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INTERNATIONAL ADVANCED LEVEL

INFORMATION TECHNOLOGY

GETTING STARTED GUIDE

Pearson Edexcel International Advanced Subsidiary in Information Technology (XIT11)
Pearson Edexcel International Advanced Level in Information Technology (YIT11)
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and August 2020 (International Advanced Level)

Pearson

Getting Started Guide: IAS/IAL Information Technology

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1 Introduction

This Getting Started Guide provides an introduction to the Pearson Edexcel International Advanced Level in Information Technology, which consists of two qualifications:

- International Advanced Subsidiary (IAS) in Information Technology
- International Advanced Level (IAL) in Information Technology

It is intended to clarify what students are expected to understand and be able to do and how they will be assessed. We hope you will find it a useful source of information both when planning delivery and during your teaching.

The Pearson Edexcel International Advanced Level Information Technology is a modular specification consisting of 4 units.

The IAS qualification consists of two 90 guided learning hours (GLH) units. It may be awarded as a qualification in its own right, or used as a stage on the way to completing the IAL.

The IAL qualification consists of the two IAS units plus two further 90 GLH IA2 units. All four units are externally assessed.

1.1 Research

The Pearson Edexcel International Advanced Level Information Technology specification was developed in consultation with the international schools' subject community, higher education and other key stakeholders. This ensures that it meets the needs of international learners, giving them the necessary knowledge and skills to support progression on to higher education and employment.
In addition, an in-depth review of other Level 3 curricula in information technology was undertaken to make sure that the two qualifications are comparable in demand to others taken in high-performing jurisdictions worldwide.

1.2 Key features

The specification has many attractive features, including:
Contemporary content based on current practices and standards

Updates will be published on the Pearson Edexcel website, if required, to ensure that the specification remains current throughout its lifetime.

Modular structure consisting of four equally sized units

This enables students to take examinations at the right time for them.

Clear specification that sets out requirements unambiguously

In addition to specifying in detail what students need to understand and be able to do for each unit, the specification provides essential information about assessment arrangements and administrative requirements.

Examination-only assessment with papers set and marked by Pearson Edexcel

A combination of written and practical examination papers is used to assess students' knowledge, understanding and practical skills.

There is no teacher-marked coursework. Instead, Units 2 and 4 use three-hour computer-based examinations to assess students' technical expertise.

Accessible exam papers that help students get the results they deserve

Unambiguous wording and consistent use of command words across papers and between series ensure that our expectations are clear. Ramping in terms of demand within a question, as well as within a paper gives students a fair chance of gaining some marks on every question throughout the paper.

Our mark schemes use a consistent notation and format that shows clearly what marks are awarded for, with additional guidance where necessary to make the assessment requirements clear.

Qualification structure

The IAS qualification consists of two units -1 and 2. The IAL qualification consists of all four units - 1, 2, 3 and 4. This allows students who originally wanted to study the IAS to change their minds and continue onto IAL and carry over their IAS marks.

Transferable skills that are valued by HE and employers

Whilst studying for the IAS or IAL, there are many opportunities for student to acquire valuable cognitive, intrapersonal and interpersonal skills which will help prepare them to respond with confidence to the demands of undergraduate study and the world of work.

1.3 Support

Pearson Edexcel is committed to promoting great information technology teaching. Our package of support to help you plan and implement the new IAS and IAL in Information Technology includes:

Planning – an editable scheme of work, with suggestions for classroom activities and suggested resources, which you can adapt to suit the structure of your school year and your preferred delivery method.

This Getting Started Guide and a separate suggested resource lists for each unit.

Understanding the assessment requirements – two sets of sample assessment material (SAM) - a general one published on the IT web page and a secure version available to registered centres only, to help you and your students familiarise yourselves with the format and level of demand of the examination papers.

Marked exemplar responses - using SAMs - these give more details on how marks are allocated to certain responses

Principal Examiner reports - these are published at the end of each examination series to provide detailed feedback on students' performance.

ResultsPlus - Analysing student performance - our online ResultsPlus service provides detailed analysis of students' examination performance, helping you to identify aspects of your scheme of work that could be improved to provide more detailed coverage of specific topics and skills.

Help and support – our subject advisor team is a direct and personal source of help and support. Sign up to receive the regular e-newsletter, which will keep you up to date with qualification and service news.
Click here to contact the subject advisor team.

Training events – Getting Ready to Teach events are available to equip teachers with the information they need to plan and deliver the specification successfully. Other events can also be planned to meet teachers' needs, please contact your local Regional Development Manager for information on additional training events.

2 What's changed?

The Pearson Edexcel International Advanced Subsidiary and Advanced Level Information Technology are new qualifications. They replace the previous Applied ICT qualification. Although some popular elements of the Applied ICT qualification have been retained, the new qualifications have a substantial amount of new content. Some topics that were tested in the coursework component are now included in the written examinations.

2.1 Structure

These qualifications have a modular structure. The IAS consists of two units and the IAL of four units. Each unit requires 90 hours of guided learning.

The IAS can be awarded as a qualification in its own right or used as a stage on the way to completing the IAL.

Students wishing to take the IAS qualification study Units 1 and 2 and those wishing to take the IAL qualification study additional two IA2 units. All four units are mandatory. This ensures that all students follow a coherent programme of study.

2.2 Content

The new qualification covers fundamental concepts of IT in considerably more breadth and depth than the previous Applied ICT. New IAS content includes digital technologies and systems, networks, security, structured query language (SQL) and coding for the web. IT systems in organisations, systems development and emerging technologies, including virtual and augmented reality and the internet of things, are covered in IA2.

Like the Applied ICT, the specification has a strong practical element and relational databases remain a key focus. In Unit 1, in addition to learning how data is structured in a relational database, students are taught how to use SQL to manipulate data. Data normalisation is covered in Unit 3 and the whole of Unit 4 is devoted to working with relational databases.

Project management is now a theory topic in Unit 3. Students learn approaches to, and tools for, managing IT projects, but they are not expected to manage a project of their own.

The digital literacy skills in the Applied ICT specification – use of applications, such as spreadsheets, presentations and multimedia software – have been removed. Instead, in Unit 2 students learn how to code for the web using HTML, CSS and JavaScript.

2.3 Assessment

Each of the four units in the new specification is assessed through an externally set and marked examination.

There is no teacher-assessed coursework.

Units 1 and 3 each has a traditional, 2-hour written examination paper.
Units 2 and 4 have 3-hour practical examinations. Although students need to use a computer for the examination, some questions require them to provide a written response.

In unit 2, the examination paper will include:

- questions that are answered on the hard copy in the same way as units 1 and 3
- questions that require the student to produce code as the response. This will be submitted electronically.

In Unit 4 students will respond using the template provided for each examination series. This will include written responses and screen prints of codes and outputs from the database that they develop.

3 Overview

Information Technology (IT) is a discipline in its own right, concerned with how computers and other digital devices are used separately and in combination to store, retrieve, transmit, manipulate and secure data, with particular emphasis on the functional and usability requirements of end users. Students of IT learn to apply their knowledge and understanding to design, develop and evaluate IT solutions that are fit for purpose. They also learn about the wider issues – both positive and negative – associated with society's use of and dependence on IT systems.

The Pearson Edexcel International Advanced Level Information Technology specification is designed to give students a wide ranging understanding of current information technology concepts and develop their specialist technical knowledge and skills. In addition, the specification provides opportunities for students to develop and practice the cognitive, interpersonal and intrapersonal skills required to excel in a professional IT environment.

We hope that it will awaken students' interest in and enthusiasm for IT, and encourage them to consider studying the subject at university and eventually a career in the IT sector.

3.1 Aims and objectives

Students who study the IAS in Information Technology will:

- Acquire knowledge and understanding of essential information technology concepts – contemporary digital hardware and software technologies, networks, the online environment, IT systems, data and databases – as well as the wider issues associated with the widespread use of IT
- Learn how to use diagrammatic tools to represent network designs, data flows, processes and entity-relationships.
- Be able to design networks and IT systems using appropriate technology to meet needs.
- Learn how data is structured in databases and how to use SQL to manipulate structured data.
- Develop practical skills in the use of the three core web languages – HTML, CSS and JavaScript – as well as a solid understanding of web design principles, enabling them to produce user-friendly, interactive web products.

In addition, those who go on to study the IAL in Information Technology will:

- Broaden their knowledge and understanding of information technology concepts – data manipulation, enabling technologies, IT systems in organisations, systems development, emerging technologies.
- Learn how to interpret and construct data dictionaries, design data validation rules and normalise data into first, second and third normal form.

- Find out how to interpret and use project management tools – Gantt charts, critical path analysis, precedence tables.
- Develop technical skills in the use of relational database software that enables them to amend, construct and interrogate databases, import and export data and create appropriate user interfaces.

3.2 Structure

The IAS and the IAL in Information Technology are modular qualifications. The IAS is the first half of the IAL and may be awarded as a discrete qualification. It consists of two equally weighted mandatory IAS units (Units 1 and 2).

The IAL consists of four equally weighted mandatory units – the two IAS units, plus two IA2 units (Units 3 and 4) that build upon the knowledge, understanding and skills developed in the IAS.

Figure 1 provides an overview of the two qualifications.

Qualification	Qualification code	Teaching time required	Number of units	Delivery Method
International Advanced Subsidiary in Information Technology	XIT11	180 GLH	2	Taught over one year, with the option to top up to the IAL in Year 2.
International Advanced Level in Information Technology	YIT11	360 GLH	4	Taught over two years (two units studied in each year).

Figure 1

3.3 Content

The compulsory content of the IAS and IAL in Information Technology combines knowledge and understanding of the fundamental concepts of information technology with practical application of IT technical skills.

Each unit of the qualification consists of a number of related topics.

Each topic is divided into sections, comprising a set of numbered statements. In some instances, lettered sub-bullets specify the detail of what must be covered.

As a minimum, all the statements in the content must be taught.

IAS units

Unit 1

This unit takes a 'broad brush' approach to provide students with a solid grounding in the fundamental concepts of information technology.

Topic 1
Students learn about the hardware and software components of contemporary digital devices and how to select appropriate devices to meet the needs of individuals and organisations.

