



# **2010 Technological Studies**

## **Intermediate 2**

### **Finalised Marking Instructions**

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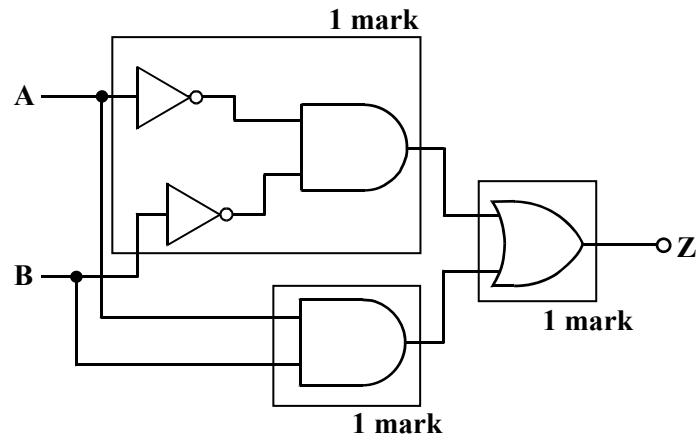
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## Section A

1. (a) (i)  $Z = (\bar{A}.\bar{B}) + (A.B)$   
 1 mark 1 mark (including oring function)

2 marks

(ii)



3 marks

- (b) (i) Affected by static electricity or any other relevant answer

1 mark

(ii) Integrated circuit

1 mark

Total 7 marks

2. (a) (i) Diaphragm 3/2 valve spring return

1 mark

(ii)

Port	Connection	
1	Main air	1 mark
2	Output port	
3	Exhaust	1 mark

2 marks

2. (continued)

(b)	(i)	Area	=	$\frac{\pi d^2}{4}$	$\frac{3 \cdot 14 \times 25^2}{4}$		
			=	490.6 mm <sup>2</sup>		1 mark	
		Area	=	$\frac{\pi d^2}{4}$	$\frac{3 \cdot 14 \times 5^2}{4}$		
			=	19.6 mm <sup>2</sup>		1 mark	
		Area <sub>eff</sub>	=	490.6 - 19.6			
			=	471 mm <sup>2</sup>	1 mark (answer from given working)		3 marks
	(ii)	F	=	PA			
			=	0.6 × 471	1 mark (allow FTE)		
			=	282.6 N	1 mark (answer from given working)		2 marks

Total 8 marks

3.	(a)	Ep	=	mgh			
			=	75 × 9.81 × 10	1 mark		
			=	7357.5 J	1 mark (answer from given working)		2 marks

(b)	(i)	h	=	$\frac{E_p}{mg}$			
			=	$\frac{7700}{75 \times 9.81}$	1 mark		
			=	10.47m	1 mark (answer from given working)		2 marks

(ii)	Force in legs/	$\left\{ \begin{array}{c} \text{strain energy} \\ \text{or} \\ \text{kinetic energy} \end{array} \right\}$	1 mark		
	1 mark				2 marks

(c)	(i)	0 J	1 mark		
	(ii)	7.7 kJ	1 mark		2 marks

Total 8 marks

4. (a) .....darkness is sensed. This sends a signal to the control unit which will activate the output driver switching on the fan and heater. When the hands are removed the fan and heater will switch off.
- 1 mark for each relevant statement 3 marks
- (b) System boundary on correct place  
(enclosing subsystem but not in/outputs )  
showing as a broken line 1 mark
- (c) (i) Open loop 1 mark
- (ii) No feedback etc 1 mark 2 marks
- (d) 1 LDR 1 mark
- 2 (variable) resistor/pot 1 mark 2 marks
- (e) Transistor/MOSFET 1 mark
- Total 9 marks**

5.	(a)	(i)	$R_T$	=	$\frac{R_1 \times R_2}{R_1 + R_2}$		
				=	$\frac{6.8 \times 3.4}{6.8 + 3.4}$	1 mark	
				=	$\frac{23.12}{10.2}$		
				=	2.27 kΩ	1 mark (answer from given working)	2 marks
		(ii)	$R$	=	2.27 + 5.6		
				=	7.87 kΩ	1 mark (allow for FTE)	1 mark
	(b)	(i)	$A_2$	1.5mA	1 mark		
			$A_3$	2.25mA	1 mark (allow for FTE)	2 marks	
		(ii)	$V$	=	IR		
				=	2.25mA × 7.87 kΩ	1 mark	
				=	17.7 V	1 mark (answer from given working)	2 marks
							Total 7 marks

