Question 1:

a)
i.
Tutor comments:

TMA_01 Question 1 was well answered. Through your academic career you will create a lot of notes, storing them appropriately is important. Part b) your OpenStudio submission link was incorrect.

ii.
The feedback I received from the tutor at this point in my studies was very important to me. I have only ever studied maths modules before this course, and was not fully aware of the importance of making notes, As a lot of the work is solving problems, and most of the 'notes' are given to us in the handbook, we just have to apply them. And the maths I have done so far there is very little need for collaboration, so sharing of working is limited at this low level of maths.

iii.
I have now started to organise my notes better, not only in this module, but I have invested in a reMarkable which I use not only to take notes directly onto .PDFs but also I can organised the hand written maths work and file them in folders, which I have setup to sync with my computer. This means I can easily search for topics and find my notes quickly.

Word count: 196

b)
i.

$$47.5\,\mathrm{ms} = 47.5 \times 10^{-6}\,\mathrm{s}$$

$$\frac{1}{47.5 \times 10^{-6}\,\mathrm{s}} = 21053.2\ldots$$

$$\frac{21053.2\ldots}{1000} = 21.1\,\mathrm{kHz}$$

to 3 s.f.

ii.

$$21.053\ldots \times 2.45 = 51.5\ldots$$

$$\frac{1}{51.5\ldots} = 0.0194\ldots$$

$$0.0194\ldots \times 1000 = 19.4\ldots$$

$$= 19.4\,\mu\text{s}$$

to 3 s.f.

c)

Distance/Km	Signal power/W
0	2.8×10^{-1} W
2.35	2.8×10^{-2} W
4.7	2.8×10^{-3} W
7.05	2.8×10^{-4} W
9.4	2.8×10^{-5} W
11.75	2.8×10^{-6} W

Hence the signal can tavel 11.75 km before the signal power is attenuated to $2.8\,\mu$W.

d)

Convert 01100010-11101001-11110001-11000111-10101011-01011101 into hexidecimal, first split it into nibbles;

$$0110 \to 6$$
$$0010 \to 2$$
$$1110 \to E$$
$$1001 \to 9$$
$$1111 \to F$$
$$0001 \to 1$$
$$1100 \to C$$
$$0111 \to 7$$
$$1010 \to A$$
$$1011 \to B$$
$$0101 \to 5$$
$$1101 \to D$$

So the hexadecimal representation is $62 : E9 : F1 : C7 : AB : 5D$.

Question 2:

a)
i.
I would select a class 2 bluetooth device because with a maxium power output of $2.5\,\mathrm{mW}$ it has a range of about $10\,\mathrm{m}$, and it is intended for personal area networks for tings like mobile phones. Whereas class 1 is designed for business or industrial use with a higher power output of $100\,\mathrm{mW}$ and a range of about $100\,\mathrm{m}$. And class 3 has a very short range of about $1\,\mathrm{m}$ with a power output of $1\,\mathrm{mW}$.

ii.
Both Bluetooth and WIFI are great for short range wireless communication. But they differ in their properties and uses. Class 2 bluetooth devices use about $2.5\,\mathrm{mW}$ with a range of about $10\,\mathrm{m}$ and a bitrate between about 1-3 $\mathrm{Mbit\,s^{-1}}$. Making it ideal for accessories like keboards of headphones, where energy and hence battery, efficiency matters.

WIFI on the other hand operates a power output up to $100\,\mathrm{mW}$ and offers a range of about $80\,\mathrm{m}$ with bitrates in the hundreds of $\mathrm{Mbit\,s^{-1}}$. This allows for large data intensive tasks such as video streaming of file sharing. But with this comes high energy usage it makes WIFI less suitable for battery-powered devices.