Topic 2
Computer networks are the subject of Topic 2. Students learn about network models and communication protocols and how to produce outline designs for networks to meet specified requirements. This topic also addresses network security – threats to networks and mitigating measures that can be taken.

Topic 3
This topic deals with the online environment. Students learn how the internet is structured and features and functions of the world wide web. They are introduced to the concepts of static versus dynamic web page content and client-side versus server side scripting – useful background information for Unit 2. This topic includes consideration of the impact and potential of operating online, online communities, as well as cloud storage and cloud computing.

Topic 4
Topic 4 is about IT systems. In addition to the theory, students learn practical diagrammatic techniques for depicting data flow and processes in systems.

Topic 5
Data and databases are the subject of Topic 5. Students learn the difference between data and information and between structured and unstructured data. They are introduced to the concept of a relational database, learn entity-relationship modelling and gain practical experience of using SQL to manipulate data and data structures – providing a solid foundation for those who go on to study relational databases in depth at IA2 (Unit 4).

Topic 6
In Topic 6 students are introduced to some of the wider issues associated with the use of IT.

Unit 2

This is a practical unit. Students learn how to use HTML, CSS and JavaScript to create user friendly web products.

Topic 7
Topic 7 focuses on HTML. Students learn about the structure of a web page and how to use HTML to define the page structure, format text and add components, including links, lists, images and

forms.

Topic 8
In Topic 8 students learn how to use CSS in conjunction with HTML to style web pages, position content and create simple animations. Students also learn about responsive design techniques and how to design for differently sized screens.

Topic 9
JavaScript is the focus of Topic 9. Students learn how to use JavaScript code to add dynamic interactivity to web pages.

Topic 10
This topic focuses on web design, covering basic principles, accessibility and usability.

Topic 11
The semantic web is the focus of this topic, although students should be encouraged to write semantic code right from the start.

IA2 units
Unit 3

Unit 3 builds on the content of Unit 1, developing students' knowledge and understanding of key IT concepts.

Topic 12
This topic covers various aspects of data. It picks up where Unit 1, Topic 5, Data and databases leaves off. Students learn about data integrity and data normalisation. They learn how to interpret and construct data dictionaries, design validation rules and produce logical data models. This topic also includes an introduction to 'Big Data'.

Topic 13
Four important enabling technologies are covered in this topic – virtualisation, distributed systems, human computer interaction (HCI) and encryption. The concept of cloud storage is revisited (introduced in Unit 1, Topic 3). Students learn more about how data is stored in the cloud, how it is secured and are introduced to the features and functions of database management systems (DBMS) that enable user access and views to be controlled – something they'll gain practical experience of in Unit 4.

Topic 14
This topic considers the role of IT systems in organisations. It covers four specific types of system: transaction processing, customer relationship management, management information systems and intelligent transportation systems and considers operational issues associated with their use.

Topic 15
IT project management is the subject of this topic. Students learn why the development of a new IT system needs to be properly

managed and two popular methodologies for managing projects – waterfall and agile. They gain practical experience of specifying SMART targets and using various project management tools.

Topic 16
Topic 16 introduces students to three emerging technologies – machine learning, virtual and augmented reality and the Internet of Things (IoT).

Unit 4

This is a practical unit focusing on the use of relational database software to organise and interrogate data. It picks up on the knowledge and understanding students have already gained when studying Unit 1, Topic 5: Data and databases, and Unit 3, Topic 12: Manipulating data and Topic 13: Enabling technologies (Sections 13.3: HCI and 13.4: Storing and securing data). There are three topics.

Topic 17
This topic deals with the need for relational databases, how user requirements and characteristics impact on database design and how the design of a database can affect the user experience.

Topic 18
Relational database concepts are the subject of Topic 18. Students learn how to structure data into tables, records and fields, using appropriate data types and formats, use keys to create relationships between tables, techniques for improving the quality of data entry and validating user input.

Topic 19
This topic focuses on the skills students need to acquire in order to produce effective database solutions. Evaluation is a common theme throughout this unit. Students learn why it is important to evaluate database solutions, how to go about it, including how to identify potential enhancements.

3.4 Assessment

Examination papers

A full range of knowledge, understanding and skills are assessed in both IAS and IAL qualifications. Units 01 and 03 are traditional written examination papers covering knowledge and understanding of IT concepts and systems. Units 02 and 04 are practical examinations which require use of a computer and assess technical knowledge and skills in practical contexts, along with related theoretical understanding.

Instructions for the conduct of the practical examinations (ICE) will be issued by Pearson Edexcel prior to the start of each examination series.

Clear and accessible language is used in all the papers. Command words signal what sort of response is expected. Every question has just one command word which generally appears at the start.

The table in **Appendix 6 of the specification** **(pages 66 - 67)** provides an explanation of each of the command words used. Students should understand what type of response each command word requires, as well as the significance of the number of marks allocated to a question.

Figure 2 summarises the assessment structure.

Unit	Paper code	Type	Lev	Marks	Time	Availability	Weighting
1	WIT11/01	Written exam	IAS	80	2h	June *(First assessed in June 2019)*	50% of IAS 25% of IAL
2	WIT12/01	Practical exam	IAS	80	3h	June *(First assessed in June 2019)*	50% of IAS 25% of IAL
3	WIT13/03	Written exam	IA2	80	2h	June *(First assessed in June 2020)*	25% of IAL
4	WIT14/01	Practical exam	IA2	80	3h	June *(First assessed in June 2020)*	25% of IAL

Figure 2

At the end of each examination series, the principal examiner for each paper reports on student performance, identifying areas of weakness and offering suggestions for improvement.

Assessment objectives

There are four assessment objectives common to both the IAS and the IAL. These are listed in Figure 3, along with their respective component weighting.

		% of IAS	% of IA2	% of IAL
AO1	Demonstrate knowledge and understanding of the concepts of IT	24	10	17
AO2	Apply knowledge and understanding of the concepts of IT	40	36	38
AO3	Analyse and evaluate IT information and problems	10	14	12
AO4	Use analysis and evaluation to design solutions	26	40	33

Figure 3

AO1 and AO2 together have a weighting of 64% in IAS, compared with 46% in IA2.

As you would expect, IA2 requires higher order skills than IAS. This is reflected in the 54% weighting allocated to AO3 and AO4 in Units 3 and 4 - compared with 36% in Units 1 and 2.

In the context of AO1, 'demonstrate' means showing knowledge and understanding, for example, by stating, describing or explaining an aspect of the subject content. This assessment objective generally tests knowledge recall and understanding. The questions below both target AO1.

SAM Paper WIT11/01, Q4(a)(i)

Explain the difference between 'data' and 'information'.
(2 marks)

SAM Paper WIT12/01, Q2(d)

Explain how CSS and HTML work together to define a web page.

(2 marks)

In the context of AO2, 'apply' means using knowledge and understanding of an aspect of the subject content in a particular context. The question below assesses students' ability to use their knowledge of the difference between data and information to identify an example of each in the customer details supplied.

SAM WIT11/01, Q4(a)(ii)

Give **one** example of data and **one** example of information relating to customer details.

(2 marks)

In the practical exams AO2 is generally assessed with code items that ask students to apply a specific skill. The question below is an example. It requires students to open a file and amend some code.

SAM Paper WIT12/01, Q2(c)

The web page needs a paragraph to be displayed in a box with rounded corners.

- The font size must be 36 pixels
- The background colour must be hot pink (#FF69B4)
- The radius of the corners must be 10 pixels

Open the file Q02c.html page in your editor.
Amend the code to complete the definition for #roundbox.
Save the amended code as Q02cFINISHED.html.
(3 marks)

AO3 and AO4 both require independent thinking. In the context of AO3, 'analyse and evaluate' involves decomposing/assessing a problem or issue and requires a written response. In the example below students must consider competing arguments for and against joining an online professional community and draw an informed conclusion. 6 of the 12 marks available are allocated to AO3; the remaining six are divided equally between A01 and AO2 since in their response students must demonstrate and apply their knowledge and understanding of online communities.

SAM WIT11/01, Q6

Dylan has found his first job in an IT department. He is deciding whether to join an online community of other IT professionals.
Evaluate the advantages and disadvantages of Dylan joining an online community for IT professionals.
(12 marks)

A04 is about designing solutions to problems and by its very nature is highly practical. The question below is an example. It requires students to analyse a problem and design an appropriate solution.

SAM WIT11/01, Q5(b)

Sometimes, customers leave without paying for the fuel. In order to stop this, the service station puts a camera and a motion sensor on each of the four pumps. The service station will have a date- and time-stamped photograph of all vehicles using the service station.

Draw a flowchart to describe this process.

(6 marks)

Awarding and reporting

The IAS is graded on a five-grade scale from A to E. The IAL is graded on a six-grade scale from A* to E. Students whose level of achievement is below that required for a grade E will receive an unclassified U result.

Individual unit results are reported. Grade boundaries for each unit are determined by an awarding committee at the end of each examination series. Raw marks are then converted into uniform marks. The uniform marks at each grade threshold for each unit and for each qualification can be found on page 54 of the specification.

Students can re-sit units. If a student re-sits a unit more than once, only the better of the two most recent attempts will be available for aggregation to a qualification grade. Please refer to details regarding resitting units in the Administration and general information section of the specification.

Hardware and software requirements

Information Technology is a practical subject that involves the use of computer resources, both hardware and software.

The table below summarises the hardware and software requirements for Pearson Edexcel International Advanced Subsidiary and International Advanced Level Information Technology.

IAS and IAL	Students will need occasional access to a computer with an Internet connection in order to undertake research, access learning materials and participate in online training. They may want to use office productivity applications, such as word processing, presentation and drawing software, for tasks such as writing notes and reports, creating presentations and producing diagrams. For Unit 1, students should be exposed to a wide range of digital devices, and technologies. However, centres aren't expected to provide all of these. Instead, students should be encouraged to visit IT retail outlets, attend trade exhibitions and read online product reviews. Although not a requirement, it is desirable for students to have some practical experience of networking to reinforce the theory covered in Unit 1. They could, for example, network two or more Raspberry Pi computers together (see https://www.raspberrypi.org/learning/networking-lessons/). It is also advantageous for students to have access to relational database software whilst studying Unit 1. This will give them an opportunity to create database structures and use SQL commands to query and manipulate data. For Unit 2, students will need to make extensive use of a computer with a text editor and browser software installed. Modern browsers come bundled with JavaScript so there should be no need to install it separately. However, it will need to be enabled. Students do not have to upload their web pages to a web host, although it is a valuable experience for them to have and will strengthen their understanding of how the world wide web functions.
IAL only	For IA2, students will need to make extensive use of a database management system (DBMS), such as Microsoft Access, which resides and stores files on a standard personal computer. If available, students may want to use specialist project management software to draw Gantt charts, critical paths etc, although this is not a requirement. Ideally, students should be using applications such as Google Drive or DropBox, however this is not a requirement.

