2012 Technological Studies

Intermediate 2

Finalised Marking Instructions

Section A

1. (a) (i)

boundary around sub-systems but not external in/outputs

1 mark

(ii) To separate the outside world from Input, process and outputs. **1 mark**

(b) Light level is set,/ this is compared with actual light level./ If light level is too bright motor switches on closing the blind./ A blind sensor detects the position of the blind./ When it is closed it will stop./

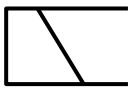
(**1 mark** for each relevant statement) **3 marks**

(c) (i) Closed loop has feedback while open loop does not **1 mark**

(ii) (blind) Motor **1 mark**

Total 7 marks

2. (a) (i)

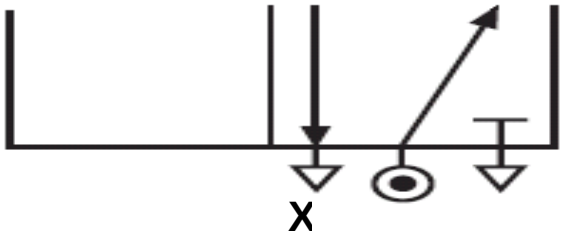


1 mark

1 mark
(sketched in correct position on valve but any order)

2 marks

(ii)



1 mark

(b) (i)

$A_{effective} = A_{piston} - A_{rod}$

$= 706{\cdot}5 - 28{\cdot}26$

$= \underline{678{\cdot}24 mm^2}$

1 mark answer from working

$A_{piston} = \frac{\pi d^2}{4}$

$= \frac{3{\cdot}14 \times 30^2}{4}$

$= \underline{706{\cdot}5 mm^2}$ **1 mark**

$A_{rod} = \frac{\pi d^2}{4}$

$= \frac{3{\cdot}14 \times 6^2}{4}$

$= \underline{28{\cdot}26 mm^2}$ **1 mark**

(if R or Ø values used in incorrect formula – 1 mark)

3 marks

(ii) $F = PA$

$= 0{\cdot}6 \times 678{\cdot}24$

$= 406{\cdot}94 N$

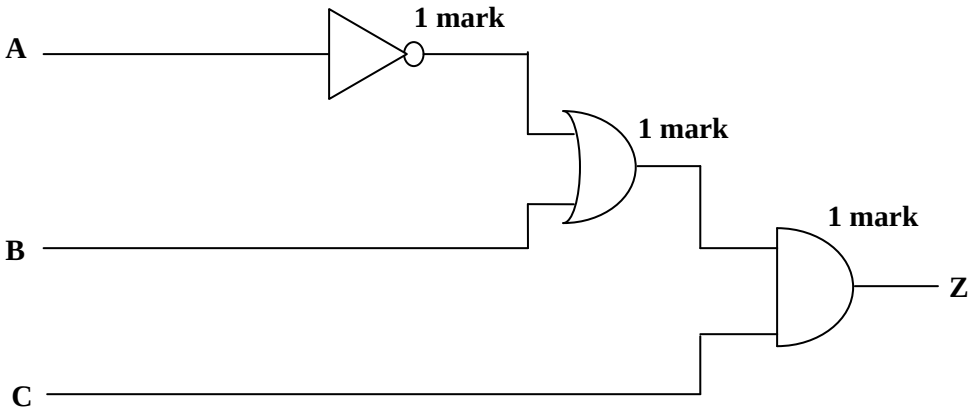
1 mark (allow FTE)

1 mark (answer from working)

2 marks

Total 8 marks

3. (a)



3 marks

(b) 7400 – (Quad 2 input NAND) **1 mark**

7402 – (Quad 2 input NOR) **1 mark** **2 marks**

(c) (i) Transistor Transistor Logic **1 mark**

(ii) 5v (±0·25v) **1 mark**

(iii) faster; not affected by static, etc **1 mark**

Total 8 marks

4. (a) 20 LUX **1 mark**

(b) (i) 5 - 4.5 = 0.5v **1 mark**

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

$\frac{0{\cdot}5}{4{\cdot}5} = \frac{5}{R_2}$ **1 mark** (allow FTE)

$R_2 = 45k\Omega$ **1 mark** (answer from working) **2 marks**

(iii) off, Transistor is not saturated **2 marks**
(1 mark) **(1 mark** – allow FTE)

(c) *As the light level increases…*

the resistance will decrease / and voltage (V_1) will decrease. **2 marks**
(1 mark) **(1 mark** – FTE allow)

Total 8 marks

5.