6.	let dirs = %11110000	1 mark
	high 6 or let pins = %11000000	1 mark
	let pins = %10100000	1 mark
	let pins = 0	1 mark
	for counter = 1 to 10	1 mark
	next counter	1 mark
	goto main	1 mark

Total 7 marks

7. (a) **25°C** **1 mark**
- (b) (i)  $V_{sig} = \frac{R}{R_T} \times V_{CC}$
- $V_b = \frac{1}{6} \times 5$  **1 mark**
- $= 0.83 \text{ V}$  **1 mark (answer from given working)** **2 marks**
- (ii) **On** **1 mark (allow FTE)**
- Transistor in saturation/above 0.7 V** **1 mark** **2 marks**
- (c)  $h_{FE} = \frac{I_c}{I_b}$   $I_c = h_{FE} \times I_b$
- $= 100 \times 50 \mu\text{A}$  **1 mark**
- $= 5 \text{ mA}$  **1 mark (answer from given working)** **2 marks**
- (d) **Emitter** **1 mark**

**Total 7 marks**

8. (a) **Compound gear** **1 mark**
- (b) (i)  $VR = \frac{V_{in}}{V_{out}} = \frac{2250 \text{ rev/min}}{150 \text{ rev/min}} = 15:1$  **1 mark**
- (ii)  $G_R = \frac{G_{OUT}}{G_{IN}} = \frac{60}{12} = 5:1$  **1 mark**
- (iii)  $G_{RCD} = \frac{15}{5} = 3$  **1 mark (allow FTE)**
- $D = 45 \times 3$
- $D = 135 \text{ teeth}$  **1 mark** **2 marks**
- (c)
  - **less friction**
  - **quieter**
  - **less lubrication required etc**
  - **lighter****1 mark**

**Total 6 marks**

## Section B

9. (a) if pin 2 = 0 then main 1 mark  
 low 4 1 mark  
 if pin 2 = 1 then label 1 1 mark  
 pause 100 1 mark  
 next counter 1 mark  
 gosub motorback 1 mark  
 goto main 1 mark  
 return 1 mark

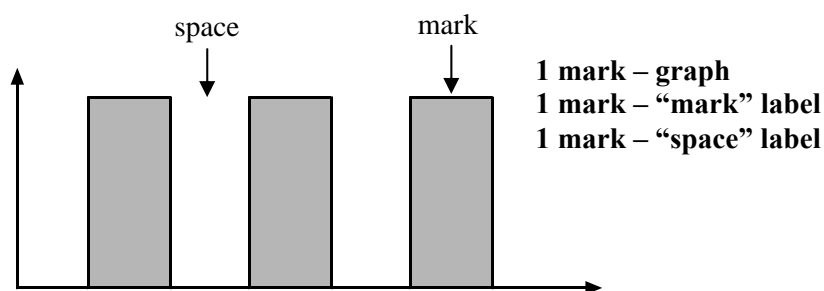
1 mark per correct PBASIC line

8 marks

- (b)  $250 \times 0.1 = 25$  seconds (accept 29 seconds)

1 mark

- (c) (i)

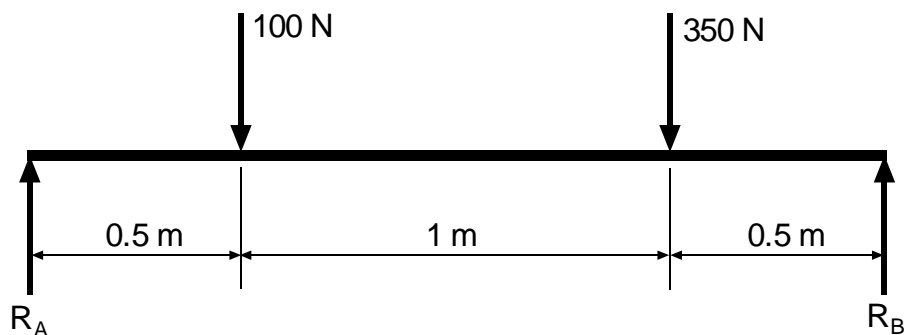


3 marks

- (ii) No change in output torque

1 mark

- (d)



1 mark All forces

1 mark All sizes

2 marks

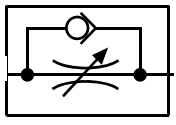
- (e) (i)  $\Sigma \text{CWM} = \Sigma \text{ACWM}$   
 $(R_A \times 2) = (100 \times 1.5) + (350 \times 0.5)$  1 mark  
 $R_A \times 2 = 150 + 175$   
 $R_A = \frac{325}{2}$  1 mark  
 $= 162.5 \text{ N}$  1 mark (answer from given working)


