GCE AS/A LEVEL

WJEC GCE AS/A Level in

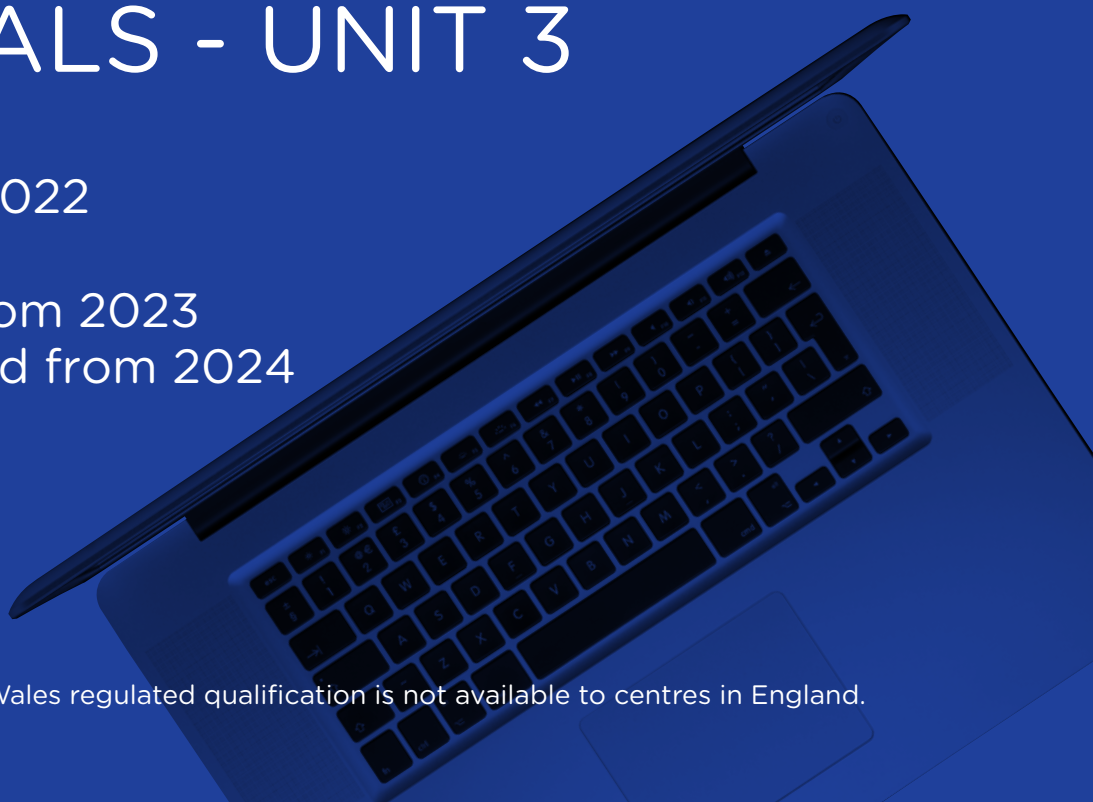
# DIGITAL TECHNOLOGY

APPROVED BY QUALIFICATIONS WALES

# SAMPLE ASSESSMENT MATERIALS - UNIT 3

Teaching from 2022

For AS award from 2023
For A level award from 2024



# For teaching from 2022
# For A level award from 2024

# GCE AS and A LEVEL in DIGITAL TECHNOLOGY

# SAMPLE ASSESSMENT MATERIALS

# UNIT 3

# Contents

| Candidate Name | Centre Number | | | | | Candidate Number | | | | |
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**GCE AS and A LEVEL**
**DIGITAL TECHNOLOGY**

**UNIT 3**

**Connected Systems**
**SAMPLE ASSESSMENT MATERIALS**

**2 hours 30 minutes**

**These sample assessment materials, including the mark scheme, are shown in paper-based form.**

**The live assessments will be provided onscreen only, in compliance with section 16 in the subject-approval criteria for GCE Digital Technology.**

## INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Answer **all** questions.

Write your name, centre number and candidate number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

## INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part question. You are advised to divide your time accordingly.

The total number of marks available is 100.

You may use a calculator.

You are reminded of the need for good English and orderly, clear presentation in your answers. The quality of your written communication (QWC), including appropriate use of punctuation and grammar, will be assessed in your answer to question **9**.

Answer **all** questions.

**1.** Data collection takes place in many ways.

(a) Suggest **two** reasons why an organisation would choose to use an autonomous device to collect data. [4]

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(b) Describe what is meant by manual data collection and how this can be carried out. [6]

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**2.** Cloud services are used for services and file-based applications.