3.5 Transferable skills

In recent years, higher education institutions and employers have consistently flagged the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work.

Both the IAS and IAL support the development of cognitive, intrapersonal and interpersonal skills. A subject interpretation of each skill, together with a mapping showing opportunities for student development is available outlined in **Appendix A** at the end of this guide.

4 Course planning

4.1 Delivery models

Both the IAS and the IAL in Information Technology qualifications are modular, with assessment opportunities available in June each year.

Centres can deliver Units 1 and 2 in the first year. The units could be taught in parallel or sequentially, depending on what is most appropriate for staffing and timetabling.

The 'long thin' approach, where both units are taught in parallel across the whole year, is ideal for developing and consolidating the technical skills covered in Unit 2. However, it only works if sufficient time is allocated for revision, particularly to revisit Unit 1 topics covered early in the year.

The 'short fat' approach, where units are taught one after another, allows students to focus on just one thing at a time, but means they have less time to develop skills, knowledge and understanding and a maturity of approach.

Centres offering only the IAL may also start with Units 1 and 2 in the first year and then go on to deliver Units 3 and 4 in the second year. However, they could decide to structure the course differently and adopt an integrated approach. For example, by teaching all the database content from Unit 1 (Topic 5), Unit 3 (Topic 12) and Unit 4 together or teaching all the IT systems content from Unit 1 (Topics 4) and Unit 3 (Topics 14 and 15).

Whichever approach is adopted, centres should be aware that many of the topics introduced in Unit 1 are revisited and studied in more depth in Units 3 and 4 and that students will benefit from learning about data dictionaries and normalisation (Unit 3, Topic 12) prior to or alongside studying Unit 4.

4.2 Resources

Students will need access to suitable hardware and software for practical work, but it is not necessary for all lessons to be timetabled in a computer room. A normal classroom environment is more appropriate for teacher-led and group-work activities.

If at all possible, students should be given the opportunity to view IT systems in action preferably in a number of different environments and organisations and/or meet IT professionals.

Given the evolving nature of IT a text book is likely to be out of date even before it is printed. Instead, **a list of suggested resources for each unit is published on the IAL IT subject page on Pearson Edexcel website.**

5 Delivery and assessment guidance

This section provides detailed information, suggested teaching approaches and resources for each unit of the specification. It is not definitive. The specification must be referred to as the authoritative source of information.

5.1 Unit 1

This is an IAS level unit, designed to give students a broad understanding of basic IT concepts along with some practical design and modelling skills.

Subject content

The content of the unit is arranged as six topics.

Topic 1: Hardware and software

In Topic 1 students learn about the functions and features of contemporary digital devices.

Section 1.1 focuses on hardware – computers, mobile phones, peripherals and storage devices (Statement 1.1.1) – and the technologies they use (Statement 1.1.2).

Students must know the difference between a function and a feature. One function of a smart phone, for example, is to take photographs. A feature of the camera is that it has a telephoto lens that is optically stabilised so that it performs better in low light.

Students are expected to recognise that computers take many forms, from embedded microprocessors to distributed clouds. They should be familiar with a variety of types, including desktops, laptops, single board computers, wearable computers, games consoles and super computers.

They should be taught about types of peripheral devices used for input/output, including keyboard, mouse, joystick, microphone, scanner, monitor, speaker, printer, web cam, touch screen, graphics tablet, biometric scanner, barcode reader, chip and pin and different types of sensors.

The storage devices they should be familiar with include magnetic, solid state and optical hard drives, magnetic tape drives, removal solid state (SSID) cards, network attached storage (NAS) and RAID storage.

SAM Unit WIT11/01, Question 1(b)(ii) asks about the frequency response of speakers. It requires straightforward knowledge recall (AO1) and exemplifies one way in which this content could be assessed.

Students need to be able to read and explain the meaning of device specifications and understand factors that are used to assess the performance of digital devices (Statement 1.1.6)

Nowadays many digital devices have more than one function. Students must understand the term 'technological convergence' – the combination of two or more different technologies in a single device – and be able to judge if a device demonstrates technological convergence (Statement 1.1.3).

SAM Unit WIT11/01, Question 1(d) asks about the benefits of technological convergence. Students have to apply their knowledge and understanding in the specific context of a fitness device worn on the wrist (AO2).

Convenience is an obvious benefit of technological convergence, but students need to be aware of the pros and cons of using a dedicated rather than a multi-functional device - is 'good enough' functionality and convenience preferable to the greater functionality offered by a dedicated device?

Embedded systems are a ubiquitous component of our everyday lives. Students must be familiar with the concept of an embedded system –a computer system dedicated to a particular function within a larger mechanical or electrical system, often operating in real time – and be able to give examples of devices that use embedded systems for specific functions (Statement 1.1.4).

Students must be familiar with the term 'firmware' – what it is, where it resides, what it does, why it sometimes needs to be updated and how to do so (Statement 1.1.5).

Students must be able to construct expressions to calculate file sizes and file transmission times (Statement 1.1.7) and to convert between binary and denary using the IEC binary prefixes – 1 kibibyte is 1024 bytes (Statement 1.1.8).

In the examination, the use of calculators is not permitted. Students will not be expected to do complex mental arithmetic, instead they will be asked to give an expression for deriving the result.

Section 1.2 focuses on software. Students must understand the key role that software plays in digital devices. They must be able to differentiate between and understand the function of systems software and applications software and be aware of the huge variety of general-purpose and specialist applications software that exists (Statements 1.2.1 and 1.2.2).

They might it helpful to think of a computer system as a layered model, with the system software acting as the interface between the hardware and the user applications.

Students are expected to understand the difference between proprietary and free/open-source software and the role of copyright and licensing in governing how software is used and distributed. (Statements 1.2.3 and 1.2.4).

One useful classroom activity might be to provide students with a number of different scenarios and ask them to select the most appropriate software type and licence option for each.

SAM Unit WIT11/01, Question 2(b) asks a straight forward question about multiple user licensing. It requires students to recall knowledge (AO1).

Statement 1.2.5 deals with the role that updates play in fixing software vulnerabilities and rolling out new features. As well as understanding the benefits of installing updates, students must also be aware that – in some cases – compatibility issues may occur. Encourage them to follow news stories covering this topic.

Students must be able to apply the knowledge and understanding they gain when studying Topic 1 to select appropriate hardware and software to meet the needs of individuals and organisations. (Statements 1.1.9 and 1.2.6).

Topic 2: Networks
In Topic 2 students learn about network models and protocols, metrics for measuring network performance, network components and network security. They also learn how to produce network designs to meet specified requirements

Section 2.1 focuses on network models and communication protocols. Students must be taught to understand the differences between client-server and peer-to-peer networks. They should know that an ad hoc network is a type of peer-to-peer network that allows devices to communicate directly with one another without the need for any fixed infrastructure and that tethering is a method of creating a local network connection between a mobile phone and another device, such as a laptop, usually for the purpose of sharing the former's mobile internet connection. (Statement 2.1.1).

Statement 2.1.2 deals with standards and protocols. Students need to understand what a protocol is and why protocols are needed. They must know about the features of five low powered, short range, wireless communication protocols – WiFi, Zigbee, Bluetooth, 3G/4G cellular and infrared - and what they can be used for. They must also be familiar with the Ethernet network protocol that controls how data is transmitted over a local area network (LAN).

Statement 2.1.3 covers the TCP/IP protocol stack, an open standard network model used to interconnect devices on the internet. Students must be able to describe the main function

of each of the four layers in the stack, the main protocols each uses and how data passes p and down the stack. They should understand the benefits of using a layered approach.
In addition to TCP/IP, students must also know about the OSI reference model that divides the process of communicating across a network into a seven-layer stack. They should be able to name the seven layers, put them in order and describe the function of each.

SAM Unit WIT11/01, Question 3(a) asks about the Layer 7(Application) of the OSI model. It requires students to demonstrate their understanding (AO1).

Students need to understand how data passes through each of the seven layers.

Statement 2.1.3 also identifies two key internet telephony protocols – VOIP and SIP – that students are expected to understand.

Section 2.2 deals with network design and implementation
Students must understand the characteristics and features (range, scalability, security, equipment requirements etc.) of the wired and wireless transmission media listed in Statement 2.2.1 and be aware of their advantages and disadvantages.

Student must understand the role of the network components listed in Statement 2.2.3. They should be taught the difference between a hub and a switch and what each could be used for.

Students are expected to understand a range of metrics for measuring the performance of networks (Statement 2.2.2).

Statement 2.2.4 provides an opportunity for some practical work. Students must learn how to produce outline designs for networks that use wired and/or wireless technologies. There is no need for them to use formal notation. They must be familiar with a range of different types of digital devices commonly connected on networks, including warning devices, such as smoke detectors and burglar alarms, metering devices, and entertainment devices such as speakers.

SAM Unit WIT11/01, Question 3(b) shows how this requirement is likely to be assessed. It addresses Statements 2.2.3 and 2.2.4 and requires students to use analysis and evaluation in order to design a network that meets the camp's requirements. All 9 marks are allocated to AO4. Students will need time to develop and practice this skill.

It is essential that devices on a network can be uniquely identified. IP and MAC addresses are two ways of achieving this. Students should understand the difference between the two and how they work together to ensure that data on a network reaches its

intended destination (Statement 2.2.5). They should be familiar with the concept of static and dynamic IP addresses and understand why both are needed.