3 marks

- (ii)  $\Sigma F_V = 0$   
 $= 162.5 + R_B - 100 - 350$  1 mark (allow FTE)  
 $R_B = 287.5 \text{ N}$  1 mark

2 marks

Total 20 marks

10. (a) (i)  $h_{FE} = \frac{I_c}{I_b}$
- $I_b = \frac{I_c}{h_{FE}}$
- $= \frac{0.2}{150}$  1 mark
- $= 0.0013 \text{ A}$  1 mark (answer from given working) 2 marks
- (ii)  $V = IR$
- $= 0.0013 \times 220$  1 mark (allow FTE)
- $= 0.29 \text{ V}$  1 mark (answer from given working) 2 marks
- (iii)  $V_1 = 0.29 + 0.7$  1 mark (allow FTE)
- $= 0.99 \text{ V}$  1 mark (answer from given working) 2 marks
- (b) **600  $\Omega$**  1 mark
- (c) **Change fixed resistor for variable.** 1 mark
- (d) (i) **Diode** 1 mark
- (ii) **Protect Transistor (from back EMF)** 1 mark
- (e) (i) **Single Pole Double Throw** 1 mark
- (ii) **Low voltage electronic circuit cannot directly switch on solenoid rated 12V etc** 1 mark
- (f) ① **Solenoid, 3/2 valve, spring return** 1 mark
- ② **Pilot 5/2 valve spring return** 1 mark
- (g)
- 

1 mark
- 

1 mark
- 2 marks



**10. (continued)**

(h)  $A = \frac{F}{P} = \frac{150}{0.5}$

$= 300 \text{ mm}^2$  **1 mark**

$d = \sqrt{\frac{300 \times 4}{3 \cdot 14}}$  **1 mark**

$d = 19.5 \text{ mm}$  **1 mark (answer from given working)**

**3 marks**

(i) **Increased force**

**1 mark**

**Total 20 marks**

**11. (a) (i)  $20 \times 60 = 1200 \text{ secs}$  **1 mark****

$E_c = I t v$   
 $= 5 \times 1200 \times 230$  **1 mark**

$= 1380000 \text{ J}$  **1 mark (answer from given working)** **3 marks**

(ii)  $E_h = E_e = 1380000 \text{ J}$  **1 mark (allow FTE)**

$\Delta T = \frac{E_h}{cm}$

$= \frac{1380000}{4190 \times 5}$  **1 mark**

$65.9^\circ\text{C}$  **1 mark**

**Start temperature**  $= 100 - 65.9$  **1 mark**  
 $= 34.1^\circ\text{C}$

**4 marks**

(b) (i) **Heat loss through casing etc**

**1 mark**

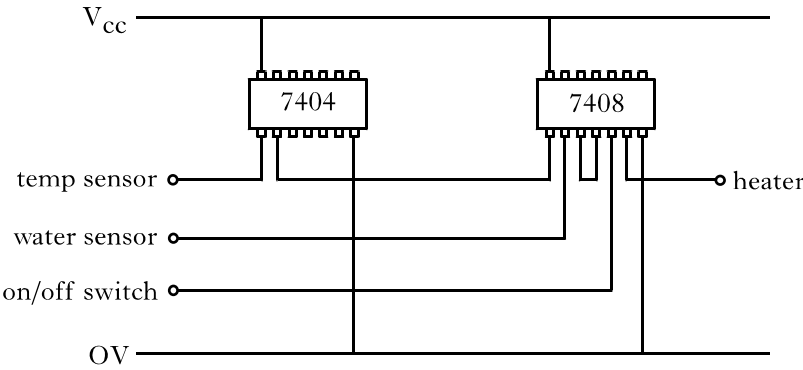
(ii) **Insulation etc (description)**

**1 mark**

(c)	P	Q	heater
	1	0	0
	1	0	0
	1	1	0
	1	1	1
	0	0	0
	0	0	0
	0	0	0
	0	0	0
<b>1 mark</b>	<b>1 mark</b>	<b>1 mark</b>	
	(Allow FTE)	(Allow FTE)	

**3 marks**

10. (continued)  
(d)



1 mark for each gate connected (3 marks)  
1 mark for power

4 marks

- |     |       |   |        |         |
|-----|-------|---|--------|---------|
| (e) | (i)   | Hex Inverter                                      | 1 mark | 2 marks |
|     |       | Quad 2 input AND gate                             | 1 mark |         |
|     | (ii)  | TTL/Transistor/transistor logic                   |        | 1 mark  |
|     | (iii) | Not destroyed by static etc (allow FTE from (ii)) |        | 1 mark  |

Total 20 marks

[END OF MARKING INSTRUCTIONS]