2013 Technological Studies

Standard Grade – Credit

Finalised Marking Instructions

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Part One: General Marking Principles for Technological Studies – Standard Grade – Credit

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: Technological Studies – Standard Grade – Credit

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.
1. (a) It uses feedback (1 KU) to monitor the output (1 KU).
   It compares feedback (1 KU)/output to the desired input (1 KU)
   
   (b) (i) Error detector 1 KU

   (ii) 
   
   ![Diagram]

   1 RNA for feedback with arrow
   1 RNA for sensor

2. (a) 

   ![Diagram]

   1 KU for each symbol
   1 RNA for correct positions

   (b) Transistor/npn Bipolar Transistor 1 KU

   (c) Saturated 1 KU

   (d) Protect the transistor (from back EMF) 1 KU

   (e) Prevents expensive components being damaged/quicker fault finding etc 1 KU

   Marks
<p>|</p>
<table>
<thead>
<tr>
<th>KU</th>
<th>RNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
3. (a) When Valve \( A \) is actuated a pilot signal (1) actuates Valve \( C \).
   Cylinder \( 1 \) (1) outstrokes and actuates (1) Valve \( D \). After a delay (1),
   Valve \( B \) is actuated (1) and Cylinder \( 2 \) outstrokes (1) and actuates
   Valve \( C \) (1). After a delay (1), both Valves \( B \) and \( C \) are actuated (1)
   causing both cylinders to instroke (1).

   1 RNA for each correct statement up to 5 marks

(b) (i)   5/2 (1 KU) Pilot (1 KU) Pilot (1 KU)  
         (ii) Reservoir 1 KU

(c) (i)   Diaphragm 1 KU  
         (ii) 

(d) Area = \( \pi \times 25^2 - \pi \times 5^2 \)  
     = 1884 mm\(^2\)  
     or 1 RNA for an area calculation using 25 or 5 mm

(e) **Main air:** Powers the cylinders 1 KU  
     **Pilot air:** Actuates the valves 1 KU
4. (a) \[ V = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{925000 \times 2}{600}} = 55 \text{ m/s} \]

1 RNA for substitution
1 RNA for answer

(b) \[ \eta = \frac{63}{150} = 0.42 \text{ or } 42\% \]

1 RNA for substitution
1 RNA for answer

(c) It is converted (1) to heat and sound (1) in the brakes.

1 RNA for form of energy
1 RNA for cause of energy loss

(d) **Advantage** Energy source is free and readily available or pollution issues

Disadvantage Inconsistent supply as some days are cloudy
Less efficient

(e) There is an existing supply chain/expensive to convert to other sources etc
More efficient

(f) It reduces waste energy/it is more cost effective/they are less likely to wear out

1 KU for each, up to 2 marks

5. (a) Pulse Width Modulation

1 KU

(b) 1 KU for identifying that mark/space ratio must change
1 KU for indicating that greater ratio = greater speed
6. (a) (i) \[ R_p = \frac{41 \times (76 + 37)}{41 + (76 + 37)} = 30 \Omega \]

1 RNA for series calculation
1 RNA for substitution
1 RNA for answer from given working

(ii) \[ R_T = 30 \Omega + 10 = 40 \Omega \]

1 RNA for answer

(b) \[ I_2 = 0.3 - 0.22 = 0.08 \text{ A} \]

1 RNA for substitution
1 RNA for answer

(c) \[ V = I \times R = 0.08 \times 37 = 2.96 \text{ V} \]

OR

\[ V_f = 12 - 3 - 6 = 3 \text{ V} \]

1 RNA for substitution
1 RNA for answer

7. quick_cook:

1 if pin 0 = 0 then quick_cook

high 6

1 for both

pause10000

low 6

1 for b0 = 1 to 5

any value from b0-13

1 for both

high 7

pause 200

low 7

pause 100

1 for both

next b0

(Allow for next counter)

1 return

Alternative:

if pin 0 = 1 then jump
goto quick_cook

Jump:
8. (a) \[ Z = (\overline{A} + B) \cdot C \]

1 RNA for NOT \( F^\text{NS} \)
1 RNA for OR \( F^\text{N} \)
1 RNA for AND \( F^\text{N} \) (including brackets)

(b) **IC number: 7408, 7404, 7432** 1 RNA for both

(c) Quad 2 input AND 1 KU

(d) **Logic Family**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>CMOS</th>
<th>TTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher power consumption</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Larger fan out</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Easily damaged by static electricity</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Can use supply voltages between 3-18 volts</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Faster switching speeds</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

(e) Identifies the position of pin 1 1 KU

(\text{NOT} – shows which way round the IC goes)
9. (a) | Name | Function | Characteristic |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM</td>
<td>Stores data required when running the program</td>
<td>Data will not remain when power is switched off</td>
</tr>
<tr>
<td>ROM</td>
<td>Stores PBASIC language for microcontroller operations</td>
<td>Data remains when power is removed</td>
</tr>
<tr>
<td>EEPROM</td>
<td>Stores the program</td>
<td>Data remains when power is removed. Data can be re-written</td>
</tr>
</tbody>
</table>

1 KU for each correct entry

(b) Electrically Erasable Programmable Read Only Memory 1 KU

(c) Links the microcontroller to the outside world 1 KU

(d) ![Diagram](image)

1 KU

(e) (let dirs =) %11111000 1 RNA

1 RNA 1 RNA

2 1 0
10. (a) Compound Gear

(b) Output Speed = \(500 \times \left(\frac{20}{50} \times \frac{15}{45}\right) = 67 \text{ rev/min}\)

\[
\begin{align*}
&1 \text{ RNA for substitution} \\
&1 \text{ RNA for answer}
\end{align*}
\]

OR

\[
\begin{align*}
500 \times 20 &= T_1 \times 50 \\
&= 200 \text{ rev/min} \\
&1 \text{ RNA substitution} \\
&1 \text{ RNA answer}
\end{align*}
\]

\[
\begin{align*}
200 \times 15 &= T_2 \times 45 \\
&= 67 \text{ rev/min} \\
&1 \text{ RNA substitution} \\
&1 \text{ RNA answer}
\end{align*}
\]

(c) Speed = \(50 \times 2 = 100 \text{ mm/min}\)

\[
\begin{align*}
&1 \text{ RNA substitution} \\
&1 \text{ RNA answer} \\
&1 \text{ RNA conversion} \quad 0.00167 \text{ m/s}
\end{align*}
\]

(d) Reduce the size of the pitch

\[
\begin{align*}
&1 \text{ KU}
\end{align*}
\]

(e) It can slip

\[
\begin{align*}
&1 \text{ KU}
\end{align*}
\]

(f) (i) Toothed

\[
\begin{align*}
&1 \text{ KU for each}
\end{align*}
\]

(ii) VEE

\[
\begin{align*}
&1 \text{ KU for each}
\end{align*}
\]

(g) (i) Crank and Slider/Cam and Follower

\[
\begin{align*}
&1 \text{ KU}
\end{align*}
\]

(ii) Rack and Pinion

\[
\begin{align*}
&1 \text{ KU}
\end{align*}
\]

[END OF MARKING INSTRUCTIONS]