FORM 4 DESIGN & TECHNOLOGY TIME: 2 hours

Name: _____________________________________ Class: ____________

-----------------------------------------------
Note to student: ---------------------------------
You are required to answer all questions

Useful Formulae:

\[ V_t = V_1 + V_2 + V_3 + \ldots \]

\[ R = \frac{V}{I} \]

\[ T = RC \]

<table>
<thead>
<tr>
<th>Areas corrected</th>
<th>Marks for Written Exam.</th>
<th>Marks for Design Folio</th>
<th>TOTAL</th>
<th>FINAL MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>20</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RM</td>
<td>20</td>
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<tr>
<td>E</td>
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<tr>
<td>F</td>
<td>20</td>
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<tr>
<td>T</td>
<td>20</td>
<td></td>
<td>200</td>
<td>%</td>
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</tbody>
</table>

DISTRIBUTION OF MARKS

Enter student’s mark obtained in every area of study in the above table.
D for Design, RM for Resistant Materials, E for Electronics, F for Food technology and T for Textiles technology
Read the Situation below and answer all questions in Section A.

Many cats and dogs help themselves by tearing the waste plastic bags that people take out before they leave for work. The council issued a directive to his residents that they should bring their black waste basket one hour before it is collected by the waste collection truck. Many residents found this directive impractical because the collection is being done when most of them are not at home. The local council asks you as a designer to design a piece of street furniture that the residents should use to put their waste bag and will not be within reach of the pests.

1. Write a design brief for the given situation.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2 marks

2. Mention THREE design criteria that you should consider for your specifications.

i. ______________________________________________________________________

ii. ______________________________________________________________________

iii. ______________________________________________________________________

3 marks

Figure A shows an idea that was given to the council. This idea was scrapped because of various design disadvantages.

Figure A: Fixed garbage bag hanger

3. a. Mention THREE disadvantages why the idea shown in Figure A is not a good option.

i. ______________________________________________________________________

ii. ______________________________________________________________________

iii. ______________________________________________________________________

3 marks
b. Sketch again **Figure A** with the changes that you will suggest to the council.

4. Sketch ONE initial idea that will satisfy the design brief mentioned in question 1 and keep in mind the disadvantages mentioned in question 3. Remember that in order to communicate your ideas to others, it is important for your sketches to be clear enough and with an indication of sizes, materials, colour, finishing and any proposed decorations.

3 marks

6 marks
5. Give THREE reasons why testing is necessary in product design.

i. ____________________________________________________________

ii. ____________________________________________________________

iii. ____________________________________________________________

3 marks

Section B – Resistant Materials

A television channel will be producing a documentary on the behaviour of birds under water. For this reason, a mimic bird (dummy) was designed to house a submerged video camera which would take shots under water without scaring the real birds. This bird will also contain all mechanical and electronic parts, but shall be remote-controlled. **Figure B** shows an initial sketch of this bird.

![Figure B: Sketch of the mimic bird](image)

6. The casing of the mimic bird was made from plastic, which was then covered with feathers to make it look as if it was a real bird. The casing was formed by fitting two symmetrical halves together.

   a. The halves could be produced by injection moulding. Fill in the blanks in the following paragraph to describe the process of injection moulding works.

   During injection moulding, plastic _________ are inserted inside a barrel and _________ . A _________ inside the barrel pushes the material inside a mould. Once the plastic has cooled down, the _________ is opened and the resulting product removed.

   \[ \frac{1}{2} \text{ mark} \times 4 = 2 \text{ marks} \]
b. The halves could also be produced by vacuum forming. Briefly define what vacuum forming is.

__________________________________________________________________________

__________________________________________________________________________

1 mark

c. Tick the more suitable manufacturing process for producing the mimic duck casing.

☐ injection moulding  ☐ vacuum forming

Give ONE reason for your answer.

__________________________________________________________________________

1 mark × 2 = 2 marks

d. Tick the most suitable joint for fixing the two halves of the mimic duck casing together.

☐ permanent joint  ☐ temporary joint

Provide ONE reason for your answer.