Network security is the focus of **Section 2.3.** Students must understand threats to network security (Statement 2.3.1) and a range of hardware and software techniques for securing networks (Statement 2.3.2). They should recognise that deploying a combination of techniques provides a greater level of security than using just one. They should be encouraged to look out for news stories – of which there are many – that cover breaches of security.

SAM Unit WIT11/01, Question 2(c) asks students to describe one way in which multi-factor authentication, requiring users to provide two or more pieces of evidence, could be implemented by an organisation. It requires straightforward recall of knowledge and understanding (AO1).

Topic 3: The online environment

In Topic 3 students learn about the internet and the world wide web, operating online, online communities, cloud storage and cloud computing.

Section 3.1 deals with the internet and World Wide Web. Students must be clear about the difference between the two.

Statement 3.1.3 covers static and dynamic web page content, whilst statements 3.1.4, and 3.1.5 deal with client-side and server-side scripting.

SAM Unit WIT11/01, Question 3(c) illustrates how this content could be assessed. It is an extended open response question that requires students to apply their knowledge of how client-side and server-side work together to an online booking system. In this case a written explanation is required. The 6 available marks are distributed equally between AO1, AO2 and AO3.

Students should be made aware of to the connection between the theory being covered here and the practical work they undertake in Unit 2.

Section 3.2 looks at the pros and cons of operating online – impact and potential (Statement 3.2.1), security risks (Statement 3.2.2) and the concept of a digital footprint (Statement (3.2.3).

Section 3.3 covers online communities.

SAM Unit WIT11/01, Question 6 addresses Statements 3.3.1, 3.3.2 and 3.3.3. Students are expected to apply their understanding of online communities to a specific context - the advantages and disadvantages of joining an online community for IT professionals. The question is worth 12 marks- (3 each for AO1 and AO2 and 6 for AO3) and requires an essay-style response. In preparation for

the examination, students need to practice tackling these sorts of questions.

Statement 3.3.3 considers the monetarisation opportunities provided by online communities. Students should be able to find lots of relevant information about this online and – of course – there is always a lot about it in the press.

Section 3.4 deals with cloud storage (Statement 3.4.1) and cloud computing (Statement 3.4.2). Students should understand the security issues specific to storing data in the cloud.

SAM Unit WIT11/01, Question 2(a) is worth four marks and assesses students' understanding of the benefits of storing data in the cloud rather than on a local server. It requires straightforward recall of knowledge and understanding (AO1).

Topic 4: IT systems

In Topic 4 students learn what an IT system is, the components of IT systems and how to design and evaluate IT systems to meet specified requirements. They also learn how to depict aspects of IT systems using conventional notation.

Sections 4.1 and **4.4**. deals with systems design. Students must understand the concept of an IT system – a collection of interconnected devices working together to achieve a desired outcome (Statement 4.1.1) and the advantages and disadvantages of IT systems for individuals and organisations (Statement 4.4.1).

SAM Unit WIT11/01 Question 1(a)(ii) illustrates one way in which this content can be assessed.

Students must understand how to decompose an IT system into smaller sub-systems/components (Statement 4.1.2) and be able to evaluate the fitness for purpose of an IT system (Statement 4.1.4).

From their work on Topic 1, students should already be familiar with a range of contemporary digital devices. Statement 4.4.2 looks at how these devices work together in an IT system.

Students are expected to be able to design IT systems to meet specified requirements (Statement 4.1.3).

SAM Unit WIT11/01, Question 1(c) requires students to identify appropriate components for an IT system for a baby monitor. They must apply their knowledge and understanding to the context (AO2).

Section 4.2 covers the flow of data within an IT system and the use of data flow diagrams (DFDs) to provide a graphically

representation of that flow, including the processes which transform data and where data is stored. Students must be able to interpret and create DFDs for given scenarios (Statements 4.2.1 and 4.2.2). The DFD symbols they must recognise and use are specified in Appendix 7 of the specification (Page 69). They will only be expected to work with Context Level and Level 1 DFDs.

SAM Unit WIT11/01, Question 5(a) shows a partially completed DFD for purchasing fuel at a service station. Students must supply the names of the six components whose labels have been omitted. This question addresses AO3 since it requires students to analyse and evaluate the given information in order complete the table.

Section 4.3 covers the use of flowcharts to represent a system. Students must be able to interpret and create flowcharts for given scenarios (Statements 4.3.1 and 4.3.2). The flowchart symbols they must recognise and use are specified in Appendix 7 of the specification (Page 68).

SAM Unit WIT11/01, Question 5(b) requires students to produce a flowchart to describe a process for capturing and storing information about vehicles filling up fuel at a service station. Since it requires the design of a solution, all 6 marks are allocated to A04.

Topic 5: Data and databases

In Topic 5 students learn about data and information and how data in a relational database is structured. They also learn how to use SQL to create tables and perform queries.

IT systems operate on data. **Section 5.1** covers how data differs from information (Statement 5.1.1), the difference between structured and unstructured data (Statement (5.1.2) before honing in on relational databases in **Section 5.2** and structured query language (SQL) in **Section 5.3**. It provides a foundation for study of Unit 4 for those students going on to IA2.

The ER diagram symbols which students need to know are listed in Appendix 7 (page 69). They must be able to interpret and create ER diagrams for a given scenario.

SAM Unit WIT11/01, Question 4 covers various aspects of this topic. Question 4(a)(i) requires straight forward recall of knowledge (AO1). Whereas to get the marks for the second part of the question, students must apply their general knowledge to the hotel context (AO2). The SQL query required by Question 4(b) is complex. Students must select the required fields, identify the matching fields in the two tables, count the number of occurrences, group the data and display in descending order. The 6 marks are split evenly between AO2 and AO4.

Students don’t have to be taught about normalisation at this stage. Those who go on to study IA2 will cover normalisation in Unit 3, Topic 12, Section 2.

Topic 6: Wider issues

In Topic 6 students learn about some of the wider issues associated with the use of IT, including environmental, legal moral and ethical concerns. They also learn about the impact of ubiquitous wireless access through investigating smart cities and location awareness.

Topic 6 is concerned with the impact – positive and negative – of information technology, including the profound social and ethical challenges posed by IT. There are lots of news stories around for these topics for students to explore.

Section 6.1 focuses on the environment, in particular issues associated with manufacture use and disposal of IT equipment (Statement 6.1.1) and the role of IT in environmental monitoring and efficient use of resources.

Section 6.2 considers some of the legal, moral and ethical issues associated with IT.

Statement 6.2.1 focuses on legal issues. Students must be aware that the purpose of data protection legislation is to prohibit the disclosure and/or misuse of information about individuals. They should know about the data protection laws that apply in their own country and those that affect organisations and individuals operating in the global arena.

Students must be familiar with the term 'intellectual property (IP)' and be aware of mechanisms that exist to protect IP, i.e. patents, trademarks and copyright. They should know about the Berne Convention for the Protection of Literary and Artistic Works, an international agreement governing copyright.

Students should understand how computer misuse laws, such as the UK's Computer Misuse Act, or the USA's Computer Fraud and Abuse Act (CFAA), apply both in their own country and affect organisations and individuals operating in the global arena.

Statement 6.2.2 lists various moral and ethical aspects of the use of IT about which students are expected to be informed.

SAM Unit WIT11/01, Question 2(d) covers the issue of inclusion and assesses students' understanding of factors that prevent some people from using IT and benefitting from the advantages it offers. It requires straightforward knowledge recall (AO1).

Statement 6.3 considers the ubiquitous wireless access that underpins many of our services and infrastructure, addressing two specific aspects – smart cities and location awareness.

A smart city is one that makes optimal use of all the

interconnected information available today to better understand and control its operations and optimise the use of finite resources. Its citizens can easily access the information they need so as to make informed choices.

This topic is revisited in Section 16.3 of Unit 3, which covers the Internet of Things.

Approaches to delivery

The subject content of this unit is best taught in a broadly linear fashion, working through the six topics sequentially. However, some centres may choose to work across topics, using a series of context-based teaching and learning activities that combine different aspects of the unit content. Careful mapping will be required if this approach is taken to avoid any of the content being omitted.

Before launching into **Topic 1**, it might be worthwhile spending some time ensuring that all students have a sound grasp of relevant IT-specific terminology. Encourage students to become digital-product aware. When reviewing a digital device, they should get into the habit of asking themselves – What is it for? (Function) What features does it have? How effective is it? (Performance) As the functionality and performance of digital devices inevitably improve over time, encourage students to keep abreast of what is currently available.

In **Topic 2** students learn how to design networks that meet specified requirements. If at all possible, try to give them an opportunity to convert some of their designs into actual functioning networks.

When studying network security, use real-world examples to illustrate the threats.

To help with **Topic 3**, you could get your students to research a variety of online communities with purposes other than primarily social – IT professionals, jobs, support etc. Students should explore the features and services that these communities offer and the impact/implications of their use. The concept of a 'digital tatoo' is also worth exploring. Students should be encouraged to explore their own digital tattoo and think about the consequences of others having access to it – getting into university, applying for a job etc.

Topic 3 sets the context for coding for the web – the subject of Unit 2 – and some of the practical work for that unit could be integrated here.

Students should be given an opportunity to do some practical work related to the cloud, using applications such as Google Drive and Google Docs.

When working on **Topic 4**, students should explore a wide range of IT systems and attempt to decompose them into sub-systems and components. This will stand them in good stead when designing IT systems to meet specific needs.

Sufficient time must be allocated for students to develop and practice drawing and interpreting DfDs, flowcharts and E-R

diagrams

For **Topic 5**, make sure students know the difference between information and data and encourage them to be think about the multitude of ways in which data is captured, stored and processed in IT systems. Although understanding and use of SQL, is assessed in the written paper, try to give your students the opportunity to gain practical experience of using SQL – preferably with a large data set.

For **Topic 6**, ask students to keep a look out for articles in the press relating to issues associated with the widespread use of IT. Aim to ensure that they are able to explain some of the tradeoffs, such as maintaining personal privacy versus getting web content tailored to their interests or having access to vast quantities of rich media content versus the damage to the environment caused by storing it in energy-hungry data centres.

As well as learning the subject content of the unit, students need to be taught how to tackle the examination paper. They should learn the meaning of the command words used in the paper, how to tackle questions that require an extended written response and those that require them to produce a diagram or write SQL code.