(a) $Ek = \frac{1}{2}mv^2$

$= \frac{1}{2} \times 80 \times 9^2$ **1 mark**

$= 3240J$ **1 mark** **2 marks**

(b) $Ek = Ep$

$Ep = 3240J$ **1 mark** (stated or inferred - allow FTE)

$Ep = mgh$

$h = \frac{Ep}{mg}$

$= \frac{3240}{80 \times 9{\cdot}81}$ **1 mark**

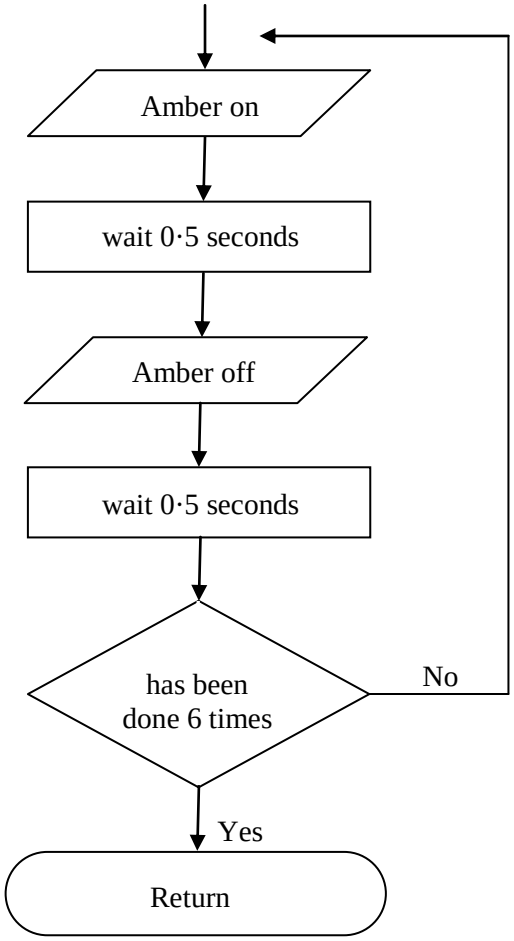
$= 4{\cdot}13m$ **1 mark** (answer from working)

Vaulter will clear the bar. **1 mark** (allow FTE) **4 marks**

(c) Energy lost due to friction or air resistance resulting **(1 mark)** in heat and sound energy **(1 mark)**. **2 marks**

Total 8 marks

6. (a)



Amber on/off	**1 mark**	
both waits	**1 mark**	
decision inc feedback	**1 mark**	
return	**1 mark**	
correct symbols (all)	**1 mark**	**5 marks**

(b) (let dirs) = %11100000 or 224 **2 marks**
(1 mark) **(1 mark)**

Total 7 marks

7. (a) (i) $R_T = \frac{R_1 \times R_2}{R_1 = R_2}$

$= \frac{5{\cdot}6 \times 6{\cdot}8}{5{\cdot}6 + 6{\cdot}8}$ **1 mark**

$= \frac{38{\cdot}08}{12{\cdot}4}$

$= 3{\cdot}07\text{k}\Omega$ **1 mark** (answer from working) **2 marks**

(ii) $10 + 3{\cdot}07 + 2{\cdot}2 = 15{\cdot}27\text{k}\Omega$ **1 mark** (allow FTE) **1 mark**

