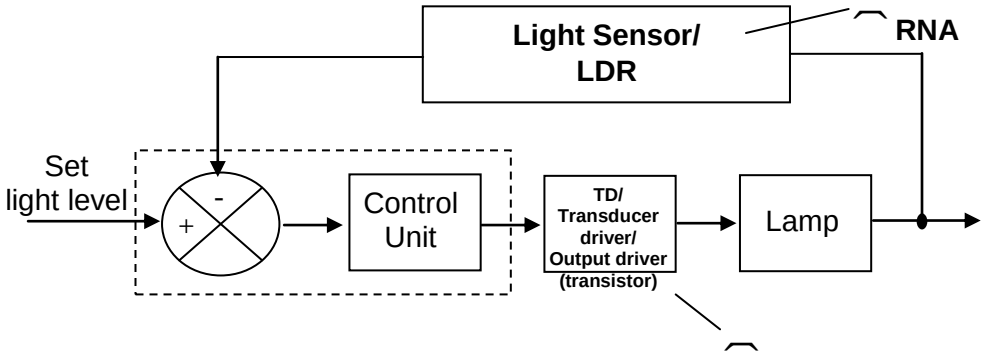
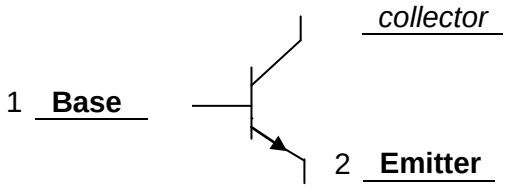
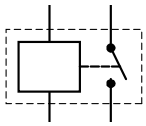
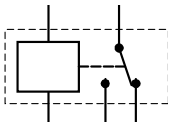
2011 Technological Studies