(a) Summarise the differences between file backup and file archive systems. [4]

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(b) Discuss the advantages and disadvantages of using cloud services for database applications. [8]

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**3.** Biometric data is individually unique and is often used for security purposes.

(a) Describe the complexities of capturing and storing biometric data. [6]

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(b) Explain the legal issues associated with an organisation in Wales capturing and storing biometric data. [8]

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**4.** Cyber-attacks can be damaging for organisations.

(a) Explain **two** potential consequences of a cyber-attack on an online retailer. [4]

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(b) Suggest the resilience controls that could be put in place to help an organisation recover from and mitigate a cyber-attack. [6]

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**5.** Analyse the functionality provided by the DNS system. [8]

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**6.** In a certain computer an uncompressed movie file format uses 2 megabytes of storage space per frame. The video is recorded at a frame rate of 30fps, and the length of the movie is 30 seconds.

(a) Calculate the total storage size of this movie file in gigabytes. [3]

You may assume no sound or meta data is stored with the image at this point.

You should show your workings.

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(b) Sound is now added to this movie file. It uses an uncompressed format which requires 512 kilobytes of storage per second.

Calculate the new movie file size in gigabytes. [3]

You should show your workings.

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**7.** Large data sets can be analysed in different ways.

(a) Describe how large data sets can be analysed and used. [4]

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(b) Describe the use of Artificial Intelligence technologies in relation to large data sets, outlining the potential social implications which may arise. [10]

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**8.** Expert systems are used in many areas of finance, industry and society.

(a) Outline the role of a knowledge engineer in relation to expert systems. [4]

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(b) Describe what is meant by the term heuristics in relation to expert systems. [6]

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**9.** Analyse the social and environmental impacts associated with the proliferation of mobile handheld devices and the infrastructure to support their use. [16] [QWC]

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For continuation only

# MARK SCHEME

## Guidance for examiners

### Positive marking

It should be remembered that candidates are writing under examination conditions and credit should be given for what the candidate writes, rather than adopting the approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

For questions that are objective or points-based, the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

Mark schemes often list points which may be included in candidates' answers. The list is not exhaustive. *The inclusion of 'Credit any other valid response.*' (or similar instruction) within mark schemes allows for the possible variation in candidates' responses. Credit should be given according to the accuracy and relevance of candidates' answers.

Appropriate terminology is reflected in exemplar responses in mark schemes. However, unless there is a specific requirement within a question, candidates may be awarded marks where the answer is accurate but expressed in their own words.

### Banded mark schemes

For band marked questions, mark schemes are in two parts, the indicative content and the assessment grid.

The indicative content suggests the range of points and issues which may be included in candidates' answers. It can be used to assess the quality of the candidate's response. As noted above, indicative content is not intended to be exhaustive and candidates do not have to include all the indicative content to reach the highest level of the mark scheme.

However, in order to reach the highest level of the mark scheme a candidate must meet the requirements of the highest mark band. Where a response is not creditworthy, that is, it contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

Candidates' responses to questions are assessed against the relevant assessment objectives. In GCE Digital Technology Unit 3, each question will address one assessment objective.

The marking of banded mark questions should always be positive. This means that, for each candidate's response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

Examiners should first read and annotate the candidate's answer to pick out the evidence that is being assessed in that question. The mark scheme can then be applied. This is done as a two stage process.

**Stage 1 – Deciding on the band**

Beginning at the lowest band, examiners should look at the candidate's answer and check whether it matches the descriptors for that band. If the descriptors at the lowest band are satisfied, examiners should move up to the next band and repeat this process for each band until the descriptors match the answer.

If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the candidate's response should be used to decide on the mark within the band. For instance, if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content.

Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

**Stage 2 – Deciding on the mark**

During standardising (the marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a candidate's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **1.** | | *Data collection takes place in many ways.* | 4 | | 4 |
| | (a) | *Suggest two reasons why an organisation would choose to use an autonomous device to collect data.* | 4 | | 4 |
| | | Award **one** mark for a basic suggestion for each reason, for example:<br><br>• It is more cost effective than employing people<br>• The organisation does not have to transport people to a location to collect data<br>• Data can be collected instantly (in real time)<br>• Data can be collected multiple times (improving accuracy/currency).<br><br>Award **two** marks for a more developed suggestion for each reason, for example:<br><br>• Using an autonomous device can be more cost effective than employing and transporting people to a location to collect data<br>• Using an autonomous device allows data to be collected instantly and more frequently, which will improve its accuracy/currency.<br><br>NB: candidates must suggest **two** reasons for full marks.<br><br>Credit any other valid response. | | | |
| | (b) | *Describe what is meant by manual data collection and how this can be carried out.* | 6 | | 6 |
| | | **Indicative content**<br>Answers may refer to the following:<br><br>• Manual data collection<br>  • collection of data performed by a human rather than a machine<br>  • data may then be entered into a computer for processing.<br><br>• How manual data collection can be carried out<br>  • via a one-to-one interview<br>  • via a focus group<br>  • using a questionnaire<br>  • by observation.<br><br>Credit any other valid response. | | | |

