2011 Technological Studies

Intermediate 2

Finalised Marking Instructions

Section A

1. (a) (i) **ALU** **'Brain' of the microcontroller, controls all other sub systems** **1 mark**

CLOCK **Synchronises all sub-systems** **1 mark**

EEPROM **Stores program** **1 mark**

(Answers must be functional/related) **3 marks**

(ii) **Bus** **1 mark**

(b) (i) **00101001** **1 mark**

(ii) **5, 3 and 0** **1 mark**

Total 6 marks

2. (a) (i) **1 mark**

$$Z = (A + B) \cdot \overline{C}$$

1 mark **1 mark** **3 marks**

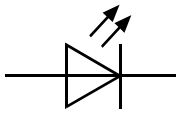
(ii)

D	E	Z
0	1	0
0	0	0
1	1	1
1	0	0
1	1	1
1	0	0
1	1	1
1	0	0

(Allow FTE for column Z)

1 mark per column **3 marks**

(b) (i)



1 mark symbol
1 mark orientation **2 marks**

(ii) **Protect LED, restrict the amount of current going to the LED**
Or
Have most of the 5V dropped across it protecting the LED **1 mark**

Total 9 marks

3. (a) **$E_p = mgh$**

= 65 x 9·81 x 80 **1 mark**

= 51, 012 J **1 mark (answer from given working)** **2 marks**

(b) (i) **E_k = 51·012 - 31·5 (Allow FTE)** **1 mark**

= 19·512 kJ **1 mark** **2 marks**

(ii) $V^2 = \frac{E_k}{\frac{1}{2}m}$ **1 mark**

$V = \sqrt{\frac{19 \cdot 512}{\frac{1}{2} \times 65}}$ **(Allow FTE)** **1 mark**

V = 24.5 m/s **1 mark (answer from given working)** **3 marks**

Total 7 marks

4. (a) **Error detector** **1 mark**

(b) (i) **Negative** **1 mark**

(ii) **To maintain the desired level/reduce error** **1 mark**

(c) **The speed is set…the error detector compares this signal with the actual speed from the speed sensor. If there is a difference/error then the control unit will switch on the output driver activating the motor increasing the speed. When the speed sensor detects the speed at the same level as the set speed the motor will switch off.**

1 mark per statement **3 marks**

Total 6 marks

5. (a) **If pin 2 = 0 then main**
pause 2000
for counter = 1 to 5
let pins = % 10100000 OR (low 6 and high 5)
next counter
let pins = 0
goto main

1 mark each correct line **7 marks**

(b) **Easy to update/change operating procedure** **1 mark**

Total 8 marks

6. (a) (i) **100 + 270 = 370 Ω** **1 mark**

(ii) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{R_T} = \frac{1}{100} + \frac{1}{370} + \frac{1}{100}$ **1 mark**

(Allow FTE)

$R_T = \frac{1}{0 \cdot 0227}$ **1 mark**

$= 44\Omega$ **1 mark (answer from given working)** **3 marks**

(iii) $I = \frac{V}{R}$

$= \frac{6}{44}$ **(Allow FTE)** **1 mark**

= 0·136A **1 mark (answer from given working)** **2 marks**

(iv) **P = IV**

= 0·136 x 6 **1 mark**

(Allow FTE)

= 0·81W **1 mark (answer from given working)** **2 marks**

(b) **X should be placed between 6V cell and first node**
Or
Last node and 6V cell **1 mark**

Total 9 marks

7. (a) **Worm** **1 mark**

(b) (i) $\text{VR} = \dfrac{\text{Input speed}}{\text{Output speed}}$

$= \dfrac{1200}{3}$ **1 mark**

$= 400 : 1$ **1 mark (answer from given working)** **2 marks**

(ii) $400 = \dfrac{80}{1} \times \dfrac{D}{50}$ **1 mark**

$\dfrac{400}{80} = \dfrac{D}{50}$

$D = 5 \times 50$ **1 mark**

$= 250\text{mm}$ **1 mark (answer from given working)** **3 marks**

(c) (i) **Belt 2** **1 mark**

(ii) **Increase in friction (not reduce slippage)** **1 mark**

Total 8 marks

8. (a) **Valve ① lever 3/2 valve spring return** **1 mark**
Valve ③ pilot 5/2 valve spring return **1 mark** **2 marks**