Standard Grade Credit

Finalised Marking Instructions

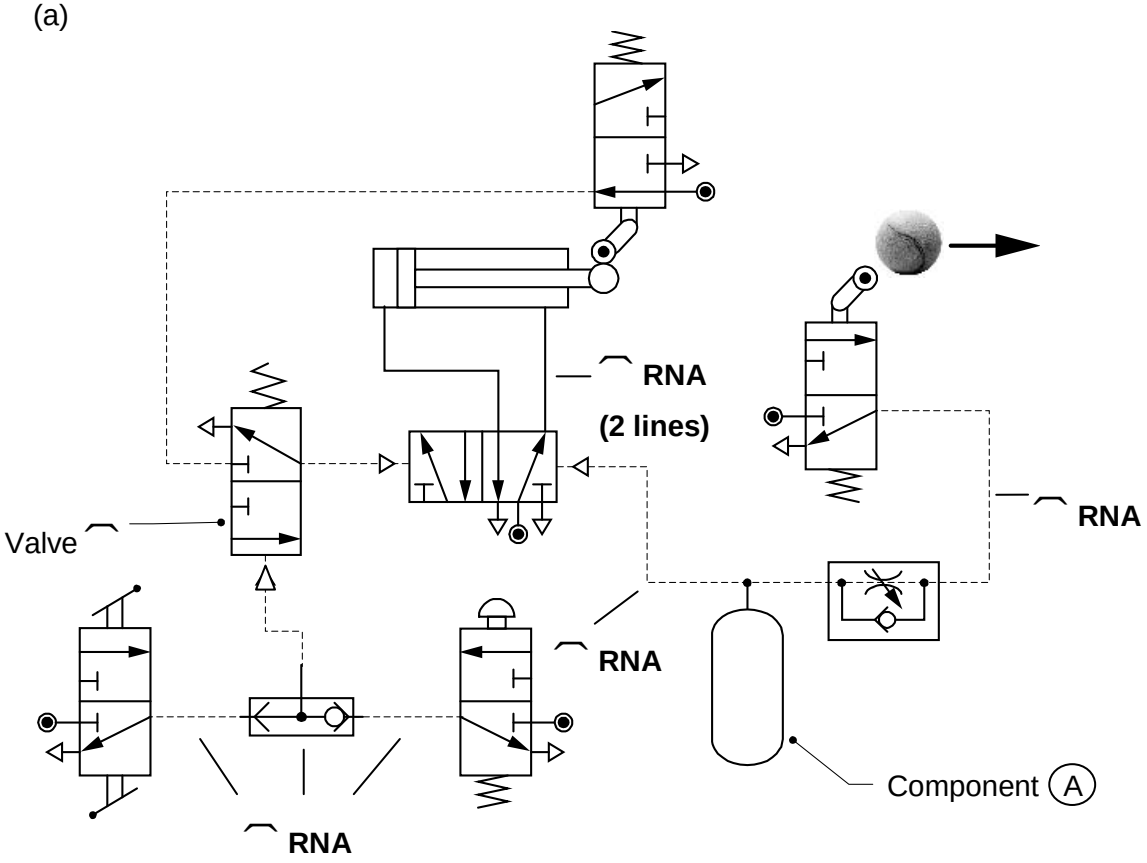
Mark Allocation

			Marks	
			KU	RNA
1.	(a)			2 1 0
	(b)	Control diagram ⌒ **KU**	1 0	
	(c)	Compares the set level to the feedback level ⌒ **KU** ⌒ **KU**	2 1 0	
2.	(a)	Light Dependent Resistor ⌒ **KU**	1 0	
	(b)	As the light level increases the LDR's resistance decreases. As the light level increases V_{out} increases. The variable resistor acts as a sensitivity control etc ⌒ **RNA for each correct descriptive statement up to 3.**		3 2 1 0
	(c)	(i) 400 Ω (-420 Ω)		1 0
		(ii) $\mathbf{V_{out}} = \frac{\mathbf{R_1}}{\mathbf{R_2}} \times \mathbf{V_{CC}}$ $= \frac{\mathbf{1500}}{\mathbf{1900}} \times \mathbf{5}$ ⌒ **RNA for substitution** **FTE** → = **3·95 V** ⌒ **RNA for answer from given working**		2 1 0

	KU	RNA
2. (continued)		
(d) Complete the circuit diagram to show how a diode could be used to protect the transistor from back-voltage (e.m.f.).	**1 0**	**2 1 0**
⌒ KU for diode symbol		
⌒ RNA for wiring		
⌒ RNA for orientation of diode		
(e) The transistor is fully switched on when V_{BE} is 0·7 V.		
(i) Saturated/saturation **⌒ KU**	**1 0**	
(ii)		
		
⌒ KU for each correct	**2 1 0**	
(⌒ KU if names reversed)		
(f) (i) It allows a low powered circuit to control a high powered circuit. There is no physical link between the circuits. Control circuits can't work with very high currents	**2 1 0**	
⌒ KU for each correct answer up to 2		
(ii)  		
SPST/ Single Pole Single Throw **⌒ KU**	**2 1 0**	
SPDT/ Single Pole Double Throw **⌒ KU**		
(iii) DPDT/Double Pole Double Throw **⌒ KU**	**1 0**	

Marks	
KU	RNA

3. (a)



all 3 shuttle pipes **KU for at least 1 correct pilot line**

			0
			4
			3
			2
			1
			0
1			
0			
(b) (i)	Component (A)	**Reservoir** **KU**	
1			
0			
			3
			2
			1
			0
(ii)	Valve (1)	**3/2/Pilot/Spring Return**	

	Marks	
	KU	RNA

3. (continued)

(c) $A_1 = \pi r^2 = \pi \times 15^2 = 706mm^2$ ⌒ RNA for correct area calculation