| Band | AO1 |
|---|---|
| **3** | **5-6 marks**<br>A very good description, which shows:<br>• thorough knowledge and understanding of manual data collection<br>• a confident grasp of how manual data collection can be carried out. |
| **2** | **3-4 marks**<br>A good description, which shows:<br>• generally secure knowledge and understanding of manual data collection<br>• a generally secure grasp of how manual data collection can be carried out. |
| **1** | **1-2 marks**<br>A basic description, which shows:<br>• some knowledge and understanding of manual data collection<br>• some grasp of how manual data collection can be carried out. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **2.** | | *Cloud services are used for services and file-based applications.* | | | |
| | (a) | *Summarise the differences between file backup and file archive systems.* | 4 | | 4 |
| | | Award **one** mark for a limited summary of the differences between file backup and file archive systems, for example:<br>• File backup relates to current data whilst file archive relates to data you have to keep.<br><br>Award **two** marks for a basic summary of the differences between file backup and file archive systems, for example:<br>• File backup relates to current data you would need in the event of a system disaster. File archive relates to data you have to keep but don't need to see all the time.<br><br>Award **three** marks for a more developed summary of the differences between file backup and file archive systems, for example:<br>• File backup relates to current data you would need in the event of a system disaster such as data corruption. File archive relates to data you have to keep but only need to access occasionally. The ability to search the archive is key.<br><br>Award **four** marks for a fully developed summary of the differences between file backup and file archive systems, for example:<br>• File backup relates to current data you would need in the event of a system disaster such as data corruption, accidental deletion. In these situations, speed of recovery is important. File archive relates to data you have to keep but only need to access occasionally. The ability to search the archive is key but the speed of recovery is not important.<br><br>Credit any other valid response. | | | |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| | (b) | *Discuss the advantages and disadvantages of using cloud services for database applications.* | | 8 | 8 |
| | | **Indicative content**<br>Answers may refer to the following:<br><br>Advantages<br>• The cost of adopting cloud services for database applications can be less than expanding an existing on-site server infrastructure<br>• Scalability tends to be designed in from the first usage rather than being considered at a later date<br>• Adopting cloud services for database applications removes pressure on an organisation to have database management and hosting specialists on site<br>• This allows for non-geographic access to the database worldwide<br>• Cloud specialist companies can offer comprehensive security which is often more robust than that of on-site servers<br>• There can be ubiquitous access from a range of devices.<br><br>Disadvantages<br>• Database redundancy increases by having cloud infrastructure as opposed to single physical hosting, which can cause synchronisation issues<br>• Access to the data is dependent on maintaining an internet connection<br>• Usage costs can lead to significant financial implications if the database is subject to heavy usage.<br><br>Credit any other valid response. | | | |

| Band | AO2 |
|---|---|
| **4** | **7-8 marks**<br>An excellent discussion which shows:<br>• thorough knowledge and understanding of cloud services for database applications<br>• a confident grasp of the advantages and disadvantages of using cloud services for database applications. |
| **3** | **5-6 marks**<br>A good discussion which shows:<br>• generally secure knowledge and understanding of cloud services for database applications<br>• a generally secure grasp of the advantages and disadvantages of using cloud services for database applications. |
| **2** | **3-4 marks**<br>A basic discussion which demonstrates:<br>• some knowledge and understanding of cloud services for database applications<br>• some grasp of the advantages and/or disadvantages of using cloud services for database applications. |
| **1** | **1-2 marks**<br>A limited discussion which demonstrates:<br>• little knowledge and understanding of cloud services for database applications<br>• little grasp of the advantages or disadvantages of using cloud services for database applications. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **3.** | | *Biometric data is individually unique and is often used for security purposes.* | | | |
| | (a) | *Describe the complexities of capturing and storing biometric data.* | 6 | | 6 |
| | | **Indicative content**<br>Answers may refer to the following:<br>• Raw biometric data is always analogue and usually three dimensional, however this is then stored as a series of mathematical data and algorithms.<br>• It is not practical for digital biometric data to be a 100% accurate representation of, for example, a fingerprint or a face. Instead, the capture renders a number of specific points on the feature rather than the feature itself.<br>• A number of different sensors have to be used to capture biometric data as the variability in subjects means it isn't possible to do this accurately using one sensor.<br>• The use of a number of sensors capturing large amounts of biometric data requires a significant amount of processing<br>• Changes to the underlying metrics can cause access issues, for example a subject having a plaster on a finger.<br><br>Credit any other valid response. | | | |

