**Question 1 (30 marks)**

This question allows you to demonstrate your ability to carry out calculations such as those introduced in Block 3, Parts 1 and 2 and the [Using Numbers (maths) booklet](https://learn2.open.ac.uk/mod/oucontent/olink.php?id=1588261&targetdoc=Using+numbers+%28maths%29).

In each case, up to half the marks are for a clear explanation of your working, so it is very important to show how you got to your answer. Guidance on this can be found in the section on Numerical answers in the [TM111 Assessment guide](https://learn2.open.ac.uk/mod/oucontent/olink.php?id=1588261&targetdoc=Assessment+guide&targetptr=4.5).

* a. A sinewave has a frequency of 475 Hz (cycles per second). What is the time *period* of this sinewave expressed in ms to 3 significant figures (see **Study Note #7.1** in the [Using Numbers (maths) booklet](https://learn2.open.ac.uk/mod/oucontent/olink.php?id=1588261&targetdoc=Using+numbers+%28maths%29))?

If the time *period* is now reduced by a factor of 5, using the value calculated above to 3 significant figures, what will be the resulting frequency of the sinewave? Express your answer in kHz to 3 significant figures.

**(8 marks)**

* b. Convert the following dotted decimal IP address into binary (see Block 3, Part 2).

**125.163.30.89**

**(6 marks)**

* c. In an optical ﬁbre, the power drops by a factor of 10 approximately every 30 km. If the transmit power is 0.3 W (= 3x10-1), how far will a signal be transmitted before the power is attenuated to 300 μW? Include a table showing the signal power vs. distance in 30 km intervals (similar to Table 1.2 in Section 1.4.4) as part of your answer.

If a high-quality coaxial cable (LDF5-50A) operating at 2 Mbps is used instead of an optical fibre, how would you expect the calculated distance value to change?

Briefly explain your answer (see Section 1.4.4). **You are not required to include another table**.

**(8 marks)**

* d. Express the following 48-bit binary MAC address in hexadecimal (see [Using Numbers (maths) booklet](https://learn2.open.ac.uk/mod/oucontent/olink.php?id=1588261&targetdoc=Using+numbers+%28maths%29)).

**01001100 – 10011111 – 01111011 – 00110101 – 11101010 – 11010110**

**(8 marks)**

**Question 2 (30 marks)**

* a.A flower nursery has commissioned you to investigate how an Internet of Things (IoT) sensor network can be effectively used to monitor several battery-powered sensors in their greenhouses. The sensors measure temperature, humidity, light intensity and soil moisture, as well as monitoring equipment such as water sprays. The owners want to use an IoT network to transmit and store sensor measurements on a server located in their nursery office. Their specification includes a requirement that the sensors must have very long battery lives; low transmission data rates with a maximum bit-rate of 8 kilobits per day, and sufficient radio range to cover all greenhouses, which can be located up to 1 km away from the nursery office.

Based on what you have learnt in Block 3, Parts 3 and 4, write a short comparison for the nursery owners on the features and technical performance of the following IoT networks: **Wi-Fi (IEEE 802.11)**, **LPWAN** and **ZigBee**.

Your comparison, which must **NOT** be a table, should reflect on the respective data-rates, coverage and battery life performance features of the three technologies and their suitability for this nursery scenario. It should also conclude with **your recommendation** to the owners for which IoT technology to adopt for their nursery.

*The maximum word limit for Question 2(a) is 350 words.*

**(15 marks)**

*(****9 marks*** *are allocated for the comparison of the three IoT technologies in terms of the features and criteria mentioned above;* ***2 marks*** *for offering a clear recommendation; and* ***4 marks*** *for the overall quality and insightfulness of the narrative).*

* b.A mobile base station (BS) in an urban environment has a power measurement of 35 µW at 180 m. Assuming the propagation follows the *inverse 4th power law* (see Section 3.2.2), what is a reasonable power value in W, to assume at a distance of 540 m from the BS? Express your answer in scientific notation to 2 decimal places.

**(5 marks)**

* c.An analogue signal has a bandwidth which extends from very low frequencies up to 12 kHz. Using the **sampling theorem** (Section 3.3.1), what is the minimum sampling rate (number of samples per second) required to convert this signal into a digital representation?

If each sample is now quantised into 512 levels, what will be the resulting transmitted bit-rate, expressing your answer in scientific notation to 2 decimal places?