Word count: 110

b)
i.

let d_1 be $333\,\mathrm{m}$ with a power measurment of $27\,\mu\mathrm{W}$

let d_2 be $1320\,\mathrm{m}$ with a power measurment of P and using the inverse cube rule

$$\frac{330}{1320} = \frac{1}{4}$$

$$\left(\frac{1}{4}\right)^3 = \frac{1}{64}$$

$$\frac{P}{27\,\mu\mathrm{W}} = \frac{1}{64}$$

$$P = \frac{27\,\mu\mathrm{W}}{64}$$

$$= 0.421\,875\,\mu\mathrm{W}$$

$$= 4.22 \times 10^{-1}\,\mu\mathrm{W}$$

to 2 d.p.

ii.

let d_1 be $330\,\mathrm{m}$ with a power measurment of $27\,\mu\mathrm{W}$
let p_2 be $216\,\mathrm{nW}$ with a distance of d_2 and using the inverse cube rule

$$p_2 = p_1 \left(\frac{d_1}{d_2}\right)^3$$

$$d_2 = d_1 \left(\frac{p_1}{p_2}\right)^{\frac{1}{3}}$$

$$= 330 \left(\frac{27 \times 10^{-6}}{216 \times 10^{-9}}\right)^{\frac{1}{3}}$$

$$= 330 \times \left(\frac{1}{8} \times 10^3\right)^{\frac{1}{3}}$$

$$= 330 \times (\sqrt[3]{125})$$

$$= 330 \times 5$$

$$= 1650\,\mathrm{m}$$

$$= 1.65 \times 10^3\,\mathrm{m}$$

to 2.d.p.

c)

i.

Accourding to the sampling theorem, if each speech signal has a bandwidth of $4\,\text{kHz}$, the minimum sampling rate would be $8\,\text{kHz}$, which is $8000\,\text{bit}\,\text{s}^{-1}$.

ii.

The number of bits required to represent 256 quantised levels is

$\log_2(256) = 8\,\text{bit}$

Therefore we needs

$$8 + 1 = 9 \text{ bits per sample, including the 1 bit for TDM sycronisation}$$

using our $8000\,\text{bit}\,\text{s}^{-1}$

$$\begin{aligned} 9 \times 8000 &= 72\,000\,\text{bit}\,\text{s}^{-1} \\ &= 72\,\text{ks}^{-1} \\ &= 7.2 \times 10^1\,\text{kbit}\,\text{s}^{-1} \end{aligned}$$

to 2 d.p.

iii.

Given there are 48 users the total bitrate would be

$$\begin{aligned} 48 \times 7.2 \times 10^1\,\text{kbit}\,\text{s}^{-1} & \\ &= 3456\,\text{kbit}\,\text{s}^{-1} \\ &= 3.46\,\text{Mbit}\,\text{s}^{-1} \qquad \textit{to 2 d.p.} \end{aligned}$$

Question 3: a)

i.

https://www.nist.gov/blogs/taking-measure/tale-two-errors-measuring-biometric-algorithms?utm$_{s}ource = chatgpt.com$

The resource I have chosen is a NIST blog post that explains the trade-off between False Match Rate (FMR) and False Non-Match Rate (FNMR) in biometric identification. Although the article is three years old and some of the statistics may have changed, the overall relationship remains the same. The article succeeds in connecting everyday biometric use, such as unlocking a phone, with high-stakes contexts like crime detection.

I found it particularly interesting that as early as the late 1990s, NIST developed the detection error trade-off curve, which still remains the sector standard today. This shows that the fundamental challenge of balancing false matches with false non-matches is not a limitation of computing power but of the nature of biometric systems themselves. No matter how advanced or fast algorithms become, the trade-off between these two types of error will always exist.

Word count: 140

ii.

FMR Vs FNMR Edit section

(created by Paul Allen on Monday 25 August 2025 at 20:00)

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A comment from Paul Allen

I found your resource on digital triage really interesting, especially in showing how practices adapted during the pandemic. I agree that the efficiency gained from online tools like consultations and messaging is a major benefit, particularly in helping clinicians manage time and resources, including the use of non-clinical staff. I also appreciated how the article balanced the positives with the challenges, such as accessibility for patients who may struggle with technology. The article also contains plenty of links to further information making it easy to explore the topic in more depth.