| Band | AO1 |
|---|---|
| **3** | **5-6 marks**<br>A very good description, which shows:<br>• thorough knowledge and understanding of capturing and storing biometric data<br>• a confident grasp of the complexities of capturing and storing biometric data. |
| **2** | **3-4 marks**<br>A good description, which shows:<br>• generally secure knowledge and understanding of capturing and storing biometric data<br>• a generally secure grasp of the complexities of capturing and storing biometric data. |
| **1** | **1-2 marks**<br>A basic description, which shows:<br>• some knowledge and understanding of capturing and storing biometric data<br>• some grasp of the complexities of capturing and storing biometric data. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **3.** | (b) | *Explain the legal issues associated with an organisation in Wales capturing and storing biometric data.* | | 8 | 8 |
| | | **Indicative content**<br>Answers may refer to the following:<br><br>• The data must be collected fairly and lawfully<br>• Data must be used only for a specific purpose<br>• The data must be adequate and only for what is needed<br>• The data must be accurate and up to date<br>• The data must not be kept for longer than needed<br>• The organisation must take account of peoples' rights<br>• The organisation must keep the data safe and secure<br>• Data cannot be transferred outside of the European Economic Area (EEA).<br><br>Credit any other valid response. | | | |

| Band | AO2 |
|---|---|
| **4** | **7-8 marks**<br>An excellent explanation which shows:<br>• thorough knowledge and understanding of the legal issues associated with capturing and storing biometric data<br>• a confident grasp of how these issues can affect an organisation in Wales. |
| **3** | **5-6 marks**<br>A good explanation, which shows:<br>• generally secure knowledge and understanding of the legal issues associated with capturing and storing biometric data<br>• a generally secure grasp of how these issues can affect an organisation in Wales. |
| **2** | **3-4 marks**<br>A basic explanation, which shows:<br>• some secure knowledge and understanding of the legal issues associated with capturing and storing biometric data<br>• some grasp of how these issues can affect an organisation in Wales. |
| **1** | **1-2 marks**<br>A limited description, which shows:<br>• little knowledge and understanding of the legal issues associated with capturing and storing biometric data<br>• little grasp of how these issues can affect an organisation in Wales. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **4.** | | *Cyber-attacks can be damaging for organisations.* | | | |
| | (a) | *Explain two potential consequences of a cyber-attack on an online retailer.* | | 4 | 4 |
| | | Award **one** mark for a basic explanation for each potential consequences of a cyber-attack on an online retailer, for example:<br><br>• The reputational damage of having had a cyber-attack can lead to a loss of sales.<br>• Losing customer data can be catastrophic for the customer as their personal details become available online.<br><br>Award **two** marks for a more developed explanation for each potential consequences of a cyber-attack on an online retailer, for example:<br><br>• The reputational damage of having had a cyber-attack can lead to a loss of sales as customers may no longer trust the online retailer's website and shop with a competitor instead<br>• Losing customer data can be catastrophic for the customer as their personal details become available online, and also have legal implications for the retailer as data protection controls have been breached. This can also be a criminal offence.<br><br>NB: candidates must explain **two** potential consequences for full marks.<br><br>Credit any other valid response. | | | |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| | (b) | *Suggest the resilience controls that could be put in place to help an organisation recover from and mitigate a cyber-attack.* | 6 | | 6 |
| | | **Indicative content**<br>Answers may refer to the following:<br><br>• The management of systems so that:<br>  • up to date malware protection is in place<br>  • access control is tightly organised<br>  • data is encrypted to a strong degree<br>  • data is backed up regularly and held offsite<br>  • networks and communications are protected by firewalls<br>  • systems are patched regularly and that there is a disaster recovery policy in place that covers backups and a potential alternative site to stage a recovery from.<br>• Network and information systems are continually monitored to detect any unusual traffic or incidents (e.g. a user logging in remotely from a foreign country).<br>• Exploring various what-if scenarios.<br>• Having an incident response programme that will implement the disaster recovery policy so that the organisation will be back up and running as quickly as possible.<br><br>Credit any other valid response. | | | |

