2012 Technological Studies

Standard Grade – Credit

Finalised Marking Instructions

Mark Allocation

				Marks	
				KU	RNA
1.	**(a)**	The system moves the camera to the position set by the user	① **RNA**		
		The error detector compares the desired position with the actual position	① **RNA**		
		The O/P driver provides the power required to drive the motor	① **RNA**		**2**
		The position sensor provides feedback	① **RNA**		**1**
		plus any other valid point. Not “control right = moves right”	**(max 2)**		**0**
		Closed loop has feedback	① **KU**	**2**	
		Open loop has no feedback	① **KU**	**1**	
				0	

2.

Init: **let dirs = %1100000**
symbol counter = b0

Action: if pin 0 = 0 then action — ① **RNA**

Alternative:
if pin 0 = 1 then jump
goto action
jump:
① **RNA**

① **RNA**
- high 7
- pause 1000
- low 7

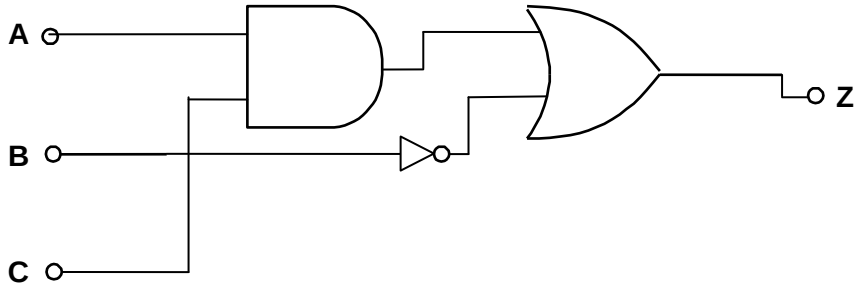
① **RNA** for counter = 1 to 3

① **RNA**
① **RNA**
- high 6
- pause 200
- low 6
- pause 200

① **RNA** next counter

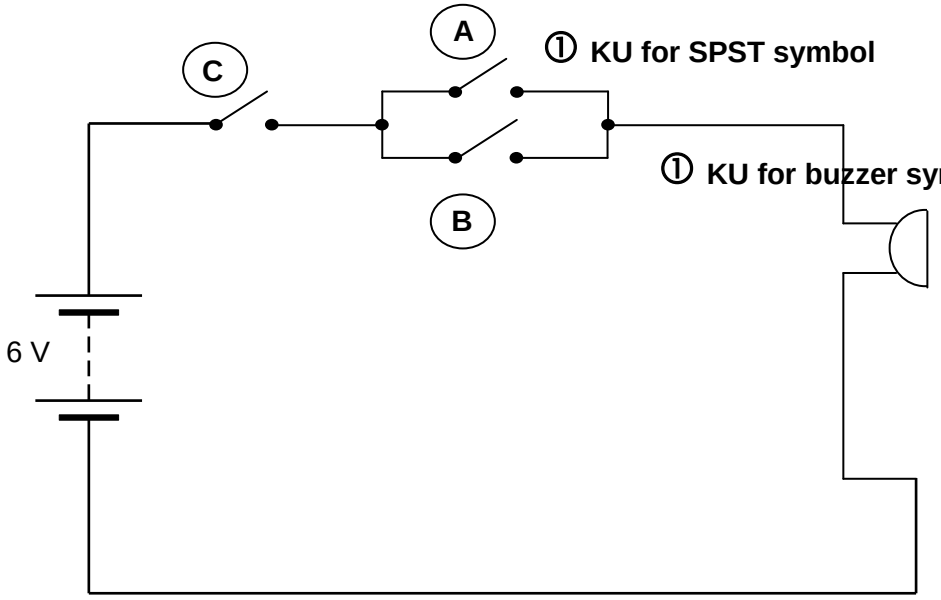
① **RNA** return

7
6
5
4
3
2
1
0

			Marks	
			KU	RNA
3	**(a)**	$Z = A \bullet \overline{B} \bullet C + A \bullet B \bullet C$		**2**
		(A•C ② RNA)		**1**
				0
	(b)	$Z = (\mathbf{A \bullet C}) + \overline{\mathbf{B}}$		
				**3**
				2
			1	**1**
			0	**0**
		① KU for 3 symbols		
		① RNA for connections to each gate		
		Quad 2 input AND **① KU**		
			2	
			1	
		Hex Inverter **① KU**	**0**	
	(d)	High power consumption/high speed switching/unaffected by		**2**
		static/low fan out **① RNA for each valid response**		**1**
				0

	Marks	
	KU	RNA

4. (a)



① **KU for SPST symbol**

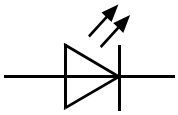
① **KU for buzzer symbol**

① **RNA for connecting components in series to parallel**

① **RNA for connecting parallel switches**

KU	RNA
