Max. Time: 1 $^{1/2}$ Hrs
Max Marks= 44 MM (20%)

Name:	ID No.	Date:

*Note:* **Write RELEVANT CALCULATION and answer in the space provided against each part of question in the question paper itself. Use Answer script for initial or rough work. Submit both question paper and answer script in the end. Do not write answer using pencil.**

Q1. A CNC tool is currently at (x=10, y=5) it is given following command
G01 X 20 Y5 F100 (consider dimensions in mm and min).
Assume that the tool follows a trapezoidal velocity profile, considering the figure below. [9 M]
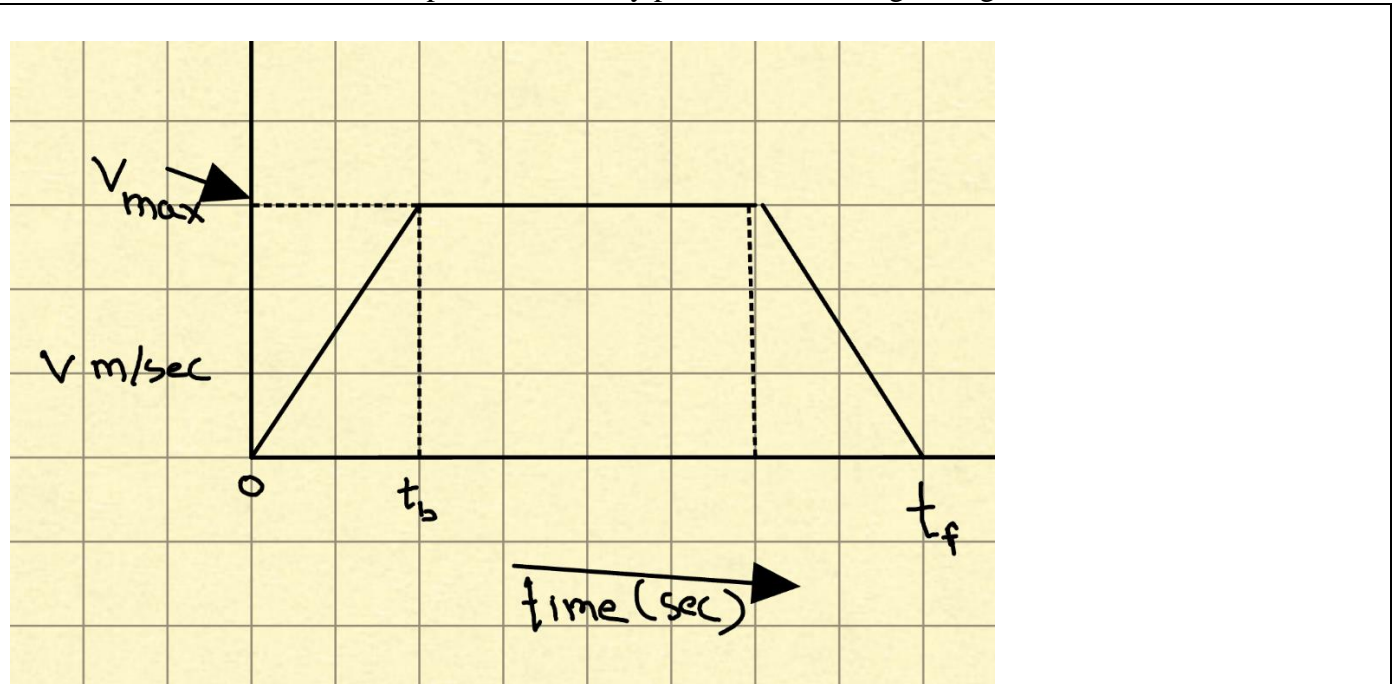
Determine t$_f$ in sec

Determine t$_b$ in sec

Determine Average tool velocity (mm/s)

Calculate V_{max} (mm/s)

Maximum acceleration tool goes through (mm/s²)

Q2. A pressure relief valve has a puppet with effective diameter as 2.5 cm. Given Full flow pressure should be 40 % more than the cracking pressure. Poppet is allowed to move a maximum of 4 mm from its closed position. Spring constant k= 4000 N/cm. Determine: [6 M]

Initial compression of spring X in mm

Cracking pressure in Bars

Full flow pressure in bars

Q3. In a system given in figure below mass 'M' =20000 kg and coeff. Of friction is 0.2 [g=10 m^2/s]. The FCV is set such that it allows maximum flow rate of 150 LPM. Pump displacement volume is 2 x 10^{-4} m^3/rev and is connected to motor with 2000 rpm. Volumetric efficiency is 90%. Area if crises-section of piston and rod is 50 cm^2 and 10 cm^2 respectively. Ignore any pipe losses.   [12 M]
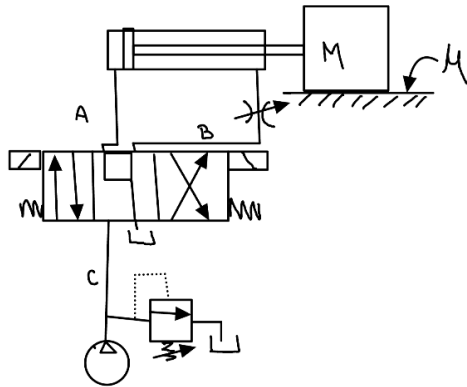
(a) What type of valve center is shown in figure?
(b). Determine force (in kN) required to push the load
(c). What is actual flow rate of pump in LPM
(d). How much flow is going inside the piston end of actuator in LPM, during extension

(e) With what speed is the load moving in m/s, during extension

(f). Is there any liquid passing by the PRV if yes/no and why and how much?