| Band | AO1 |
|---|---|
| **3** | **5-6 marks**<br>A very good suggestion, which shows:<br>• thorough knowledge and understanding of resilience controls<br>• a confident grasp of what could be put in place to help an organisation recover from and mitigate a cyber-attack. |
| **2** | **3-4 marks**<br>A good suggestion, which shows:<br>• generally secure knowledge and understanding of resilience controls<br>• a generally secure grasp of what could be put in place to help an organisation recover from and mitigate a cyber-attack. |
| **1** | **1-2 marks**<br>A basic suggestion, which shows:<br>• some knowledge and understanding of resilience controls<br>• some grasp of what could be put in place to help an organisation recover from and mitigate a cyber-attack. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|
| **5.** | *Analyse the functionality provided by the DNS system.* | | 8 | 8 |
| | **Indicative content**<br>Answers may refer to the following:<br><br>• The main function of DNS is to translate domain names, such as wjec.co.uk, to IP addresses 51.140.245.89.<br>• DNS provides a list of mail servers which accept email for domain names.<br>• DNS uses a distributed hierarchical database to store domain names and their IP addresses.<br>• DNS allows more than one name to point to the same IP address (e.g. bbc.com points to bbc.co.uk using a CNAME record).<br>• A user types a URL into a browser or a device which needs to connect with a server. This initiates an internet query to look for the domain name.<br>• If the device, or the computer the user is on, has a local Hosts file this is checked first to see if the domain name and its IP address is in there.<br>• If the domain name is not found there, or there is no file, a query is sent to the local (within the computer / devices network) DNS server.<br>• If this server is unable to resolve the name, the query is passed on to another DNS server higher up the hierarchy, until the IP address is resolved or the root server is found.<br>• The found IP address is passed back down the hierarchy until it reaches the original requesting devices which then sends data to the IP address.<br>• If an address is not found after the request going to the root server a message is displayed back at the browser or the device will fail to connect.<br><br>Credit any other valid response. | | | |

| Band | AO2 |
|---|---|
| **4** | **7-8 marks**<br>An excellent analysis which shows:<br>• thorough knowledge and understanding of the DNS system<br>• thorough examination of the functionality provided by the DNS system. |
| **3** | **5-6 marks**<br>A good analysis which shows:<br>• generally secure knowledge and understanding of the DNS system<br>• generally secure examination of the functionality provided by the DNS system. |
| **2** | **3-4 marks**<br>A basic analysis which demonstrates:<br>• some knowledge and understanding of the DNS system<br>• some examination of the functionality provided by the DNS system. |
| **1** | **1-2 marks**<br>A limited discussion. which demonstrates:<br>• little knowledge and understanding of the DNS system<br>• little examination of the functionality provided by the DNS system. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **6.** | | *In a certain computer an uncompressed movie file format uses 2 megabytes of storage space per frame. The video is recorded at a frame rate of 30fps, and the length of the movie is 30 seconds.* | | | |
| | (a) | *Calculate the total storage size of this movie file in gigabytes.*<br><br>*You may assume no sound or meta data is stored with the image at this point.*<br><br>*You should show your workings.* | | 3 | 3 |
| | | Award **one** mark for each correct step:<br><br>• 2 * 30 * 30 (1 mark for correct formula)<br><br>• 1800 (1 mark correct answer in megabytes)<br><br>• divide by 1024<br><br>• 1.758 GB or 1.7578125 GB (1 mark). | | | |
| | (b) | *Sound is now added to this movie file. It uses an uncompressed format which requires 512 kilobytes of storage per second.*<br><br>*Calculate the new movie file size in gigabytes.*<br><br>*You should show your workings.* | | 3 | 3 |
| | | Award **one** mark for each correct step:<br><br>• 512 kb * 30 = 15,360 kb (1 mark)<br><br>• Change to MB (or GB) 15.36 MB (1mark)<br><br>• Add to 1758 = 1773.36 MB<br><br>Change to gigabytes:<br>1.77 GB (1.77336) (1 Mark). | | | |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **7.** | | *Large data sets can be analysed in different ways.* | | | |
| | (a) | *Describe how large data sets can be analysed and used.* | 4 | | 4 |
| | | Award **one** mark for a limited description , for example:<br>• Large data sets can only be analysed computationally.<br><br>Award **two** marks for a basic description, for example:<br>• Large data sets can only be analysed computationally, to reveal patterns, trends and associations.<br><br>Award **three** marks for a more developed description, for example:<br>• Large data sets can only be analysed computationally, to reveal patterns, trends and associations. These data sets are too large to be stored in a DBMS.<br><br>Award **four** marks for a fully developed description, for example:<br>• Large data sets can only be analysed computationally, to reveal patterns, trends and associations, especially relating to human behaviours and interactions. These data sets are too large to be stored in a DBMS.<br><br>Credit any other valid response. | | | |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| | (b) | *Describe the use of Artificial Intelligence technologies in relation to large data sets, outlining the potential social implications which may arise.* | 10 | | 10 |
| | | **Indicative content**<br>Answers may refer to the following:<br>• Usage of Artificial Intelligence (AI) in relation to large data sets<br>  • AI and large data sets complement each other, the more data that AI has the more accurate it becomes.<br>  • Large data sets are useless without AI to analyse it as humans are unable to do it efficiently.<br>  • AI can analyse large data sets and detect unusual occurrences or anomalies in the data.<br>  • AI can recognise patterns in large data sets that humans can't see.<br>  • AI can use known conditions that have a defined probability of influencing the future outcome to work out the likelihood of that outcome.<br>• Social Implications of using AI and large data sets<br>  • AI pattern matching has been used in the detection of cancer cells for pre-diagnosis of conditions making. AI based expert systems are more accurate than humans.<br>  • AI has been used in video technology to provide facial recognition of individuals to enable tracking in crowds raising issues of privacy.<br>  • AI analysis of anomalies is used by a global network of sensors monitoring seismic activity on a real time basis. This provides data that AI can analyse and subsequently warn of potential earthquakes or tsunami.<br>  • AI analysis of a large range of weather conditions over a period of time is used to forecast the effects of global climate change.<br>  • AI-based data analytics applied to large data sets can lead to the unintended re-purposing of data as the analytics do not start with a pre-defined query but look for patterns and correlations.<br>  • Privacy issues for individuals can arise where, for example, geolocated social media data is used to infer people's residence and mobility patterns. Geotagged photos on other social media can be used to estimate tourist numbers and mobile phone presence data can be used to analyse numbers of shoppers in out of town shopping centres.<br>Credit any other valid response. | | | |