How Unit 1 is assessed

Students' knowledge and understanding of Unit 1 is assessed by means of a two-hour written examination paper, marked out of 80 and comprising between 5 and 7 questions.

The content of the unit is sampled in each assessment.

Appropriate questions are set in context. Students write their responses in the spaces provided in the question paper. Use of a calculator is not permitted.

Visuals, such as drawings and diagrams, are used where appropriate to aid students' understanding and make the paper more engaging.

The cognitive demand of the paper increases gradually throughout, with more demanding questions coming later in the paper.

Each paper has one substantial essay question worth 12 marks, e.g. SAM Unit 01 Q6, and one substantial practical question worth between 9 and 12 marks, e.g. SAM Unit 01 Q3(b).

Figure 4 summarises the question types used in Unit WIT11/01.

Question type	Description	Example command words	Mark tariff	Examples from SAM Unit 01
Multiple choice (MCQ)	Students must select one option from a set of four.	Identify	1	Q1(b)(i)
Short response	Students must recall or identify a piece of information.	Give State Name	1 - 4	Q1(c) Q2(d)
Medium open response	Students must provide a structured written response – usually a couple of sentences or a short paragraph.	Describe Explain	2 - 4	Q1(a)(i) Q1(d) Q2(b)
Essay	Students must produce an essay-style written response.	Evaluate Analyse Explain	6 or 12	Q3(c) Q6
Practical	Students must complete a practical task, such as designing a network or producing a DFD.	Complete Draw Design Write	6 or 9 - 12	Q3(b) Q4(b) Q5(a) Q5(b)

Figure 4

Around 60% of the marks for Unit 01 are allocated to Assessment Objectives 01 and 02 – demonstrate/apply knowledge and understanding of IT concepts – with the remaining 40% allocated to Assessment Objectives 03 and 04.

Approximately 25% of the marks are for completion of practical tasks such as drawing a flowchart or a dataflow diagram, producing a design for a network, or using SQL to interrogate a database.

5.2 Unit 2

This is an IAS level unit. Students learn how to use three key web languages – HTML, CSS and JavaScript – individually and in combination to create user friendly, accessible web products.

In order to carry out the practical work for this unit students will need to use a text editor to write code and a web browser to test their code in.

Popular free text editors currently available include Brackets, Visual Studio Code, Atom, Notepad++ and Komodo Edit.

Popular web browsers currently available include Firefox, Opera, Microsoft Edge, Chrome, Safari and Internet Explorer.

The World Wide Web Consortium (http://www.w3.org) is responsible for developing the standards and protocols used throughout the web, including the HTML markup language. The latest version of HTML is HTML5. The latest version of CSS is version 4. These are the ones we expect students to use.

Pearson Edexcel will inform centres of any changes regarding versions to be used via its website.

Subject content

The content of the unit is arranged as five topics.

Topic 7: Understanding the functionality of HTML

In Topic 7 students learn how to write HTML.

Section 7.1 looks at to how HTML is used to structure and add meaning to the content of web pages.

Statement 7.1.1 introduces the basic components of HTML - elements, tags and attributes. Students need to understand that a web page is composed of a number of elements, such as body, paragraph and header, and that any given element (except for the outermost html element) is contained inside another element – its parent. They need to know that tags are used to mark the beginning and end of an element, that attributes are used to add extra information to a tag and that a tag can have multiple attributes.

Students must be aware that the role of the <!DOCTYPE html> declaration>, which is at the start of every HTML document, is to declare what type of HTML the document is written in.

Statement 7.1.2 deals with the role of the lang attribute, which - when positioned inside the <html> tag - indicates the language of the document. Students must understand why search engines, browsers, screen readers and translation tools need this information.

SAM Unit WIT12/01, Question 1(d) illustrates one way in which this content can be assessed. It requires straightforward recall of knowledge and understanding (AO1).

Students are expected to understand the function of the head element in providing metadata about a document, including its title and author, links to external CSS files etc. (Statement 7.1.3).

Students must understand the difference between global and non-global attributes of elements. Statement 7.1.5 lists the global attributes which they are expected to be familiar with. They are expected to understand what each of them does, e.g. that the id attribute is used to uniquely identify an element for the purpose of styling or specifying a link target, whilst the class attribute is used to group a set of elements for styling purposes or to manipulate using JavaScript.

SAM Unit WIT12/01 Question 1(a) asks students to explain how the id attribute works in the context of the code supplied. This question addresses AO2 since students are expected to apply their general knowledge that the id attribute uniquely identifies an element to a specific piece of code.

Statement 7.1.4 has a different focus, namely best practice for writing well-organised and easy to read HTML code. It lists five 'rules' that students are expected to adhere to.

Section 7.2 covers various aspects of structural markup. Students must understand the difference between block-level elements, such as paragraphs and headers, which are displayed on a new line and inline elements, such as hyperlinks, that are displayed on the same line as the previous element (Statement 7.2.1).

Statement 7.2.2 is concerned with content models that describe an element's expected content. Students should be aware that the content of an element must match the requirements described in its content model. It lists the six content models students must be familiar with.

Students must be aware that semantic HTML emphasises the meaning of the information in a web page. Statement 7.2.3 specifies the semantic HTML elements students must be able to use to define the structure of a document – article, section, headings (<header>, <h1> – <h6>) paragraph – and to format text – thematic break, emphasis and importance.
(Topic 11 looks in detail at the requirements for writing semantic code and the reasons for doing so.)

Statement 7.2.4 focuses on lists. Students must be able to write HTML code to create unordered, ordered and definition lists, as well as nested lists.

SAM Unit WIT12/01 Question1(b) assesses students' ability to locate and correct errors in the HTML code used to create a three-level nested list. It requires application of knowledge and

understanding (AO2).

Statement 7.2.5 deals with hyperlinks. Students should know the purpose of a hyperlink and be able to use the <a> tag together with the href attribute to create links to external websites (absolute URLs), to different pages within the same website (relative URLs) or to different parts of the same page. They must also know how to create email links. They must be able to use the target attribute to specify whether the browser opens a new window to display the linked URL or simply replaces the content of the current window.

Section 7.3 covers other page components that students must be able to include in a HTML document – images, tables, forms, audio and video.

Statement 7.3.1 deals with images. Students are expected to be able to add images to web pages using the <img> tag to provide information about the image file, size and resolution.
They must be able to adjust the size of an image using the height and width attributes whilst retaining its aspect ratio.

SAM Unit WIT12/01, Question 1(c) asks students to write the code to display an image on a web page. Like most of the questions in this section of the paper, it addresses AO2.
They must know how to use the alt attribute to specify alternative text for an image and get into the habit of doing so.

Statement 7.3.2 covers tables. Students must be familiar with the HTML elements that are used to construct tables - table, table row, table data, table head, table body and table foot - and be able to use them to present information in tabular format.

They must also know how to use the colspan and rowspan attributes to combine multiple cells.

An HTML form is a very powerful tool for capturing user input from a web page. Statement 7.3.3 specifies the form components and input elements students must be able to use to create forms.

Statement 7.3.4 drills down into what happens when data on a form is submitted. Students learn about the client-server architecture in Unit 1 when studying the internet and the worldwide web (Section 3.1). In this unit, they need to understand how the action and method attributes of the form element define where and how the data is sent.

Students also need to understand what validation is, why it is important and the difference between client-side and server-side validation. They must be familiar with and be able to use the field validation attributes available in HTML5, such as the required attribute that specifies that a text input must have valid data before the form can be saved and the min and max attributes

that are used with the range input type to specify boundaries for a selected numeric value.

Statement 7.3.5 covers audio and video. Students are expected to be able to embed audio and video content in HTML documents using the <audio> and <video> tags plus various attributes to customize the output.

Inline frames (iframes) enable dynamic content from an external website to be embedded within an HTML document. Students must understand how to use the <iframe> tag to achieve this (Statement 7.3.6).

Topic 8: Understanding the functionality of CSS

It used to be common practice to incorporate style information into HTML documents to specify their look and feel. But nowadays it is recognized that separating out this information is much better. In Topic 8 students learn how to use cascading style sheets (CSS) to style HTML content.

Section 8.1 is about writing cascading style sheets (CSS). Students are expected to understand that CSS is used to control the 'look and feel' of a document, whilst HTML is used to define its structure and content. Using the two together makes it much easier to maintain consistency across multiple pages (Statement 8.1.1). SAM Unit WIT12/01, Question 2(d) assesses students' general understanding of how the CSS and HTML work together to define a web page (AO1).

Statement 8.1.2 specifies the three methods of adding CSS styles to HTML documents that students must be familiar with. They must be able to style a specific element using the style attribute, use the <style> tag inside the head section of the document to specify an internal style sheet and use the <link> tag inside the head section of the document to create a link to an external .css file. Students must understand that CSS consists of a list of rules, each of which comprises a selector and a declaration, and be able to write CSS rules (Statement 8.1.3).

Selectors define which HTML elements will be styled. Statement 8.1.4. specifies the simple selectors that students are expected to be familiar with – type, class, ID, universal and attribute.

Students also need to know how the child (>), descendant ( ), adjacent sibling (+) and general sibling (~) combinators are used to combine two or more selectors and how a CSS rule can be applied simultaneously to a set of selected elements, using groups of selectors separated by commas.

Statement 8.1.7 deals with the use of the CSS attribute selector to target elements with a specific value. Students must be able to use operators (=, ~=, ^=, *=, $=) to specify which elements are to be selected.

Cascade and inheritance are two important CSS concepts that are

dealt with in Statement 8.1.5. Students must understand that inheritance is the mechanism by which properties are passed down from a parent element to its children. They must also understand the role of the cascade mechanism in determining the end result when multiple, conflicting CSS rules apply to the same element.

SAM Unit WIT12/01 Question 2(a) presents students with a piece of code and asks them to explain how the CSS causes a hover effect on the content of a dropdown menu. Students need to apply their understanding of selectors, properties and values in order to answer the question (AO2).
Statement 8.1.6 introduces the CSS box model, consisting of a margin, a border and padding. Students must understand the concept of and be able to use the box model to add backgrounds and borders to elements (Statement 8.2.5) and control their appearance (Statement 8.3.2).