(b) **Valve ① is actuated sending pilot air to valve ③ actuating it. This sends main air to Cylinder Ⓐ making it outstroke actuating valve ⑤. This sends pilot air actuating valve ④, sending main air to cylinder Ⓑ making it outstroke. This releases valve ② stopping pilot air to valve ③ this causes cylinder Ⓐ to instroke releasing valve ⑤. This stops pilot air flowing to valve ④ making cylinder Ⓑ instroke.**

1 mark for each relevant statement, 5 total **5 marks**

Total 7 marks

Section B

9. (a) **When the on switch is pressed…the heating element will switch on. As the temperature rises the resistance of the thermistor decreases and the voltage V_2 will decrease. This will cause voltage V_1 to increase, increasing the voltage (V_{be}) across the transistor. When the transistor saturates the relay will activate breaking the 230V circuit and switching the heating element off.**

1 mark per each statement **4 marks**

(b) (i) **Single Pole Double throw** **1 mark**

(ii) **Heating element requires 230V to operate, not provided by the sensing circuit.** **1 mark**

(c) **Type 2** **1 mark**

(d) **Change sensitivity/allow for different switch or values.** **1 mark**

(e) (i) $V_2 = 5 - 1$

$= 4\ V$ **1 mark**

(ii) $\frac{V_1}{V_2} = \frac{R_1}{R_2}$

(Allow FTE) $\frac{1}{4} = \frac{R_1}{5}$ **1 mark**

$R_1 = 1 \cdot 25k\Omega$ **1 mark (answer from given working)** **2 marks**

(f) (i) $E_c = Itv$

$20 \times 60 = 1200 secs$ **1 mark**

$= 6 \times 1200 \times 230$ **1 mark**

$= 1656\ 000\ J$ **1 mark (answer from given working)** **3 marks**

(ii) $Eff = \frac{E_{out}}{E_{in}}$

$0 \cdot 85 = \frac{E_{out}}{1656000}$ **(Allow FTE)**

$E_{out} = 1407600\ J$ **1 mark (answer from given working)** **1 mark**

(iii) $E_h = Cm\Delta T$

$1407600 = 4190 \times 25 \times \Delta T$ **(Allow FTE)** **1 mark**

$\Delta T = \frac{1407600}{4190 \times 25}$

$= 13 \cdot 4^\circ C$ **1 mark (answer from given working)** **2 marks**

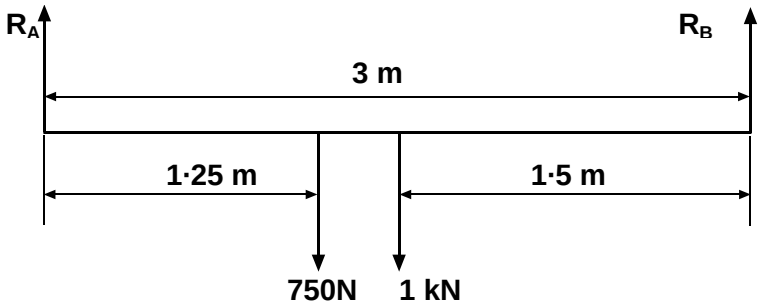
(iv) $25 - 13 \cdot 4 = 11 \cdot 6^\circ C$ **(Allow FTE)** **1 mark**

(g) **Any two relevant answers**

Description of – Finite Resources
– Less Pollution
– Save on Fuel Bills etc **1 mark each** **2 marks**

Total 20 marks

10. (a)



1 mark – forces
1 mark – length **2 marks**

(b) (i) $\Sigma CWM = \Sigma ACWM$

$(R_A \times 3) = (1000 \times 1{\cdot}5) + (750 \times 1{\cdot}75)$ **1 mark**

$R_A \times 3 = 1500 + 1312{\cdot}5$ **1 mark**

$R_A = \dfrac{2812{\cdot}5}{3}$

$R_A = 937{\cdot}5N$ **1 mark (answer from given working)** **3 marks**

(ii) $\Sigma F_{vertical} = 0$

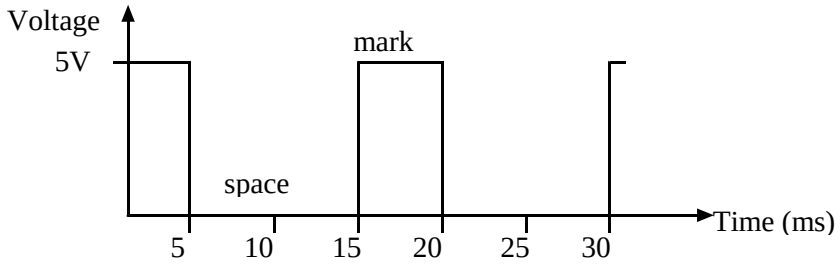
$= 937{\cdot}5 + R_B - 750 - 1000$ **(Allow FTE)** **1 mark**