__________________________________________________________________________

1 mark × 2 = 2 marks

7. Few of the internal parts of the mimic bird were made from the alloy brass.

a. Write down the TWO main metals which form brass.

______________                           ______________

½ mark × 2 = 1 mark

b. State why metals are combined together to form alloys.

__________________________________________________________________________

1 mark

c. Brass is corrosion resistant. Explain what this property mean.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>corrosion resistant</td>
<td></td>
</tr>
</tbody>
</table>

1 mark
8. **Figure C** shows some of the mechanical parts of the mimic duck. The input is derived from a d.c. motor connected to the motor pulley.

![Diagram of Figure C: Mechanical parts of the mimic duck](image)

**Figure C: Mechanical parts of the mimic bird**

a. The motor’s speed is too fast for the mechanical system to work well. Mention ONE mechanical system, apart from pulleys and belts, which can reduce this speed.

   ______________________________________________________

   1 mark

b. On **Figure C**, draw the belts which connect the following:
   
i. the motor pulley with the legs pulley
   
   ii. the motor pulley with the cam pulley

   1 mark × 2 = 2 marks

c. On **Figure C**, draw an arrow to show the type of motion at the motor pulley. Consider the given Outputs.

   1 mark

d. Name the types of motion present at:

   i. OUTPUT 1: ____________________________________________________________

   1 mark × 2 = 2 marks

   ii. OUTPUT 2: ____________________________________________________________
9. **Figure C** shows that OUTPUT 1 of the mechanism makes use of a cam and a lever.

   a. Indicate why the fixed pivot is needed.

   ____________________________________________________________________________

   1 mark

   b. Specify what class of lever is the head lever.

   __________________________________________________________

   1 mark

   c. The cam profile used in **Figure C** gives a continuous smooth rise and fall movement which makes the bird’s head move unnaturally. In the box provided, sketch another cam profile which still gives smooth rise and fall but also dwells (stops rising/falling) for some time. Label your sketch.

   2 marks
10. **Figure D** shows the electronic assembly for the duck. Study well the diagram found in **Figure D** and then answer questions from 10a to 10c.

   ![Diagram of electronic assembly for the duck](image)

**Figure D**

a. A PCB was used for making the electronic circuit. What does PCB refer to?

   ____________________________________________________________

   1 mark

b. i. What tool is used to solder electronic components?

   ____________________________________________________________

   ii. Mention ONE safety rule when soldering electronic components.

   ____________________________________________________________

   \( \frac{1}{2} \text{ mark } \times 2 = 1 \text{ mark} \)

c. The water sensor probes were made from a conductive material. In the space provided below, give the meaning of a conductive material and give ONE example of a conductive material.

   Meaning: ____________________________________________________________

   Example: ____________________________________________________________

   1 mark
11. **Figure E** shows the remote control of the bird. A slide latched type switch is used to turn ON or OFF the remote control, while the latched type push switch is used to turn on the onboard camera found on the bird. The remote control has TWO types of movement control, forward-reverse and right-left. The flashing LED found on the remote control is used to indicate when the battery is running low.

![Diagram](image)

**Figure E**

a. The controller works with EIGHT AA type batteries connected in series. Calculate the total voltage needed for the remote control shown in **Figure E**.

1 mark
bi. Use the electronic components below to complete the electronic circuit for the remote control LED indicator.

![Electronic Components Diagram](Attached Diagram)

1 mark

bii. The LED used for the remote control needs 2.1V, 20mA to light properly. Calculate the value of the resistor needed to protect the LED.

3 marks

12. The flashing rate of the LED was controlled by NE555 timer. The timer was designed to output an astable waveform with ONE second for the Mark period and ONE second for the Space period.

   a. Explain what is an astable waveform.

   ____________________________________________________________________________
   ____________________________________________________________________________

   1 mark
b. In **Figure F**, complete the astable waveform by showing THREE more Mark periods.

![Figure F](image)

1 mark

C. **Figure G** shows an electronic circuit used for timing, with a 100KΩ fixed resistor and a 1000µF electrolytic capacitor in series.

i. On **Figure G** show the negative side of the electrolytic capacitor.