| Band | AO1 |
|---|---|
| **4** | **9-10 marks**<br>An excellent description which shows:<br>• thorough knowledge and understanding of the use of Artificial Intelligence technologies in relation to large data sets<br>• thorough consideration of the potential social implications of using Artificial Intelligence and large data sets. |
| **3** | **6-8 marks**<br>A good description which shows:<br>• generally secure knowledge and understanding of the use of Artificial Intelligence technologies in relation to large data sets<br>• generally secure consideration of the potential social implications of using Artificial Intelligence and large data sets. |
| **2** | **3-5 marks**<br>A basic description which demonstrates:<br>• some knowledge and understanding of the use of Artificial Intelligence technologies in relation to large data sets<br>• some consideration of the potential social implications of using Artificial Intelligence and large data sets. |
| **1** | **1-2 marks**<br>A limited description which demonstrates:<br>• little knowledge and understanding of the use of Artificial Intelligence technologies in relation to large data sets<br>• little consideration of the potential social implications of using Artificial Intelligence and large data sets. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|---|
| **8.** | | *Expert systems are used in many areas of finance, industry and society.* | | | |
| | (a) | *Outline the role of a knowledge engineer in relation to expert systems.* | 4 | | 4 |
| | | Award **one** mark for each relevant point regarding the role a knowledge engineer in relation to expert systems, up to a maximum of **four** marks, for example:<br><br>The knowledge engineer:<br>• is the technical expert<br>• obtains the information/facts/rules/is involved in knowledge acquisition<br>• contributes to the knowledge base<br>• collects evidence from subject experts/experienced practitioners in a particular field<br>• uses structured/unstructured interviews/problem solving/concept maps to structure the knowledge into the database<br>• validates/verifies the knowledge.<br><br>Credit any other valid response. | | | |
| | (b) | *Describe what is meant by the term heuristics in relation to expert systems.* | 6 | | 6 |
| | | **Indicative content**<br>Answers may refer to the following:<br><br>Heuristics:<br>• is an approach to problem solving that uses a practical method<br>• uses various shortcuts in order to produce solutions that may not be optimal but are sufficient<br>• can be described as rules of thumb<br>• are usually derived from human experience/intuition, not purely from logic<br>• require judgement/estimation/evaluation<br>• provide an approximation, which may not be optimal.<br><br>Answers may exemplify heuristics in specific context, such as a medical diagnosis system, an architectural design system, or expert systems in general.<br><br>Credit any other valid response. | | | |

| Band | AO1 |
|---|---|
| **3** | **5-6 marks**<br>A very good description, which shows:<br>• thorough knowledge and understanding of the term heuristics<br>• a confident grasp of how heuristics relate to expert systems. |
| **2** | **3-4 marks**<br>A good description, which shows:<br>• generally secure knowledge and understanding of the term heuristics<br>• a generally secure grasp of how heuristics relate to expert systems. |
| **1** | **1-2 marks**<br>A basic description, which shows:<br>• some knowledge and understanding of the term heuristics<br>• some grasp of how heuristics relate to expert systems. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