(b) (i) $V = 1R$

$= 10\text{mA} \times 5600$

$= 56\text{V}$ **1 mark**

$A_2 = I = \frac{V}{R}$

$= \frac{56}{6800}$ **1 mark** (allow FTE)

$= 0.00824A$ **1 mark** (answer from working)

or

8mA

3 marks

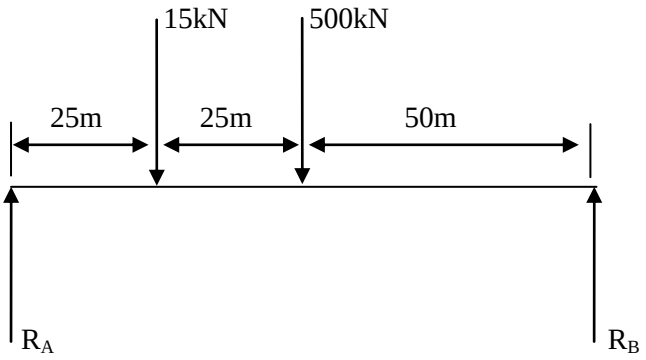
(ii) $A_3 = A_1 + A_2$

$= 10 + 8$

$= 18\text{mA}$ **1 mark** (allow FTE) **1 mark**

Total 7 marks

8. (a)



1 mark – all forces (value & direction)

1 mark – all distances

2 marks

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

$(R_A \times 100) = (15 \times 75) + (500 \times 50)$ **1 mark**

$R_A = \dfrac{1125 + 25000}{100}$ **1 mark**

$= 261 \cdot 25kN$ **1 mark** (answer from working) **3 marks**

(ii) $\sum F_{up} = \sum F_{down}$

$261 \cdot 25 + R_B = 15 + 500$ **1 mark** (allow FTE)

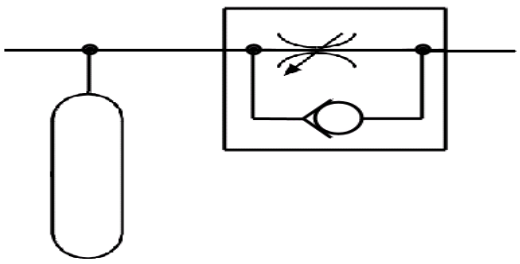
$R_B = 253 \cdot 75kN$ **1 mark** (answer from working) **2 marks**

Total 7 marks

Section B

9. (a) Diaphragm 3/2 valve spring return **1 mark**

(b)



1 mark each symbol (2 marks)

1 mark correct orientation and position **3 marks**

(c) *Valve ① is actuated* sending air to valve ⑦ via shuttle valve ②/ When valve ⑦ is actuated cylinder Ⓐ, piston will instroke opening the door. /The door will close /after a short time delay /or when valve ⑤ is pressed sending air via the shuttle valve ④/actuating valve ⑦ making cylinder Ⓐ outstroke.

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

(d)