Word count: 96

Digital Triage Edit section

(created by Daniel Rimmer on Wednesday 20 August 2025 at 21:16)

https://www.england.nhs.uk/long-read/digitally-enabled-triage/

The resource I have provided gives an interesting insight into the different ways technology has improved the efficiency within modern general practice and highlights the benefits and potential pitfalls of digital triage.

It is interesting to see how technology has developed in this sector and the benefits this has not only for the patients but the general practice of digital triage. Patients can use digital tools such as an online consultation, website, apps or even online messaging, which are tools to provide their care request prior to a face to face appointment if necessary. However, patients may find the new systems difficult to use or may not even has access to the technology or even have learning difficulties. Both positive and negative aspects of digital triage must be considered as both sides have their challenges.

A comment from Paul Allen

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iii.

When using the tutor group wiki allowed me to reflect on its usability.

In terms of effectiveness: the wiki did as it should; it provides a centralised space for student to post resources and text and allows other people to contribute in the form of comments, as in our case. I was able to add a section for myself without difficulty, and my comment to another student appeared as it should under their post. Showing that it could be used as intended.

In terms of efficiency: there is a bit more to reflect on. The layout is not immediately intuitive, and it took me to read the instructions again use the 'add new section' button, as at first I thought this would take me away from the tutorial section. But after re-reading the instructions the process was reasonably quick.

And finally in terms of satisfaction: I found it useful way for students to share resources and add comment of their own. If felt collaborative despite the interaction being asynchronous. However, the interface itself felt a little dated, in comparison to modern tools like forums of chat apps.

Overall the wiki is effective but could be improved in terms of ease of use and overall updating is design elements.

Word count: 208

b)

i.

The need for accurate age verification online has become an important issue for society as children and young people increasingly access social media, gaming platforms and other online services. Without effective checks, under-18s can be exposed to harmful content such as violent material, online grooming or even the purchase of weapons. For companies, there is also the matter of legal compliance, as UK and international regulations place a duty of care on providers to protect young users. Reliable age verification helps balance the benefits of digital participation with the necessary safeguards.

One leading approach is biometric facial analysis. This works by asking a user to provide an image of their face, which is then compared against large datasets of known age profiles. The system analyses markers such as bone structure, skin texture and facial ratios to estimate whether someone falls above or below a required age threshold. A key advantage is that it can be carried out quickly without official documents, which some users may not have or may be reluctant to share. Increasingly, the process is being integrated with live images or video to minimise fraud.

Artificial intelligence plays a major role here. AI systems are trained on huge numbers of facial images of known ages, which improves the reliability of estimates. The technology can refine its predictions by learning subtle patterns invisible to humans. However, this also raises questions of fairness, as accuracy may be lower for people from under-represented demographic groups if training data lacks diversity.

The accuracy of biometric age verification is improving, with studies suggesting that current systems can estimate ages within two to three years. This is sufficient for many purposes, such as distinguishing whether a user is under 13 or over 18. Nevertheless, no system is flawless, and for higher accuracy some services adopt a layered approach, combining AI-driven facial analysis with document checks or parental consent.

ii.

Additional resource: Ofcom (2024) Children and parents: media use and attitudes report 2024. Available at: https://www.ofcom.org.uk/siteassets/resources/documents/research-and-data/media-literacy-research/children/childrens-media-use-and-attitudes-2023/childrens-media-use-and-attitudes-report-2023.pdf (Accessed 28 August 2025).

I found this report by searching Google with the terms Ofcom children online report. It was useful because it gave up-to-date statistics on how children in different age groups access media and on which devices. It also highlighted risks faced by young people and parents' responses, which helped me explain why strong age verification is important. Word count: 393