Section 8.2 specifies the web page styling techniques students are expected to have mastered.

They must be able to specify colours, using names, hexadecimal notation and RGB values (Statements 8.2.1) and manipulate the opacity, gradients and HSL values of colours (Statement 8.2.2).

A lot of CSS properties, such as font size, margins and paddings depend on length measurements to properly display elements. Students must be able to specify length values using absolute units, that represent a physical measurement, and relative units, that have values that are relative to some other predefined value. They should be able to use font-relative lengths, viewport-percentage lengths and percentages (Statement 8.2.3).

Statement 8.2.4 lists the elements that students must be able style and Statement 8.2.5 covers use of the box model to add backgrounds and borders to elements.

SAM Unit WIT12/01, Question 2(c) requires students to specify the properties and values of a box with rounded corners (AO2).

Section 8.3 focuses on content positioning.

Students must be able to select appropriate values for the CSS position property (static, relative, absolute, fixed) and use the left, right, top and bottom properties to control the position of elements on a page. They must be able to use the float property to specify how elements are aligned and the z-index property to set the stack order of overlapping elements (Statement 8.3.1).

SAM Unit WIT12/01, Question 2(b) requires students to find and correct an error in a piece of CSS code where the inline style of an element has been set incorrectly (AO2).

The aim of responsive web design is to provide a consistent user experience regardless of the device and screen size being used. Students are expected to understand what responsive design is and techniques for achieving it (Statements 8.3.3 and 8.3.4). They should know the difference between fixed width layouts that have a predetermined width and liquid layouts that adjust to the size of

the browser window. They must understand how the use of layout grids and CSS frameworks contribute to responsive web design.

Section 8.4 deals with the use of CSS transforms and transitions to create simple animations. Students must learn how to move, rotate, scale and skew elements using the transform methods – translate(), rotate(), scale(), skew(), skewX(), skewY() – and the transition properties – property, duration, timing-function, delay – to control the speed at which the transformation occurs.

Topic 9: Understanding the functions of JavaScript

In Topic 9 students learn how to write and embed JavaScript code into HTML documents in order to enhance their interactivity.

Section 9.1 introduces the concept of the Document Object Model (DOM), which defines the logical structure of a web document and specifies how it can be accessed and manipulated by JavaScript code.
SAM Unit WIT12/01, Question 3(d) requires students to demonstrate their knowledge of the practical application of the DOM by identifying the method and property in a code snippet (AO1).

Section 9.2 covers regular expressions. Students must understand that a regular expression describes a pattern or characters, that regular expressions are used to perform pattern matching (Statement 9.2.1) and the role of regular expressions in validating user input (Statement 9.2.2). They must be able to interpret and construct search patterns and be familiar with built-in methods such as .match() and .isNaN() (Statement 9.2.3).

SAM Unit WIT12/01, Question 3(a) and 3(b) illustrate two ways in which the use of regular expressions can be assessed. 3(a) requires recall (AO1), whereas 3(b) requires application (AO2) of knowledge and understanding.

The structural components and programming constructs that students are expected to be able to use in their programs are specified in Statement 9.3.2.

SAM Unit WIT12/01, Question 3(c) requires students to complete a function by adding an appropriate conditional test and relational operator (A02).

JavaScript allows you to assign a function to be executed when the event is detected. Students are expected to understand how an event, such as onload, onmouseover, onclick and onkeydown, is used to trigger a function in JavaScript code. Statement 9.3.3 lists the type of events students should know about.

SAM Unit WIT12/01, Question 5 requires students to combine HTML, CSS and JavaScript. The question is worth 24 marks, split evenly between AO2 and AO4.

Statement 9.3.4 lists the page components students are expected to be able to produce.

Obviously, students also need to know how to detect and correct

errors in their JavaScript code (Statement 9.3.5). They should know how to use the try statement to test a block of code for errors and the catch statement to handle the error. They should also learn how to use the browser to detect JavaScript errors.

Topic 10: Designing web pages

Creating user-friendly web products begins at the design stage. In Topic 10 students learn how to design effective web pages that are accessible and easy to navigate.

Section 10.1 deals with the principles of web design. Statements 10.1.1. lists the design tools students are expected to know about and be able to use.

SAM Unit WIT12/01, Q4 uses a wireframe to describe what the required web page should look like.

Statement 10.1.2 is concerned with web typograph. Students should know which fonts are 'web-safe' and use them in their webpages fonts such as Arial and Helvetica and choose them for their web applications.

Statement 10.1.3 covers four basic design principles that students should adhere to in order to create effective page layouts – visual hierarchy, flow, colour theory and balance and contrast.

Section 10.2 deals with web accessibility – designing web pages so that people with disabilities can use them. Students must be aware of web accessibility features, such as captions on audio content for people with hearing problems, clear and consistent layout for people with learning disabilities and text alternatives (tags) for people with visual disabilities who use a screen reader. They should study the Web Content Accessibility Guidelines (WCAG) version 2.0 produced by the World Wide Web Consortium (W3C).

Section 10.3 focuses on two aspects of usability. Statement 10.3.1 covers intuitive navigation systems, listing five students must be able to use.

How to target specific devices and browsers is covered in Statement 10.3.2. Students must know how to open a specific browser by adding its name into the HREF element, e.g. <A HREF="microsoft-edge:http://www.bbc.co.uk">Open BBC in Edge Browser </A>

Topic 11: The semantic web

A semantic element is one that clearly describes its meaning. Students must understand what semantic markup is, how to add semantic markup to a web page and how it is used by browsers, assistive technologies and search engines (Statements 11.1.1 and 11.1.4).

Statements 11.1.2 and 11.1.5 list the HTML5 semantic elements students must be able to use to define the content of and add textual meaning to a web page.

Statement 11.1.6 specifies two semantic elements, figure and figcaption, that students must be able to use to markup self-contained content, such as images, videos or an audio clips.

Students should know about the additional HTML attributes developed by W3C that add extra semantic meaning to elements (Statement 11.1.7).

SAM Unit WIT12/01, Q4 v assesses not only students' ability to write HTML and CSS code, but also their web design skills and their use of semantic code. The question is worth 16 marks, divided equally between AO2 and AO6.

SAM Unit WIT12/01, Question 6 asks students to recommend changes to the HTML code provided so that it meets the requirements of the Semantic Web. The nine marks available are split evenly between AO2, AO3 and AO4.

Statement 11.1.3 deals with the non-semantic elements, div and span. Students must understand that – in contrast to semantic elements - they provide no information about the nature of the content they contain, but merely provide a means of grouping elements together.

Approaches to delivery

Students must be given adequate time to develop, practice and embed the skills covered in this unit. Begin by introducing them to HTML. Make sure that they can competently produce properly structured HTML documents before introducing CSS into the mix. Once they can use CSS to control the fonts and text layout of their documents, they will be ready to learn how JavaScript is used to add interactivity to web pages.

Students could base their work around the production of a simple web application, initially using straight forward HTML tags to create a first draft and gradually adding in style and interactivity as they learn more.

As well as producing their own web products, students should be encouraged to critically review those produced by others – both in terms of their 'look and feel' and the code they use. They will gain useful insight from group discussions and conducting peer reviews of each other's designs.

Encourage students to see the connection between the practical skills they are developing in this unit and what they learn in Topic 3 of Unit 1.

The subject content of Topics 10 and 11 is too important to leave until all the practical work has been completed. Web design skills should be taught from the outset and there should be a strong emphasis on adhering to semantic standards to promote wide accessibility for users with disabilities.

As well as learning the subject content of the unit, students need to be taught how to tackle the examination paper. They should be familiar with the format of the paper, including the requirement to hand write some answers in the space provided on the paper.

It is important that you work to develop students' practical design and web coding skills to the level at which they can respond to the requirements of the paper confidently, under pressure and without assistance. They should also practise reading and interpreting requirements, especially those specified in a wire frame.

How Unit 2 is assessed

Students' knowledge and understanding of Unit 2 is assessed by means of a three-hour practical examination paper, marked out of 80 and comprising two sections, A and B. Approximately 30 marks are allocated to Section A and 50 to Section B.

Unlike a traditional examination – the evidence students produce is predominantly computer-generated, rather than written.

The paper samples the content of the unit, with full coverage achieved over five series.

There are three questions in Section A, each composed of multiple parts. Each question focuses on one of the prescribed web languages - HTML, CSS or JavaScript. In some instances, students have to produce a written response, but for the most part they use the computer to write or amend code.

Where a written response is required students write it in the space provided in the question paper. Code responses must be saved using the specified file name.

Section B is based around a single scenario and consists of two substantial practical tasks, e.g. SAM Unit 02 Questions 4 and 5, plus one essay question worth 9 marks, e.g. SAM Unit 02 Question 6.

The table below shows the question types used in Unit WIT12/01.

Question type	Description	Example command words	Mark tariff	Examples from SAM Unit 02
Short response	Students must recall or identify a piece of information. Only used in Section A.	Give Identify State	1 - 4	Q3(d)
Medium open response	Students must provide a structured written response – usually a couple of sentences or a short paragraph. Only used in Section A.	Describe Explain	2 - 4	Q1(a) Q1(d) Q2(a) Q2(d) Q3(d)
Short practical task	Students must write or amend a piece of code. Only used in Section A.	Amend Complete Write	1 - 6	Q1(b) Q1(c) Q2(b) Q2(c) Q3(b) Q3(c)
Essay	Students must produce an essay-style written response. Only used in Section B.	Analyse and recommend Assess	9	Q6
Substantial practical task	Students must undertake a substantial piece of practical web coding work. Only used in Section B.	Create Implement	15 - 25	Q4 Q5

Approximately 85% of the marks for Unit 02 are allocated to Assessment Objectives 2 and 4, reflecting its practical nature.

Conducting the examination

Centres are expected to conduct the examination on the date and time specified in the examination timetable issued by Pearson Edexcel. However, in the event of a clash or if the number of students sitting the examination is such that they cannot all be accommodated simultaneously, the centre must apply to Pearson Edexcel for permission to hold another examination session.

Prior to the examination

Centres must set up a separate user area for each student sitting the examination. User areas must be allocated sufficient storage space to allow students to save their work.