*Hint: you will need to calculate the number of bits for each sample that produces 512 quantisation levels (see Section 3.3.2).*

**(6 marks)**

* d.The received 7 x 5 message block shown below uses **even parity** checks, with the parity bits displayed at the end of each row (A–E) and column (1–7), in the shaded cells (see Section 3.7.1). By checking each row and column respectively, determine the following:
  + i.The row-column grid reference of the error-bit.
  + ii.What change needs to be made to correct the error?

As part of your answer, briefly explain how you located the error-bit.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** |  |
| **A** | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| **B** | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| **C** | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| **D** | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| **E** | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
|  | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |

* **(4 marks)**

# Question 3 (30 marks)

* a.In Part A of Question 3 you will contribute a resource to a wiki, and then comment on a resource contributed by another student. Make sure that you contribute your resource **at least 5 days before the TMA deadline**, so that other students have an opportunity to read and comment on it.
  + i.In Block 3 Part 5 Activity 5.12 you found a web resource and added a section about it to a wiki. Now that you have studied Part 6 of Block 3, find a web resource that you think is interesting and relevant specifically to Part 6. Add a section about this resource to the [TM111 TMA03 tutor group wiki](https://learn2.open.ac.uk/mod/oucontent/olink.php?id=1588261&targetdoc=TM111+Tutor+group+wiki+-+for+TMA03).

Follow these instructions, which you will also find on the Start page of the wiki.

Follow the link (at the bottom of the Start page), to the ‘page for sharing resources’. You can edit the new page to share resources with other students in your tutor group and comment on their resources. You cannot edit the Start page. On the new page, add a new section (Using the 'Add new section' button near the bottom of the page.)

In your new wiki section you should include a link to your chosen resource, a short explanation of what the resource is about, and an explanation of why it is interesting and how it is relevant to Part 6. You should write no more than 150 words.

As your answer to Part (i) of Question 3:

• paste into your TMA document a copy of the text in your wiki section

• make a screenshot showing your wiki section and paste it into your TMA document.

**(6 marks if contributed 5 days before TMA deadline; 3 marks otherwise)**

* + ii.Choose a section in the wiki that you find interesting and that was contributed by another student. Using the wiki’s ‘Edit section’ facility, add a comment to the wiki section that you chose, explaining why it is of interest to you. You should write no more than 100 words. Precede your comment with ‘A comment from [your name]’ so that your tutor and other students can tell who the comment is from.

As your answer to Part (ii) of Question 3:

• paste a copy of your comment into your TMA document

• take a screenshot showing your comment in the wiki section and paste it into your TMA document.

**(3 marks)**

* + iii.Write a short piece of text about your experience of the wiki’s usability. You should relate your answer to **three** of the following concepts that you learnt about in Block 1 Part 6.5.1, ‘What is usability?’:

• effectiveness

• efficiency

• satisfaction

• learnability

• recoverability.

*The maximum word limit for Question 3(a)(iii) is 250 words.*

**(6 marks)**

* b.
  + i.Artificial Intelligence (AI) approaches are increasingly being used to tackle problems in medicine and health. Carry out a web search to help you understand what is meant by ‘artificial intelligence’, then write an explanation of the term in your own words.

Provide a complete reference to the web source which most helped your understanding of artificial intelligence (see the OU Library resource on [Referencing websites](http://www.open.ac.uk/libraryservices/beingdigital/objects/126/index.htm)).

*The maximum word limit for Question 3(b)(i) is 100 words, excluding the reference.*

**(3 marks)**

* + ii.The following article describes an example of using artificial intelligence to address a problem in healthcare.

[Hospital develops AI to identify patients likely to skip appointments](https://www.theguardian.com/society/2019/apr/12/hospital-develops-ai-to-identify-patients-likely-to-skip-appointments)

Write a summary of the article which includes the following information:

• How is AI being used to address this problem?

• What data / information is being used?

• What are the potential financial and other benefits?

*The maximum word limit for Question 3(b) (ii) is 250 words.*

**(7 marks)**

* + iii.In Block 3 Part 6 (Section 6.2.6) you met the idea of a ‘false positive’ and ‘false negative’. In the article above, find one example of:

• a false positive

• a false negative.

**(2 marks)**

* + iv.What drawbacks or risks are presented by the initiative described in the article?

Block 3 Part 6 (Section 6.3.2) discusses electronic triage and says that:

*‘Advanced systems use the techniques of artificial intelligence (AI) in order to replicate (and even, ideally, improve upon) the judgements of a medical expert’.*

How do you think the benefits and risks of using AI for electronic triage compare to those when using it to predict missed medical appointments?

*The maximum word limit for Question 3(b) (iv) is 100 words.*

**(3 marks)**