Yes/NO:_____
Reason:

How much in LPM

Q4. Using a transfer station blocks are to be transferred from a magazine to a processing station. The blocks are pushed out of the magazine by cylinder 1A and transferred to the processing station by cylinder 2A. Both the cylinders retract at the same time towards the end of cycle. If cycle is already in progress pressing start button (S1) does not interfere with the existing cycle. The magazine is monitored by means of a limit switch.

If there are no more blocks in the magazine, it is not possible to start the cycle. This is indicated by means of an indicator light. In reference to the control circuit shown below complete control and the logic circuit so that the above mentioned sequence can be implemented. Also draw the step displacement diagram in the space provided -below. [17 M]

Consider A1as1A and A2 as 2A
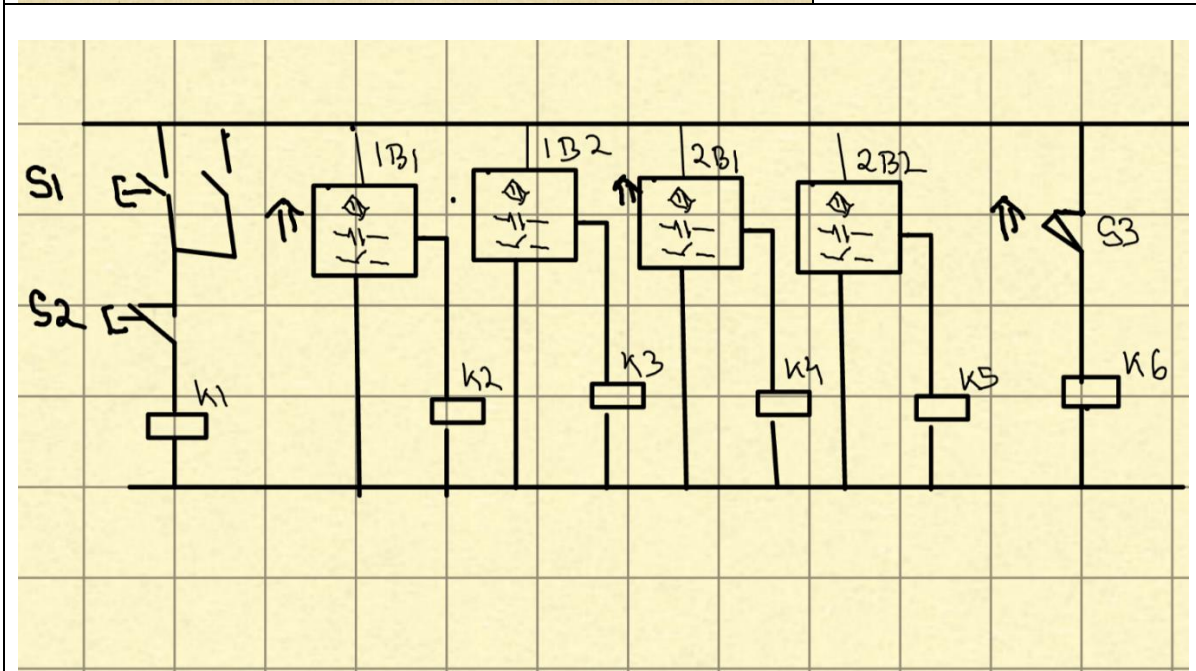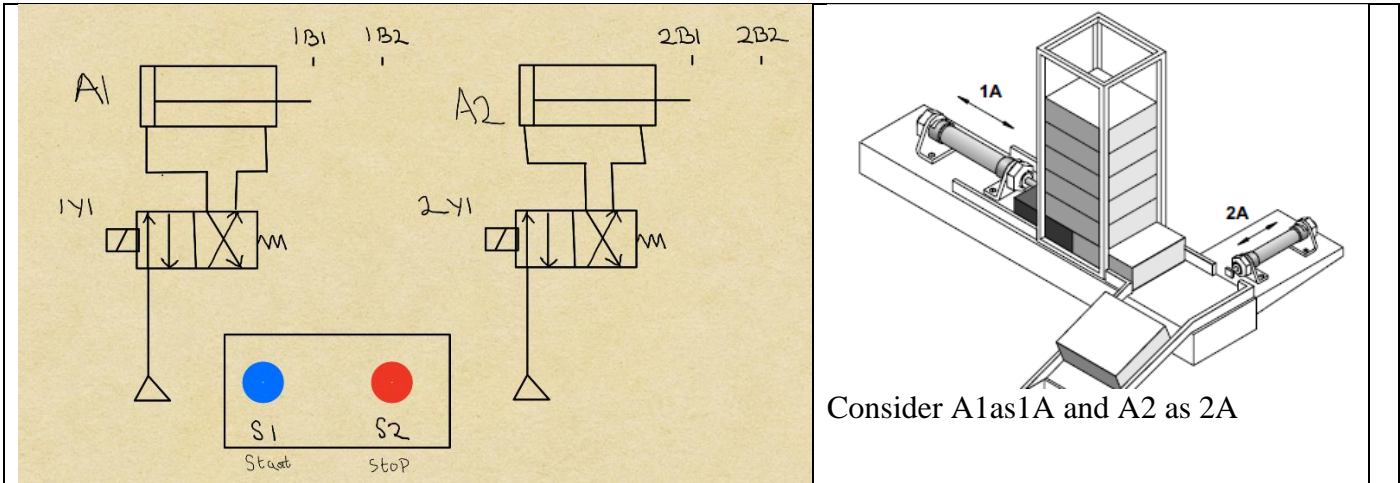
Complete this control circuit.

Logic circuit:

Step displacement diagram