The secure data files required for the examination will be made available on the Pearson Edexcel website one week ahead of the examination. The files should be downloaded and copied into each student's secure user area. Students must not be given access to the data files in advance of their exam sitting.

Workstations must be arranged so as to prevent students from viewing each other's work.

Students may not bring portable storage media into the examination.

During the examination

Centres must ensure that appropriate hardware and software is available to students. Students must use an HTML editor which is text based and does not provide 'drag and drop' or 'WYSIWYG' functionality.

No extra time can be allowed to compensate for slow machines or networks that run slowly. At least one invigilator should be conversant with the software and IT system to be used by students so that they are able to deal with any technical difficulties that may arise.

No scheduled breaks during the examination are allowed.

Students must answer all questions. The majority of questions will require students to write or amend code. However, in some instances a written response will be required. Where this is the case, students should write their answer in the space provided in the question paper.

Where questions require students to write code, they must save their work in the specified folder in their user area. The file naming conventions specified in the question paper must be followed when saving work.

Students must only have access to the files required for the examination. Access to the internet during the examination is not permitted.

After the examination

Students' paper scripts along with their digital responses (stored on a USB stick or optical disc) must be sent to the allocated Pearson Edexcel examiner in the same envelope.

Students' user areas should be removed at the end of the examination once their work has been copied to an appropriate storage medium.

Instructions for the Conduct of the Examination (ICE)

An ICE document giving detailed instruction on how the examination is to be conducted will be issued ahead of the examination, in the normal way.

5.3 Unit 3

This is an IA2 level unit that deepens and extends students understanding of IT concepts. It introduces new areas such as big data, virtual reality and the Internet of things. It develops practical skills - project management tools and information flow diagrams.

Subject content

The content of the unit is arranged as five topics.

Topic 12: Manipulating data

Topic 12 revisits the concept of data which students were introduced to in Topic 5 of Unit 1.

Section 12.1 examines some of the processes used to ensure the accuracy and consistency of data.

Statement 12.1.1 focuses on data governance. Students need to understand the processes and practices used to manage the data assets of an organisation and the benefits to an organisation of having effective data governance.

Statements 12.1.2 and 12.1.3 introduce the concept of a data dictionary. Students must understand what a data dictionary is used for and what it contains. They and must be able to interpret and construct data dictionaries.

Data validation is covered in Statements 12.1.4 and 12.1.5. Students are expected to understand the concept of data validation and be able to interpret and design validation rules for a given scenario.

SAM Unit WIT13/01, Question 1(a)(i) is a straightforward knowledge recall question (AO1), whilst the second part of the question requires students to apply their knowledge in order to devise a set of validation rules (AO2).

Section 12.2 develops students' understanding of databases, focusing on the process of normalisation. They are expected to apply what they learn here when creating relational databases for themselves in Unit 4.

Statement 12.2.1 deals with data redundancy. Students must understand what data redundancy is and the problems associated with it.

Statements 12.2.2, 12.2.3 and 12.2.4 focus on the process of normalisation, which students are expected to understand and be able to carry out.

SAM Unit WIT13/01, Question 7 is a substantial practical task, worth 10 marks, which requires students to design the tables for a relational database in 3rd normal form. All 10 marks are allocated to AO4.

Section 12.3 focuses on Big Data.

Statement 12.3.1 introduces the concept of Big Data and lists five

key issues associated with its collection that students need to know about.

Statement 12.3.2 focuses on the infrastructure and services used to collect, store and transmit the huge volumes of data involved, with Statement 12.3.3 honing in on the storage implications.

Statement 12.3.4 introduces three business intelligence tools used to extract knowledge from large volumes of data. Data warehousing techniques are used to devise an optimal structure for storing data obtained from different sources so as to facilitate data mining – testing hypotheses and finding hidden patterns in the data – and data analytics – ordering and organizing data in order to gain useful insights from it. Students must understand the purpose of three types of analytical activity: descriptive analytics that provides insight into what has happened in the past, predictive analytics that forecasts what is likely to happen in the future and prescriptive analytics that provides advice on the best course of action to pursue.

Statement 12.3.5 looks at four areas in which Big Data is already playing a significant role, i.e. healthcare, infrastructure planning, transportation and fraud detection.

Students should be reminded of what they learnt about moral and ethical issues associated with the use of IT in Topic 6 of Unit 1. They should realise that Big Data is an ever-expanding 'beast'. No data ever really gets forgotten and – as processing power and storage get cheaper – the use of Big Data is likely to become ever more intrusive and all pervading.

SAM Unit WIT13/01 Question 6 assesses students' ability to apply what they have learnt about Big Data to a particular context. It is worth 12 marks and assesses Statements 12.3.1 and 12.3.5, requiring an essay-style response. Students must demonstrate their ability to analyse and evaluate information. 6 of the 12 marks for this question are split evenly between AO1and AO2; the remaining 6 are allocated to AO3.

Teaching of this section can be linked to Section 13.4 (Storing and securing data) and 13.5 (Encryption).

Topic 13: Enabling technologies

Topic 13 covers five technologies that alone or in combination provide the means to significantly improve an organisation's overall performance.

Section 13.1 deals with virtualisation. Students are expected to understand that virtualisation creates a simulated computer environment (as opposed to a physical environment) in which to run software and allows multiple virtual machines to run on a single physical computer. They must understand two ways in which virtualisation can be achieved – containerisation and virtual machines.

Reduced costs is one obvious benefit, but students must be able to explain other benefits of virtualisation, such as better utilisation of hardware resources and the ability to backup and migrate entire

virtual environments with no interruption in service.

Section 13.2 is about distributed systems. Students must understand that a distributed system is a group of computers working together in such a way as to appear as a single computer to the end user.
One of the main reasons for using a distributed system is that it supports unlimited, horizontal scaling, i.e. extra computers can be added to boost performance as required. Students must understand why this might be needed. They must also be able to explain technical challenges associated with distributed systems – failure, concurrency, replication and performance issues.

Section 13.3 deals with human computer interaction (HCI). Students need to understand why effective HCI is important, three ways in which HCI can be implemented, i.e. visual, audio and haptic, and the ergonomic principles that underpin HCI.
There are links here to the principles of accessibility and usability which students learnt about in Unit 2, Topic 10 (Designing web pages).

Section 13.4 returns to the topic of data.

Statement 13.4.1 revisits storing data in the cloud, covered in Section 3.4 of Unit 1, Topic 3 (The cloud).

Statement 13.4.2 introduces two important ways of securing data – file encryption and password protection.

Statement 13.4.3 introduces students to the features and functions of a database management system (DBMS) that enables it to control user access to and views of the data in a database. This ties in with the practical work they will be doing in Unit 4.

Data encryption is also the focus of **Topic 13.5**, which covers three types of encryption – symmetric, asymmetric and certificate-based. Students must understand the features and functions of each.

SAM Unit WIT13/01, Question 2(a) asks student to describe the process of asymmetric encryption. The marks for this question are split evenly between AO1 and AO2 in recognition of the fact that more than just knowledge recall is required to achieve all 4 marks.

Topic 14: Using IT systems in organisations

Topic 14 has a business focus. Students study the role of IT systems in organisations and build on the knowledge and understanding of IT systems they acquired when studying Unit 1, Topic 4 (IT systems).

Section 14.1 deals with a number of different IT systems. Statement 14.1.1 is designed to give students a broad understanding of the types of activities supported by IT systems.

Statement 14.1.2 deals with transaction processing (TP). Students are expected to understand the concept of TP and be familiar with

four examples of TP systems used by organisations, i.e. electronic point of sale (EPOS), order processing, financial and Bacs.

Statement 14.1.3 focuses on customer relationship management (CRM). Students are expected to understand the concept of a CRM and be familiar with six purposes for which organisations use CRM systems.

SAM Unit WIT13/01, Question 1(b) requires students to apply their generic understanding to explain how an insurance company could use a CRM system to improve the way in which it interacts with customers. They are not expected to have a working knowledge of the insurance industry, but should be able to apply what they know to the information provided in the scenario. The 6 marks for this question are split evenly between AO1, AO2 and AO3.

Statement 14.1.4 deals with information management. Students are expected to understand the concept of a management information system (MIS) and be familiar with three reasons for using a MIS, i.e. record keeping, decision making and project management.

Statement 14.1.5 deals with intelligent transportation systems. Students are expected to understand the concept of an intelligent transportation system (ITS) and be familiar with applications of ITS for timetabling, location-based services and fleet management.

Statement 14.1.6 focuses on expert systems. Students are expected to understand the concept of an expert system and be familiar with applications of expert systems for diagnosis and identification.

Section 14.2 deals with operational issues associated with an organisation's use of IT systems.

Statement 14.2.1 considers the need to have appropriate IT governance and policies covering business-critical issues, i.e. business continuity, disaster recovery, risk management and user access/acceptable use.

Statement 14.2.2 considers IT changeover and lists the four approaches to changeover that students are expected to have studied, i.e. phased, direct, parallel and pilot.

SAM Unit WIT13/01, Question 5(b) requires students to discuss the appropriateness of alternative software changeover methods. The 6 marks for this question are split evenly between AO1, AO2 and AO3.

Statement 14.2.3 covers system maintenance and lists three methods of carrying out maintenance that students are expected to understand, i.e. perfective, adaptive and corrective.

Statement 14.2.4 deals with data archiving.

SAM Unit WIT13/01, Question 2(b)(i) requires students to explain the benefits and drawbacks of archiving data for the factory. Students have to apply their knowledge and understanding to the context (AO2).

Statement 14.2.5 is concerned with disaster recovery plans.

SAM Unit WIT13/01, Question 2(b)(ii) requires students to suggest one thing that the factory could do to prepare for a situation in which fire damages its IT systems. A generic response demonstrating knowledge and understanding is all that is required (AO1).

Topic 15: Systems development

In Topic 15 students learn about methodologies and tools for project management

Section 15.1 – Project Management

Statement 15.1.1 introduces students to the concept of and need for project management when developing IT systems.

Statement 15.1.2 covers characteristics of successful IT projects, namely satisfactory completion of the specified work within the agreed timeframe and budget.