| Question | Answer | AO1 | AO2 | Total Mark |
|---|---|---|---|---|
| **9.** | *Analyse the social and environmental impacts associated with the proliferation of mobile handheld devices and the infrastructure to support their use.* | | 16 | 16 |
| | **Indicative content**<br>Answers may refer to the following:<br>**Device growth / usage**<br>• Ubiquity: the number of handheld devices has risen from 3.6 billion in 2016 to 6 billion in 2021 and is projected to be 7.5 billion by 2026. This compares to a rise in global population from 7.4 billion in 2016 to 7.8 billion in 2021.<br>• The percentage of all internet traffic has risen from 31% in 2015 to 55% in 2021 reflecting the usage of these devices.<br>• The polluting aspect of mining finite resources such as gold, cobalt and lithium.<br>• The average user changes their mobile phone every 2 years without recycling it. This is encouraged by mobile phone manufacturers changing their models every year.<br>• 5G linked with IoT will cut energy usage as smart devices shut off when not in use and other devices (such as cars) will be able to charge or run at periods when electricity is not being so widely used.<br><br>**Impact on Business**<br>• There has been a negative impact on the desktop PC market as people use handhelds for their day-to-day usage including news, posting statuses, reading and replying to messages and/or emails and posting photos.<br>• Photography businesses such as Kodak and Polaroid went out of business.<br>• It has revolutionised personal payment for goods, with technology companies arguably more powerful than banks because of the reach that their devices have and the need that banks and finance companies have for their payment services to be on them. This is coupled with the devices being more secure for payment than using a card or cash. Mobile apps for banking also enable instant checking on expenditure.<br>• The creation of a whole new area of business in app development and marketing as well as the whole mobile infrastructure industry.<br>• 5G is likely to account for 2.6 billion subscriptions and 45% of the world's total mobile data by the end of 2025.<br>• Telecoms consumes around 3% of global energy this could increase three times with the onset of 5G with a prediction of 170% by 2026. Although the 5G standard requires devices and infrastructure to consume less power (e.g. with 4G it takes around 1kWH to download 300 HD movies, with 5G 1kWH would be enough to download 5,000 UHD movies). Telecom energy usage is expected to be around 20% of global energy by 2030. | | | |

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| | • Mobile phone manufacture and telecom infrastructure manufacture is set to boom as hundreds of 5G cells get deployed.<br><br>**Impact on Education**<br>• Mobile devices enable distance learning and access to remote resources. This has bridged the digital divide where a desktop computer is not available, or internet access is difficult (e.g. in rural areas or countries with undeveloped infrastructure).<br>• Connected handheld devices enable different ways of learning allowing a more interactive personalised approach.<br>• There has been a rise in cyberbullying and associated problems in schools related to handheld device usage.<br>• There has been a documented improvement in literacy levels related to the increased use of text messages and social media.<br><br>**Impact on Health**<br>• More than half of users use handhelds to access health related services include fitness monitoring.<br>• Personalised fitness routines are available through handheld devices that can be tailored to an individual's age, health and personal preferences.<br>• Handheld devices enable the continuous monitoring of health through tracking and monitoring such things as heart rate (in conjunction with other wearables your device can dial the emergency services should it detect an imminent cardiac arrest), sleep, diet and fitness. Specialist apps are available for monitoring chronic conditions such as diabetes.<br>• Handheld devices can be responsible for accidents for example talking or texting while driving impairs a driver's ability to respond to events more than being over the drink drive limit.<br>• Apps are available to manage prescriptions (this enables people to take medicines on time and in the right dosage) and to promote alternative treatment such as mindfulness.<br><br>**Psychological impacts**<br>• Using hand held devices can lead to a stress reduction from interaction with families and friends, users are able to take an impromptu break from whatever work they are doing and socialise. There is also a measurable increase in brain function through stimulation.<br>• Handheld devices provide entertainment from games, music and reading especially while travelling. There is evidence that they lead to an improvement in social life from better and more varied interaction.<br>• Continued handheld usage can alter the brain's perception and change neuron pathways internally. There is evidence to suggest that handhelds can reduce intelligence (through over-reliance), increase stress as well as making users anxious and enabling them to be easily manipulated. | | | |