$$A = \frac{F}{P}$$

$$= \frac{40}{0 \cdot 2}$$ **1 mark**

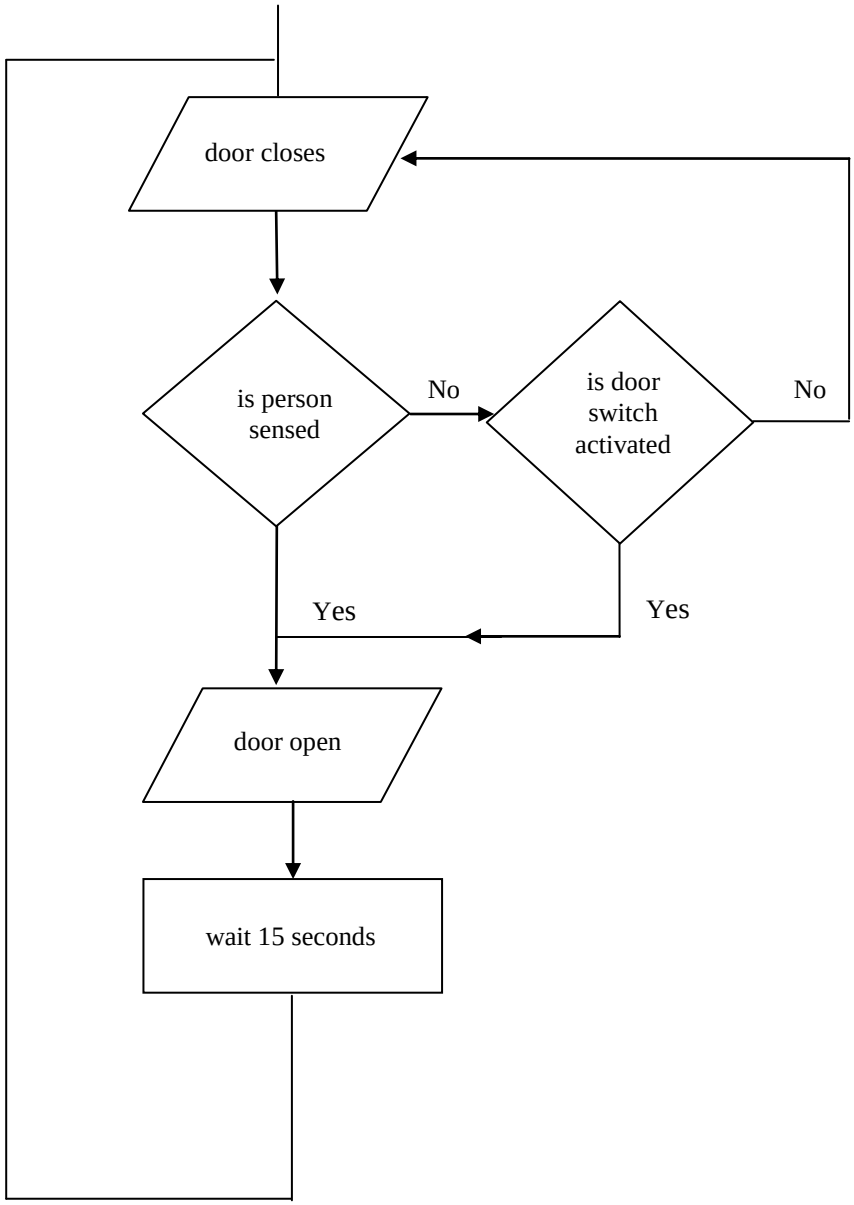
$$= 200 mm^2$$ **1 mark**

$$d = \sqrt{\frac{4A}{\pi}}$$

$$= \sqrt{\frac{4 \times 200}{3 \cdot 14}}$$

$$= 15 \cdot 96 mm$$ **1 mark** (answer from working) **3 marks**

(e)



1 mark person sensed inc feedback

1 mark door switch check inc feedback

1 mark door open

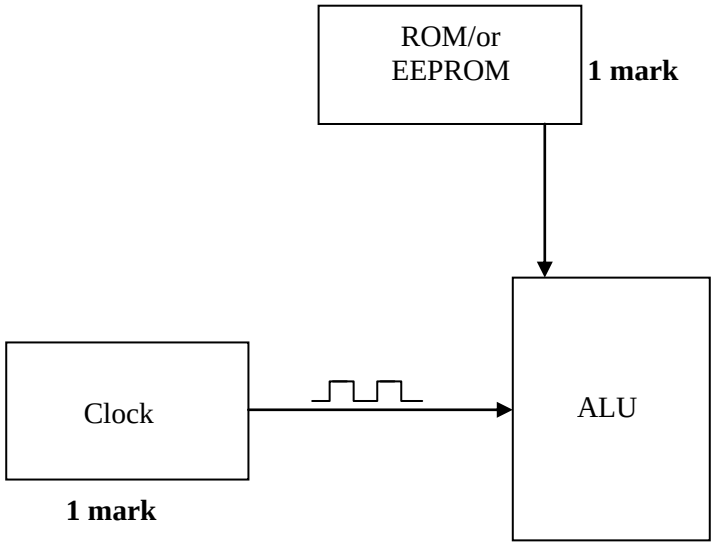
1 mark wait

1 mark loop to start

1 mark correct symbols (all)

