



# **2015 Electronic and Electrical Fundamentals**

## **Intermediate 2**

### **Finalised Marking Instructions**

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## **Part One: General Marking Principles for: Electronic and Electrical Fundamentals Intermediate 2**

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

- (a)** Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader/Principal Assessor.
- (b)** Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

### **GENERAL MARKING ADVICE: Electronic and Electrical Fundamentals Intermediate 2**

The marking schemes are written to assist in determining the “minimal acceptable answer” rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates’ evidence, and apply to marking both end of unit assessments and course assessments.

## Part Two: Marking Instructions for each Question

### Section A

Question		Expected Answer(s)	Max Mark	Additional Guidance
1.	(a)	$145_{10}$	2	
1.	(b)	$BA_{16}$	2	
1.	(c)	$10101110_2$	2 (6)	
2.	(a)	1 = base, 2 = collector, 3 = emitter	3	
2.	(b)	1 = gate, 2 = drain, 3 = source	3 (6)	
3.	(a)	Half-wave rectifier	2	
3.	(b)	Full-wave rectifier	2 (4)	
4.	(a)	Common Source Amplifier or FET Amplifier.	1	
4.	(b)	Gain = $V_{OUT}/V_{IN} = 12/0.4 = 30$	2 (3)	
5.	(a)	Upwards	1	
5.	(b)	$I = F/Bl = 1.6/(0.2 \times 0.4) = 2A$	2 (3)	
6.	(a)	180° phase shift	1	
6.	(b)	$V_{OUT} = V_{IN} \times R_f/R_i = 0.4 \times 5 = 2V$	2	
6.	(c)	Required gain = 10 hence max $R_i$ will be when $R_v = 50k\Omega$ hence $R_i = 5k\Omega$	3 (6)	

Question		Expected Answer(s)	Max Mark	Additional Guidance																																																																						
7.	(a)	$Z = (A + \bar{B} + C) \cdot (\overline{\bar{A} + B + C})$	2																																																																							
7.	(b)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th></th> <th></th> <th>1</th> <th></th> <th>2</th> <th>1·2</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> <th><math>A + \bar{B} + C</math></th> <th><math>\bar{A} + B + C</math></th> <th><math>\overline{\bar{A} + B + C}</math></th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table>				1		2	1·2	A	B	C	$A + \bar{B} + C$	$\bar{A} + B + C$	$\overline{\bar{A} + B + C}$	Z	0	0	0	1	1	0	0	0	0	1	1	1	0	0	0	1	0	0	1	0	0	0	1	1	1	1	0	0	1	0	0	1	0	1	1	1	0	1	1	1	0	0	1	1	0	1	1	0	0	1	1	1	1	1	0	0	4	
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7.	(c)	$Z = A \cdot \bar{B} \cdot \bar{C}$	2 (8)																																																																							
8.	(a)	$R_t = 2 + 12//4 = 5\Omega$	2																																																																							
8.	(b)	$I_s = 10/5 = 2A$	1																																																																							
8.	(c)	$V_{12\Omega} = 2 \times 3 = 6V$ $I_{12\Omega} = 6/12 = 0.5A$	3																																																																							
8.	(d)	$P = VI = 10 \times 2 = 20W$	1																																																																							
8.	(e)	$E = Pt = 20 \times 10 \times 60 = 12kJ$	1 (8)																																																																							

Question		Expected Answer(s)	Max Mark	Additional Guidance																																				
9.	(a)	<p>Opening conditions</p> <p>Opening time      A = 1 Keypad              B = 1 Swipe Card        C = 0</p> <p><math>F = A.\bar{B}.\bar{C} + A.B.C</math></p>	2																																					
9.	(b)	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>Z</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table>	A	B	C	Z	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	1	1	0	1	0	1	1	0	0	1	1	1	1	2	
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Section B

Question			Expected Answer(s)	Max Mark	Additional Guidance
10.	(a)	(i)	0111 <sub>2</sub>	2	
10.	(a)	(ii)	1000 <sub>2</sub>	2	
10.	(b)		$Z = \overline{A \cdot B \cdot C}$	3	
10.	(c)		one possible solution	6	