1 mark

ii. Calculate the time for the capacitor to charge.

![Figure G](image)

2 marks
13. **Figure H** shows the block diagram used for the electronic circuit needed to control the bird’s movement. As a safety feature the designers used an AND gate so that the duck mechanical movement can never be operated when it is on land. However, a safety switch was also included so that when the bird is not placed in water it can also be tested.

![Figure H](image)

**Figure H**

a. Complete the truth table below. THREE of them were done for you.

<table>
<thead>
<tr>
<th>Remote Signal</th>
<th>Water sensor</th>
<th>Test switch</th>
<th>DC Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>0</td>
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<td>1</td>
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</tbody>
</table>

$\frac{1}{2} \text{ mark } \times 4 = 2 \text{ marks}$

b. **Figure I** shows a FOURTEEN pin logic gate IC.

i. What does IC refer to?

ii. On **Figure I** label pin 10 of the IC.

$\frac{1}{2} \text{ mark } \times 2 = 1 \text{ mark}$
c. On Figure J complete the electronic circuit to show how all LOGIC INPUTS and OUTPUTS are connected. In your answer also show how the AND gate is connected with the OR gate. The first one has been done for you.

![Figure J](image)

Figure J $\frac{1}{2} \text{ mark } \times 4 = 2 \text{ marks}$

d. On Figure K, complete the electronic circuit to operate a DC motor in forward and reverse direction through DPDT relay switch.

![Figure K](image)

Figure K 2 marks
14. Some elderly people struggle to maintain a healthy diet. A food outlet wants to design and make food suitable for these people.

a. Mention THREE food problems that elderly people come across.

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________

3 marks

b. Mention TWO methods how the food outlet would decide on the food it will manufacture.

__________________________________________________________________________________

__________________________________________________________________________________

2 marks

c. A well balanced diet is still needed in elderly years. Suggest a healthy meal to be eaten at noon that you would prepare for persons who are elderly and inactive. Draw and label the food in the plate below.

5 marks
15. a. Recommend ONE suitable cooking method you would use to cook one of the food items that you suggested in your meal. Give a reason for your answer.

Cooking method: ____________________________________________________________

Reason: _________________________________________________________________

2 marks

b. Mention the THREE methods of heat transfer.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

3 marks

16. Match the following phrases with their appropriate endings.

<table>
<thead>
<tr>
<th></th>
<th>Eating food high in calcium</th>
<th>prevent digestive problems.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>A diet rich in fibre can</td>
<td>important for people suffering from coronary heart disease.</td>
</tr>
<tr>
<td>3</td>
<td>Too much salt in the diet</td>
<td>helps to avoid osteoporosis.</td>
</tr>
<tr>
<td>4</td>
<td>Low saturate fat meals are</td>
<td>tired and irritable.</td>
</tr>
<tr>
<td>5</td>
<td>A lack of iron can make you</td>
<td>can raise the blood pressure.</td>
</tr>
<tr>
<td></td>
<td>feel</td>
<td></td>
</tr>
</tbody>
</table>

5 marks

Section E – Textiles

17. Today people are more environmental conscious and recycle most of every day materials. Describe TWO ways of recycling textiles products.

a.____________________________________________________________________

b.____________________________________________________________________

4 marks

18. Many times fabrics need to be shaped to drape well and neatly. In the table below name and describe TWO methods of shaping fabrics.

<table>
<thead>
<tr>
<th>Name</th>
<th>Describe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

4 marks
19. Buttons and button holes are often used as fastenings on cushions. List TWO alternative fastenings that could be used.

a. ____________________________________________________________

b. ____________________________________________________________

2 marks

20. Name TWO non-woven fabrics commonly used in textiles products.

a. ____________________________________________________________

b. ____________________________________________________________

2 marks

21. Observe carefully the diagram of a piece of fabric shown below.

a. Name the weave used to construct the fabric shown.

__________________________________________________________________

2 marks

b. On the diagram label the following:

- The Warp Threads
- The Weft Threads
- The True Bias

6 marks