6 marks

(f)



1 mark

1 mark

2 marks

Total 20 marks

10. (a) $10^{o}C$ **1 mark**

(b) (i) Variable resistor **1 mark**

(ii) Alters the 'switch on' condition **1 mark**

(c) $V_1 = \frac{75}{77} \times 6$ **1 mark**

$= 5{\cdot}84V$ **1 mark** (answer from working) **2 marks**

(d) $V_2 = 1{\cdot}6 - 0{\cdot}7$ Saturation (0·7V) **1 mark**

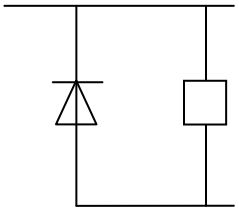
$= 0.9V$ **1 mark** (answer from working) **2 marks**

(e) $h_{FE} = \frac{I_c}{I_b}$

$I_b = \frac{I_c}{h_{FE}}$

$= \frac{0 \cdot 2}{100}$ **1 mark**

$= 0{\cdot}002A$ **1 mark** (answer from working **2 marks**

(f) 

1 mark correct symbol

1 mark correct orientation and position

2 marks

(g) (i) $E_e = Itv$ $t = 30 \times 60$

$= 10 \times 1800 \times 12$ **1 mark** $= 1800$ seconds **1 mark**

$= 216000$ J **1 mark** (answer from working) **3 marks**

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

$= \frac{190000}{216000}$ – (FTE) **1 mark**

$= 0{\cdot}879$

$= 88\%$ **1 mark** (answer from working) **2 marks**

(h) Better insulating material on case/door seal **1 mark**
Ensure door is always shut **1 mark** **2 marks**

(i) (i) Solar, wave, tidal, wind, hydro etc **1 mark**

(ii) Any relevant answer
- lack of sunlight
- no wind etc. **1 mark**

Total 20 marks

11. (a)

```
main:     for counter = 1 to 210          1 mark
          if pin 2 = 1 then freshen       1 mark
          pause 10000                     1 mark
          next counter                    1 mark
freshen:  high 7                          1 mark
          pause 200                       1 mark
          low 7                           1 mark
          goto main                       1 mark
```

8 marks

(b) 2100 seconds
or
35 minutes

1 mark

(c) (i) RAM

1 mark

(ii) Volatile, information lost when no power.

1 mark

(d) $A = (\overline{T} + P) \bullet S$

$\overline{T}$ **1 mark**
$+$ **1 mark**
$\bullet$ **1 mark**

3 marks

(e)

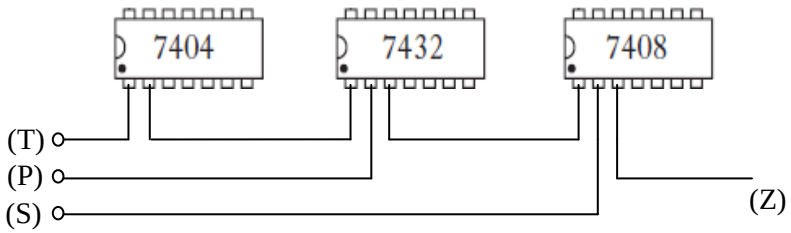
X	Y	Z
1	1	0
0	0	0
1	1	0
0	1	0
1	1	1
0	0	0
1	1	1
0	1	1

1 mark per column

3 marks

$Y = X + P$ allow FTE $Z = Y \bullet S$ allow FTE

(f)



1 mark for each correct gate connection

3 marks

Total 20 marks

[END OF MARKING INSTRUCTIONS]