open book and notes exam. No electronics. Please answer all problems in the space provided and limit your answer to the space provided. **No questions are allowed.**

Q1. What is the minimum and maximum number of direct interface pins needed to interface a 24-key keypad?

<1 mark>

Minimum number of pins 10 Maximum number of pins 24

Q2. The HD44780 LCD controller has 80 bytes RAM and a character generator ROM.

<2 marks>

a) What is the function of this RAM?

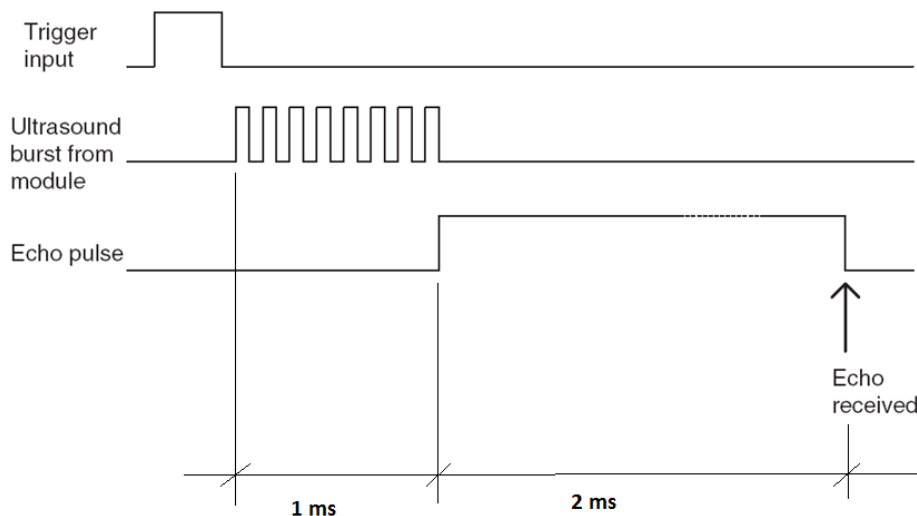
 Holds the codes of the display characters

b) What is the function of this ROM?

 Translates character codes to their shapes.

Q3. For the times shown below of an ultrasonic object sensor, what is the object's distance?

<1 mark>



Round trip time = 1 + 2 = 3 ms

Time = 3/2 = 1.5 ms

Distance = Sound speed * Time

= 340 m/s * 1.6/1000

= 51 cm

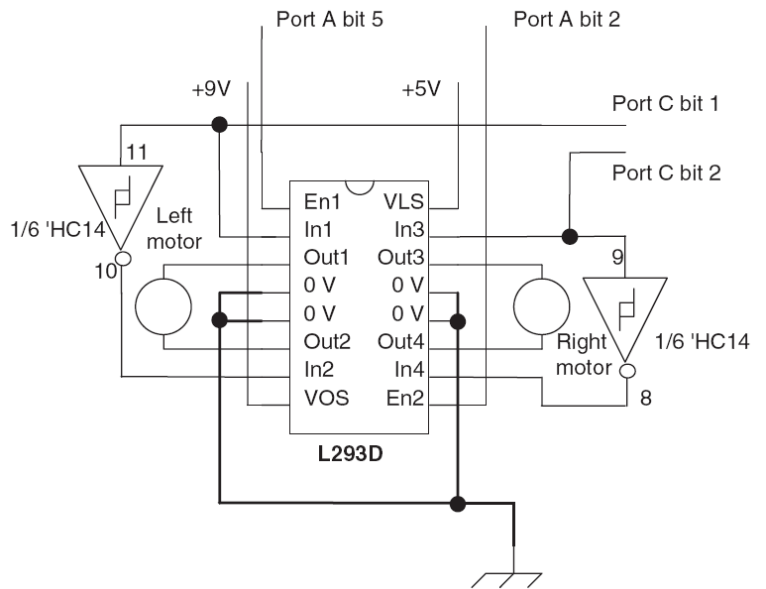
Q4. What is the main feature of a servo motor?

<1 mark>

Allows controlling the motor's speed/position/torque precisely

Q5. What happens when the microcontroller driving this circuit outputs 0x20 on Port A and 0x02 on Port C?

<1 mark>



The left motor rotates in the forward direction; the right motor does not rotate.

Q6. Configure the following control registers of the PIC16F873A microcontroller's ADC module to start one conversion. Assume that 8-bit precision is sufficient for this application, only one analog channel is needed, and $f_{osc} = 10 \text{ MHz}$ is used. Below each bit of the two registers, enter 0, 1, or x.

<4 marks>

ADCON0:

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0
ADCS1	ADCS0	CHS2	CHS1	CHS0	GO/DONE	—	ADON
bit 7							bit 0
0	_1_	_0_	_0_	_0_	_1_	_x_	_1_

ADCON1:

R/W-0	R/W-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
ADFM	ADCS2	—	—	PCFG3	PCFG2	PCFG1	PCFG0
bit 7							bit 0
0	_1_	_x_	_x_	_1_	_1_	_1_	_0_

Conversion frequency $\leq 1 / 1.6 \text{ microseconds} = 625 \text{ KHz}$

Needed frequency division = $10 \text{ MHz} / 626 \text{ KHz} = 16$

1 mark for the PCFG field, 1 mark for the ADCS field, 0.5 for each of the other 4 fields.

<Good Luck>