| | | | | |
|---|---|---|---|---|
| | • Use of handhelds can trigger obsession and addictive behaviour through overuse which can have an impact on health leading to an obsessive need to check handhelds dozens of times a day, an overreliance on the device to give answers and an increase in stress when the device is unable to perform as quickly as is wanted (e.g. in areas of low signal). This can lead to nomophobia (an extreme fear of not having your phone or not being able to use it.)<br>• The "death of conversation" as texting and messaging takes over and a consequent reduction in face to face communication.<br><br>**Wider societal impacts**<br>• Handheld devices promote independence in elderly and disabled people enabling them to communicate and interact in areas they may otherwise have struggled in.<br>• Trolling on social media in particular has led to widespread anxiety and stress in those affected. The anonymity and wide access that handheld devices, in conjunction with social media apps, has given has brought out the worst in people and enabled them to say things in public that they wouldn't be able to do if they were physically present.<br>• The use of hand held devices and the associated social media apps has enabled social justice campaigns (e.g. BLM, environmental concerns) to have a wider audience. The absence of any control, or a need to confirm opinion as fact, has also led to widespread conspiracy theories such as the anti-vaxxers and the 5G theories.<br>• There is a widespread adverse reaction to mobile phone masts/towers and aerial cabling with largely misplaced concerns about the amounts of electromagnetic radiation produced.<br>• Non-sharing of phone masts between companies has resulted in unnecessary duplication of infrastructure.<br>• SpaceX recently launched 595 satellites in order to beam 5G signals to area that would be hard to reach with masts. The ultimate aim is for 30,000 satellites forever altering the view of the night sky.<br>• Future deployment can have an impact on ecosystems. Bees exposed to low band radio wave radiation for 10 minutes suffer colony collapse. Einstein believed that humans would last 3 years at most if bees disappeared. Wireless radiation has an impact on bird migratory navigation and the production of eggs. 5G will result in mobile operators deploying between 100 and 350 small cells per square kilometre (indoors and out) it is unknown what effect this may have on bees, birds or other life.<br><br>Credit any other valid response. | | | |

| Band | AO2 |
|---|---|
| **4** | **13-16 marks**<br>An excellent analysis which shows:<br>• thorough knowledge and understanding of the social and environmental impacts associated with the proliferation of mobile handheld devices<br>• thorough consideration of the social and environmental impacts of the infrastructure necessary to support the use of mobile handheld devices.<br><br>• Writing is very well structured and organised, using accurate grammar, punctuation and spelling.<br>• A range of specialist terminology is used with accuracy. |
| **3** | **9-12 marks**<br>A good analysis which shows:<br>• generally secure knowledge and understanding of the social and environmental impacts associated with the proliferation of mobile handheld devices<br>• generally secure consideration of the social and environmental impacts of the infrastructure necessary to support the use of mobile handheld devices.<br><br>• Writing is generally well structured and organised, using mainly accurate grammar, punctuation and spelling.<br>• Specialist terminology is used with accuracy. |
| **2** | **5-8 marks**<br>A basic analysis which demonstrates:<br>• some knowledge and understanding of the social and/or environmental impacts associated with the proliferation of mobile handheld devices<br>• some consideration of the social and/or environmental impacts of the infrastructure necessary to support the use of mobile handheld devices.<br><br>• Writing shows some evidence of structure though some errors in grammar, punctuation and spelling affect meaning.<br>• Basic use of specialist terminology. |
| **1** | **1-4 marks**<br>A limited discussion which demonstrates:<br>• little knowledge and understanding of the social or environmental impacts associated with the proliferation of mobile handheld devices<br>• little consideration of the social or environmental impacts of the infrastructure necessary to support the use of mobile handheld devices.<br><br>• Some errors in grammar, punctuation and spelling, which affect clarity of communication.<br>• Limited use of specialist terminology. |
| | **0 marks**<br>Response not creditworthy or not attempted. |

## Mapping of questions to specification content and assessment objectives

| Question | | | Specification content (main focus) | | | | Mark allocation | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Section | | | Part | Total Marks | AO1 Marks | AO2 Marks |
| | | | 2.3.1 | 2.3.2 | 2.3.3 | | | | |
| **1** | (a) | | 4 | | | (a) | **4** | 4 | |
| | (b) | | 6 | | | (a) | **6** | 6 | |
| **2** | (a) | | | | 4 | (c) | **4** | 4 | |
| | (b) | | | | 8 | (c) | **8** | | 8 |
| **3** | (a) | | | 6 | | (b) | **6** | 6 | |
| | (b) | | | 8 | | (b) | **8** | | 8 |
| **4** | (a) | | | 4 | | (c) | **4** | | 4 |
| | (b) | | | 6 | | (c) | **6** | 6 | |
| **5** | | | | | 8 | (a) | **8** | | 8 |
| **6** | (a) | | 3 | | | (b) | **3** | | 3 |
| | (b) | | 3 | | | (b) | **3** | | 3 |
| **7** | (a) | | 4 | | | (c) | **4** | 4 | |
| | (b) | | 10 | | | (d) | **10** | 10 | |
| **8** | (a) | | 4 | | | (d) | **4** | 4 | |
| | (b) | | 6 | | | (d) | **6** | 6 | |
| **9** | | | | | 16 | (d) | **16** | | 16 |
| Total marks | | | **40** | **24** | **36** | | **100** | **50** | **50** |