2	**2**
1	**1**
0	**0**

(b)



① **KU**

KU	RNA
1	
0	

(c) A resistor should be connected ① **RNA** in series ① **RNA**

KU	RNA
2	
1	
0	

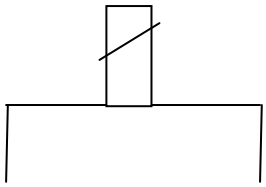
			Marks	
			KU	RNA
5.	**(a)**	It is predictable/negative aesthetics of wind power ① **KU**	1 0	
	(b)	Wind causes a turbine to turn ① **RNA**		
		Turbine causes a generator to turn and produce electricity ① **RNA**	2 1 0	
	(c)	**Pollution/limited supply** ① **RNA for each valid descriptive response**	2 1 0	
	(d)	**(i)** E = MC Δ T 7000 000 = 100 x 4190 x Δ T ① **RNA for substitution** Δ T = 16·7°C ① **RNA for answer from working(FTE)** Final Temp = 10 + 16·7 = 26·7°C (27°C) ① **RNA**		3 2 1 0
		(ii) $\eta = \frac{Eout}{Ein} = \frac{7\,MJ}{11MJ} =$ ~~①~~ **RNA for substitution** 0·636 **=** 64% ① **RNA for answer from working**		2 1 0

			Marks	
			KU	RNA
6.	**(a)**	Easier to reprogram/requires fewer components/ shorter assembly time/etc Smaller/cheaper must be qualified — ① **KU for each valid** explanation/answer	**2 1 0**	
	(b)			

Sub-system	**Function**		
Clock	Synchronises the system/keeps all parts working in time with each other	① **KU**	**4 3**
I/0 Port	***Links the microcontroller to the outside world***	① **KU**	**2 1 0**
EEPROM	Stores the program	① **KU**	
ALU	Performs calculations	① **KU**	

(c)	Electrically (Electronically), Eraseable, Programmable, Read-Only Memory — ① **KU**		**1 0**	
(d)	Reduce overall program size/make program easier to understand/reduces memory requirement — ① **KU for each valid explanation/response**		**2 1 0**	
	Microcontrollers use binary numbers in their calculations and operations.			
(e)	**(i)** **56 = %** 00111000 — ① **RNA**			**1 0**
	(ii) **%11001101 =** 205 — ① **RNA**			**1 0**
(f)	PWM/Pulse Width Modulation — ① **KU**		**1 0**	