$R_B = 812{\cdot}5N$ **1 mark (answer from given working)** **2 marks**

(c)
```
symbol space = b1
if pin 1 = 0 then main
if pin 0 = 0 then main
gosub down
end
high 7
pause mark
return
```

1 mark each line **8 marks**

(d) (i)



1 mark for digital signal
1 mark for correct time **2 marks**

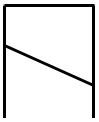
(ii) **As diagram above** **1 mark**

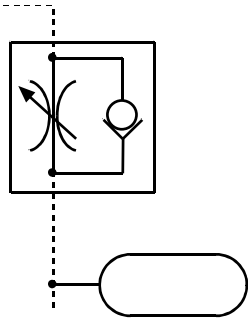
(e) (i) **Random Access Memory** **1 mark**

(ii) **Information can be lost when power is removed** **1 mark**

Total 20 marks

11. (a) (i) **Solenoid** **1 mark**

(ii)  **1 mark**

(b) (i) 

1 mark **symbol**
1 mark **position**
1 mark **orientation** **3 marks**

(ii) **Reservoir** **1 mark**

(c) $\mathbf{A = \pi r^2}$ $\mathbf{F = PA}$

$\mathbf{= 3 \cdot 14 \times 5^2}$ $\mathbf{= 0 \cdot 25 \times 78 \cdot 5}$ **1 mark**

$\mathbf{= 78 \cdot 5 mm^2}$ **1 mark** $\mathbf{= 19 \cdot 625 N}$ **1 mark (answer from given working)** **3 marks**

(d) **Effective area is smaller on instroke due to piston rod /and larger on outstroke (SAC spring stiffness less than/force due to air pressure)**

1 mark each statement **2 marks**

(e) **Clean, efficient, less likely to break** **1 mark**

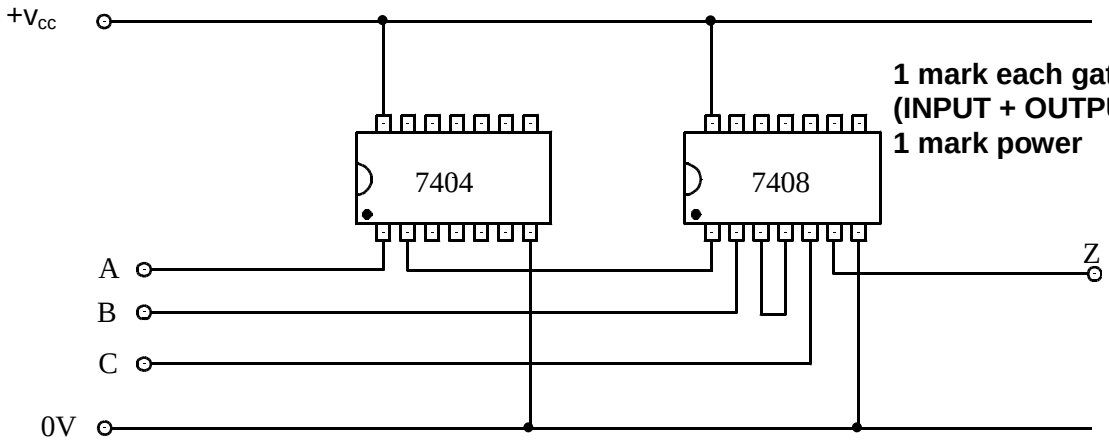
(f) (i) **7404 — Hex Invertor** **1 mark**

7408 — Quad 2input AND gate **1 mark** **2 marks**

(ii) **TTL** **1 mark**

(iii) **5V** **1 mark**

(g)



1 mark each gate
(INPUT + OUTPUT)
1 mark power

4 marks

Total 20 marks

[END OF MARKING INSTRUCTIONS]