$A_2 = \pi r^2 = \pi \times 5^2 = 78mm^2$

$A_{TOTAL} = A_1 - A_2 = 628mm^2$ ⌒ RNA for combined area

$F = 628 \times 0{\cdot}5 = 314N$ ⌒ RNA for subs

(if only using A_1 max 2 marks) ⌒ RNA for ans from working

RNA: 4 3 2 1 0

(d) 1 **Reduce area of cylinder** ⌒ KU

Larger piston rod diameter

2 **Reduce main air pressure** ⌒ KU

KU: 2 1 0

	Marks	
	KU	RNA

4. init: symbol counter = b0

clean: **for counter = 1 to 3** *'set for ... next loop to 3* — RNA

OR **low 7** / **high 6** — **let pins = %0100000** *'cleaning head down* — RNA

pause 5000

OR **low 6** / **high 7** — **let pins = %10000000** — RNA — RNA **for both**

pause 5000

alternative position for low 7

next counter — RNA

OR **high 5** / **low 7** — **let pins = %00100000** — RNA

label: **if pin0 = 0 then label** — RNA

OR **let pins = 0** — **let pins = %00000000 or low 5** — RNA

return — RNA

If candidates do not switch off pin then max – 2 marks

9 8 7 6 5 4 3 2 1 0

		Marks	
		KU	RNA
5.	(a)		
	RNA time in seconds calculation		
	E_e = I t V		3
	= 7 × (20 × 60) × 120 **RNA for substitution**		2
	= 1008000 J **RNA for answer from given working**		1 0
	= 1 MJ		
	(b) (i) η = useful power out / total power in		
	RNA for substitution		
	= $\frac{17\times8}{23}$ = 0·774 (77·4%) **RNA for answer from given working**		2 1 0
	(ii) Energy is lost/due to friction etc or sound/heat		2
	RNA **RNA**		1 0
	(c) Reduces energy consumption		
	Reduces cost of running system etc **KU**	1 0	
	(d) (i) 1 Coal/gas/oil **KU each up to 2**	2	
	2	1 0	
	(ii) Energy source can be replenished/won't run out		
	Reduces pollution/greenhouse gas etc	2	
	Uses less resources **KU each up to 2**	1 0	

	Marks	
	KU	RNA

6. (a) $Z = \overline{(A \bullet B) + (B \bullet C)}$

RNA for ANDing inputs

RNA for OR conditions

Alt $(\overline{A} \bullet B \bullet C) + (A \bullet \overline{B} \bullet C) + (A \bullet B \bullet \overline{C})$

2

(b)

A	B	C	Z	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	**1**	**1**
1	0	0	0	
1	0	1	**0**	**3**
1	1	0	**1**	**2**
1	1	1	1	**1**

RNA each correct entry **0**

(c) Protects the LED (from large current) **1**

KU **0**

(d)

Characteristic	**TTL**	**CMOS**
Large fan out		✓
Higher power consumption	✓	
Easily damaged by static electricity		✓
Faster switching speed	✓	
Can use supply voltages from 3-18 V		✓

4
3
2
1
0

KU for each correct single entry

Marks	
KU	RNA

7. (a) Electrically Erasable Programmable Read Only Memory

1 0

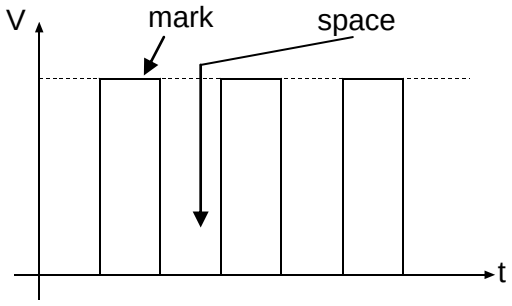
(b)

Name	Function	Characteristic
ROM	*Stores PBASIC language for microcontroller operations.*	*Data remains after power is switched off.*
RAM	Stores data required when running the program.	Data will not remain when power is removed.
EEPROM	Stores the program.	Data remains after power is switched off. Data can be re-written.

4 3 2 1 0

⌒ **KU for each correct entry**

(c) (i)



3 2 1 0

⌒ **KU for pulsed/on-off signal**

⌒ **KU for identifying/describing mark and space**

⌒ **KU for identifying/describing that speed is determined by mark/space ratio**

(ii) Maintains a high torque/smooth turning

Only required 1 output pin from microcontroller

1 0

				Marks	
				KU	RNA
8.	(a)	$\sum CWM = \sum ACWM$			
		$(1600 \times 0{\cdot}8) + (1200 \times 2) + (1000 \times 3) = F \times 4$	**RNA for substitution**		
		$F = \frac{6680}{4}$	**RNA for transposition**		**3 2 1 0**
		$= 1670$ N	**RNA for answer from given working**		
	(b)	**1** Lubrication/ball bearing/using alternative materials		**2 1 0**	
		2	**KU each up to 2**		
	(c)	(i) Speed of Drum $2000 \times 1 = 50 \times X$	cir = πd		
			= 3·14 × 0·1 m		
		$X = \frac{2000}{50}$	= 0·314 m **RNA for circumference**		
		= 40 rev/min	**RNA for drum speed**		
		Speed of Load Drum speed × Circumference			**3 2 1 0**
		= 40 × 314			
		= 12560 mm/min OR = 0·2 m/s	**RNA for answer from working**		
		(ii) **Part A** Wheel	**KU**	**2 1 0**	
		Part B Worm	**KU**		
			KU total if answers reversed		
	(d)	(i) Rack & Pinion	**KU**	**1 0**	
		(ii) Crank & Slider	**KU**	**1 0**	

[END OF MARKING INSTRUCTIONS]