		Marks	
		KU	RNA
7.	**(a)** **Mechanism A** Compound gear (train) ① **KU**	**2**	
	Mechanism B Crank & slider (any order) ① **KU**	**1 0**	
	(b) **Rotational to reciprocal** (**Any order**)	**1 0**	
	(c) Output speed = $2000 \div \left(\frac{80}{20} \times \frac{48}{15}\right) = 156$ rev/min ① **RNA for substitution**; ① **RNA for answer from working**; ① **RNA for VR_1**; ① **RNA for VR_2**		**4 3 2 1 0**
	Alt: $20 \times 2000 = 80 \times T_1$ ① **RNA**; $T_1 = 500$ rev/min ① **RNA**; $15 \times 500 = 48 \times T_2$ ① **RNA**; $T_2 = 156$ rev/min ① **RNA**		
	(d) Worm and wheel ① **KU**	**1 0**	
	(e) Lubricating moving parts or bearings on shafts ① **KU** **correct description**	**1 0**	
	(f) 1 Rack and pinion ① **KU**	**2**	
	2 Worm and nut ① **KU** **Allow FTE from (b) if applicable**	**1 0**	

			Marks	
			KU	RNA
8.	**(a)**	When Valve (A) is activated Valve (C) changes state causing the DAC to outstroke slowly. When the DAC is fully outstroked it actuates Valve (D) which sends a pilot signal to Valve (C) . This caused Valve (C) to change state and instroke the DAC. If Valve (A) and Valve (B) are actuated the DAC will outstroke quickly. ① **RNA for each valid point up to a (maximum of 5)**		**5** **4** **3** **2** **1** **0**
	(b)	**Valve (C)** 5/2 / pilot / pilot ① **KU for each term any order**	**3** **2** **1** **0**	
		Device (E) Uni Directional Restrictor ① **KU**	**1** **0**	
	(c)	**(i)** Solenoid ① **KU**	**1** **0**	
		(ii)  ① **KU** **FTE from (c) (i)**	**1** **0**	
	(d)	$A = \pi r^2 = \pi \times 15^2 = 706\ mm^2$ $a = \pi r^2 = \pi \times 5^2 = 78{\cdot}5\ mm^2$ } ① **RNA for either calculation**		
		$A_{TOTAL} = 706 - 78{\cdot}5 = 627{\cdot}5\ mm^2$ ① **RNA for answers**		**4** **3**
		$F = P \times A$ $= 0{\cdot}2 \times 627{\cdot}5$ ① **RNA for substitution (FTE)** $= 125{\cdot}5\ N$ ① **RNA for answer from working**		**2** **1** **0**

					Marks	
					KU	RNA
9.	**(a)**	$\frac{V_1}{V_2} = \frac{R_1}{R_2}$	$\frac{V_1}{4\times3} = \frac{0\times5}{4\times5}$ ① **RNA for substitution**			
			$V_1 = \frac{0\times5\times4\times3}{4\times5}$			
			= 478 Ω ① **RNA for answer from given working**			**2 1 0**
	(b)	**(i)** 5 kΩ	① **RNA**			**1 0**
		(ii) $I_B = \frac{V}{R} = \frac{3\times2-0\times7}{1500}$	① **RNA for voltage calculation** ① **RNA for substitution**			**3 2**
		= 0·0017A (1·7 mA)	① **RNA for answer from given working**			**1 0**
	(c)	**(i)** **Relay**	Allows the electronic circuit to control high powered electrical circuits	① **KU**	**1 0**	
		(ii) **Base Resistor (R_b)**	Protects the transistor from high current	① **RNA**		**1 0**
		(iii) **Diode**	Protects the transistor from back EMF/voltage	① **RNA**		**1 0**
	(d)	Components will not be damaged/quicker to fix or adapt design/etc		① **RNA**	**1 0**	

			Marks	
			KU	RNA
10.	**(a)**	Free body (diagram) ① **KU**	**1** **0**	
	(b)	ΣCWM = ΣACWM		
		(1300 x 0·5) + (6000 x 1·5) + (1800 x 2) = R_2 x 3 ① **RNA for substitution**		
		650 + 9000 + 3600 = R_2 x 3		
		$R_2 = \frac{13250}{3}$ ① **RNA for transposition**		**3**
		= 4416·7 N ① **RNA for answer from given working**		**2** **1** **0**

[END OF MARKING INSTRUCTIONS]