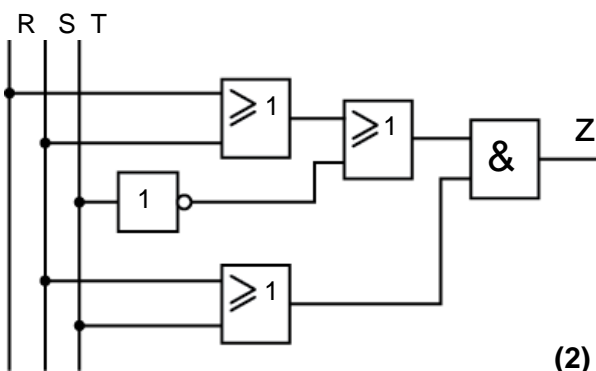
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Question	Expected Answer(s)	Max Mark	Additional Guidance																																																																																										
<p>10. (d)</p>	 <p>(2)</p> <p>Three input solutions is also acceptable.</p> <table border="1" data-bbox="335 739 909 1142"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th><math>R+S+\bar{T}</math></th> <th><math>S+T</math></th> <th>Z</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table> <p>(4)</p>	A	B	C	$R+S+\bar{T}$	$S+T$	Z	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	0	0	1	0	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	6																																					
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<p>10. (e)</p>	<table border="1" data-bbox="311 1310 997 1691"> <thead> <tr> <th></th> <th></th> <th></th> <th>TP1</th> <th>TP2</th> <th>1+2</th> <th>TP1</th> <th>TP2</th> <th></th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> <th>(A.B).(A.C)</th> <th>B.C</th> <th></th> <th>0</th> <th>0</th> <th>FAULT</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td></tr> </tbody> </table> <p>Marks awarded for construction/derivation of truth table and identifying the location of the faulty output (4)</p> <p>Fault occurs when input A, B and C are on and the output of gate 4 is low. As this does not happen when B and C are on there is no problem at TP2 then the output of gate 1+2 or the input to gate 4 may be held low (2)</p>				TP1	TP2	1+2	TP1	TP2		A	B	C	(A.B).(A.C)	B.C		0	0	FAULT	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	1	1	0	1	0	1	0	0	0	1	1	1	1	1	1	0	1	0	6	
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Question			Expected Answer(s)	Max Mark	Additional Guidance
11.	(a)	(i)	40V	1	
11.	(a)	(ii)	$40 \times 0.707 = \mathbf{28.28V}$	2	
11.	(a)	(iii)	1.2ms	1	
11.	(b)	(i)	$E = B \times l \times v = 2.25 \times 10^{-3} \times 2.5 \times 10 = \mathbf{6.25mV}$	2	
11.	(b)	(ii)	$F = B \times l \times I$ hence $I = F / (B \times l)$ $I = 0.4 / (1.2 \times 10^{-3} \times 2.5) = \mathbf{133.33A}$	3	
11.	(c)	(i)	$V_S = V_{R1} + V_{R4} + V_{R5} + V_{R7}$ $V_{R1} = I_5 \times (R_1 // R_2) = 3 \times (20 \times 20) / 20 + 20 = 3 \times 10 = \mathbf{30V}$ $V_{R4} = V_{R3} \times R_4 / R_3 = (I_5 - I_4) \times 2 = (3 - 1) \times 2 = \mathbf{4V}$ $V_{R5} = I_5 \times R_5 = 3 \times 10 = \mathbf{30V}$ $V_{R7} = I_7 \times R_7 = 3 \times 15 = \mathbf{45V}$ $V_S = 30 + 4 + 30 + 45 = \mathbf{109V}$	5	
11.	(c)	(ii)	$I_T = I_{R6} + I_{R5} = 5 + 3 = 8A$ $R_T = V_S / I_T = 109 / 8 = \mathbf{13.625\Omega}$	2	
11.	(c)	(iii)	$R_4 = V_{R3} / I_{R4} = 4 / 1 = \mathbf{4\Omega}$ or by current division	1	
11.	(c)	(iv)	$V_{R6} = V_S = \mathbf{109V}$	1	
11.	(c)	(v)	$R_6 = V_{R6} / I_{R6} = 109 / 5 = \mathbf{21.8\Omega}$	2	
11.	(d)	(i)	$I_{R2} = I_S - I_{R3} = 8 - 2 = 6A$ $P = I^2 \times R = 6 \times 6 \times 10 = \mathbf{360W}$	2	
11.	(d)	(ii)	$P_T = V_S \times I_S = 180 \times 8 = \mathbf{1440W}$	1	
11.	(d)	(iii)	$E = P \times T = 1440 \times 24 \times 60 \times 60$ $= \mathbf{124416000J} = \mathbf{124.416MJ}$	2	
				<b>(25)</b>	



Question			Expected Answer(s)	Max Mark	Additional Guidance
12.	(a)		Common Emitter Amplifier (1) <b>C<sub>1</sub></b> :- Coupling Capacitor (1) <b>C<sub>2</sub></b> :- Coupling Capacitor (1) <b>C<sub>3</sub></b> :- Decoupling Capacitor or Bypass Capacitor (1)	4	
12.	(b)	(i)	By Kirchoffs $V_{R3} = V_S - V_{out} = 12 - 6 = 6V$ $I_{R3} = V_{R3}/R_3 = 6/1500 = \underline{4mA}$	2	
12.	(b)	(ii)	$G = 400 = I_c/I_b$ hence $I_b = I_c/G = 4mA/400 = \underline{10\mu A}$	2	
12.	(b)	(iii)	$I_{R2} = V_{R2}/R_2 = 1.4/6800 = \underline{206\mu A}$	2	
12.	(b)	(iv)	$I_{R1} = I_{R2} + I_b = 206 + 10 = 216Ma$ $V_{R1} = V_S - V_{R2} = 12 - 1.4 = 10.6V$ Hence $R_1 = V_{R1}/I_{R1} = 10.6/216Ma = \underline{49.074k\Omega}$	3	
12.	(c)	(i)	Non inverting Op Amp	1	
12.	(c)	(ii)	Gain = $(R_2/R_1) + 1 = (50/10) + 1 = 5 + 1 = 6$ Gain = $V_{OUT}/V_{IN}$ hence $V_{IN} = V_{OUT}/gain = 550mV/6 = \underline{91.66mV}$	4	
12.	(c)	(iii)	a) By adjusting the variable resistor Rv (1) b) Offset Null adjustment (2)	3	

Question			Expected Answer(s)	Max Mark	Additional Guidance
12.	(d)	(i)		2	
12.	(d)	(ii)		2	
				(25)	

[END OF MARKING INSTRUCTIONS]