Statements 15.1.3 and 15.1.4 deals with the use of specific, measurable, achievable, relevant and time-bound (SMART) targets to specify project objectives. As well as understanding what SMART targets are used for, students must also be able to specify SMART targets for a given scenario.

SAM Unit WIT13/01, Question 5(a) requires students to explain how a given objective meets each of the SMART criteria (AO2).

Statements 15.1.5 and 15.1.6 identify four project management tools that students are expected to understand and be able to use, i.e. nodes and Gantt charts, requirements definition, critical path analysis and precedence tables.

SAM Unit WIT13/01, Question 4(b) requires students to interpret a precedence table represented as an arc network diagram (AO2).

Sections 15.2 and 15.3 cover two different project management methodologies.

Section 15.2 deals with the waterfall approach – a linear process consisting of a number of distinct phases – and **Section 15.3** with the agile approach – an incremental, iterative process which relies on effective teamwork.
SAM Unit WIT13/01, Question 4(a) asks students to apply their understanding of the agile methodology to a specified context. The 6 marks available are split evenly between AO1, AO2 and AO3.

Topic 16: Emerging technologies

Topic 16 covers technologies that are fast moving and which may develop in unexpected directions. Students should try to keep informed about current developments.

Section 16.1 is about machine learning. Students are expected to have an understanding of the concept, features and functions of machine learning and be able to differentiate between supervised and unsupervised machine learning algorithms.

Section 16.2 covers the concepts and uses of virtual and

augmented reality.

SAM Unit WIT13/01, Question 3(a) requires students to discuss the advantages and disadvantages of using virtual reality for training. The 6 marks available are split evenly between AO1, AO2 and AO3.

Section 16.3 introduces the Internet of Things (IoT). Students must understand the concept of the IoT (Statement 16.3.1), its impact on individuals, organisations and data (Statement 16.3.2), the underlying infrastructure (Statement 16.3.3) and some of the security issues related to its use. (Statement 16.3.4).
They have to be able to produce high-level designs for systems that make use of the IoT, (Statements 16.3.5 and 16.3.6), as illustrated by SAM Unit WIT13/01, Question 3(b), which requires students to draw an information flow diagram for an IoT system for a city parking management system. This question assesses AO4 since it requires students to design a solution.

Approaches to delivery

The subject content of this unit is best taught in a broadly linear fashion, working through the five topics sequentially. However, some centres may choose to work across topics, using a series of context-based teaching and learning activities that combine different aspects of the unit content. Careful mapping will be required if this approach is taken to ensure complete coverage of the content.

Delivery of the subject content lends itself to a combination of tutor-led presentations and individual and group learning tasks, ideally supplemented with occasional input from guest speakers from the IT sector. This is particularly pertinent for Topic 14.

Before starting Topic 12, remind students of what they have already learnt about data and databases in Topic 5 of Unit 1. You could use the concept of 'garbage in, garbage out'(GIGO) to explain the importance of data quality. Encourage students to think about the causes and potential consequences of poor quality data. This leads naturally on to the need for and methods of implementing data validation. Make sure that students get plenty of practice interpreting and designing validation rules.

Show students some examples of data dictionaries (there are plenty available online). Encourage them to identify common features and recognise the benefits of constructing and maintaining a data dictionary. Give them plenty of opportunities to use and construct data dictionaries. This content is best taught in conjunction with data normalisation.

Students must understand the process and stages of data normalisation. This is a hard concept to grasp, so build in plenty of practice time for student to carry out the process themselves.

If at all possible these sections on data integrity and normalisation should be taught in conjunction with Unit 4 and students should be encouraged to apply what they learn here when designing their own databases.

Introduce students to the concept of Big Data - where it comes from, what makes it 'big' and how people use it to solve problems. Point out how the world's data is projected to grow. Use Google Traffic to demonstrate a big data resource that people use every day. Encourage students to think about how the data it uses is collected. Get them to investigate other applications of Big Data, particularly in the areas listed in Statement 12.3.5.

Remind students of what they learnt in Unit 1, Topic 6 about IT's impact on the environment and encourage them to think about the environmental impact of the online data centres required to store Big Data.

Use case studies to introduce each of the enabling technologies in Topic 13. For example, you could use Google as an example of a distributed system. Ask students to find other examples. Get them to articulate the difference between distributed systems, networks and cloud computing. Ask them to explain the connection between distributed systems and Big Data. Steer them into recognising that virtualisation enables one computer to act as many, whilst in distributed systems many computers behave as one.

HCI is a massive field in its own right. Students are only expected to have a broad overview. Encourage them to pay attention to how HCI is implemented in the systems they use, identifying good and bad examples. If possible, give them an opportunity to use a haptic interface operating in a virtual environment, such as Optimus Prime. Get them to select and/or discuss appropriate methods of HCI for given scenarios.

Students should be given an opportunity to do some practical work related to cloud storage, using applications such as Google Drive or DropBox. Get them to investigate security issues associated with cloud storage – there are plenty of articles on the web on this. What are the alternatives?

Features and functions of a DBMS are best taught in conjunction with Unit 4. Ideally, give students the opportunity to experience a client-server system, such as MYSQL. They may have done this earlier in the course when studying Unit 1, Topic 5. Here, the emphasis is on how the DBMS controls access to and views of the data.

A number of organisations have produced free materials for teaching encryption. One example is 'Keeping secrets secret' created by The Royal Institution UK and Microsoft Research. You could use this or something similar with your students.

Case studies/visits to investigate IT systems in use in organisations are the best way of introducing Topic 14. There's no harm in using your own school/college systems as a starting point.

You could introduce the topic of project management by getting students to research successful and failed IT projects (The British NHS' project to create a unified electronic health records system for all citizens is a good example of the latter) and to identify key success factors. Give them plenty of opportunities to master interpreting and producing Gantt charts, critical path analysis and precedence tables.

Nowadays most IT projects tend to adopt the agile rather than the waterfall approach, or a combination of both. You could ask students to investigate why this is the case. One company that has made the transition is Toyota and students should be able to find some information about it online. The very nature of emerging technologies ensures that they are always in the news. Encourage your students to look out for relevant news items. Get them to find 'cool' examples of IoT applications and produce information flow diagrams to show how they work.

How Unit 3 is assessed

Students' knowledge and understanding of Unit 3 is assessed by means of a two-hour written examination paper, marked out of 80 and comprising between 5 and 7 questions.

The content of the unit is sampled in each assessment.

Each question is composed of multiple parts, linked by a common scenario.

Students write their responses in the spaces provided in the question paper.

Visuals, such as drawings and diagrams, are used where appropriate to aid students' understanding and make the paper more engaging.

The cognitive demand of the paper increases gradually throughout, with more demanding questions coming later in the paper.

The table below shows the question types used in Unit WIT13/01.

Question type	Description	Example command words	Mark tariff	Examples from SAM Unit 03
Short response	Students must recall or identify a piece of information.	Give State Complete	1 - 4	Q1(a)(i) Q1(a)(ii) Q4(b)(i) Q4(b)(ii) Q5(a)
Medium open response	Students must provide a structured written response – usually a couple of sentences or a short paragraph.	Describe Explain	2 - 4	Q1(b) Q2(a) Q2(b)(i) Q2(b)(ii)
Essay	Students must provide an essay-style written response.	Discuss Explain Evaluate	6 or 12	Q3(a) Q4(a) Q5(b) Q6
Practical	Students must complete a practical task, such as designing a relational database structure or an IoT system	Draw Design	6 or 9 - 12	Q3(b) Q7

The marks for Unit 03 are roughly evenly split between AO1 and A02 – demonstrate/apply knowledge and understanding of IT concepts – and the higher order cognitive skills required by AO3 and AO4 – analyse, evaluate and design solutions.

5.4 Unit 4

This is an IA2 level unit that develops students' understanding of and ability to work with relational databases. It builds on concepts introduced in Topic 5 of Unit 1 – Data and databases and Topic 12 of Unit 3 – Manipulating data (data normalisation).
In order to carry out the practical database work for this unit students will need to use a database management system (DBMS) that resides and stores files on a standard personal computer. It is anticipated that most will use Microsoft Access.

Subject content

The content of the unit is arranged in three topics.

Topic 17: Use of features of database solutions

In Topic 17 students learn about the need for database systems and factors that affect how they are designed and operate.

Section 17.1 sets the scene.

Statement 17.1.1 considers why database software is used to hold and manipulate data.

Statement 17.1.2) focuses on factors that affect the design of databases, e.g. the nature of the data to be stored, the required outputs, security and legal requirements, the target audience.

Students must be taught how to evaluate databases and judge the effectiveness/appropriateness of the features they use (Statements 17.1.3, 17.2.3 and 17.3.4).

They are expected to apply this knowledge and understanding when creating their own databases.

Section 17.2 focuses on user needs.

Students must be able to analyse user requirements and design database solutions that meet users' needs (Statements 17.2.1 and 17.2.2).

Section 17.3 considers aspects of the user experience.

Statements 17.3.1 identifies features of a database that can be tailored to meet the needs of the target audience.

Statement 17.3.2 considers how the design of a database impacts on the user experience.

Statements 17.3.3 specifies that students must be able to develop database solutions that are suitable for the target audience and deliver an appropriate user experience.

Statement 17.3.4 states that students must be able to evaluate a database solution in terms of the user experience it delivers and suggests improvements.

Topic 18: Relational database concepts

In Topic 18 students learn the basics of how to construct and amend relational database structures and use data entry and validation techniques to control the quality of data entry.

Section 18.1 covers the practical skills students need to acquire in order to be able to build appropriate database structures.

Statement 18.1.1 lists the four basic building blocks of relational databases – tables, records, fields and relationships. Students have already come across these in Topic 5 of Unit 1. In this unit, they must learn how to use them to construct actual database structures.

Statements 18.1.2 lists the five data types students must understand and be able to use.

SAM Unit WIT14/01, Question 1(a)(i) illustrates one way in which students' ability to apply their knowledge of data types is assessed (AO2).

Students must also be able to format data types appropriately using common and customized formats (Statement 18.1.3).

Students must be able to evaluate all aspects of the database structures they create (Statement 18.1.4).

SAM Unit WIT14/01, Question 2(c) illustrates the type of evaluation students may be asked to undertake. It asks them to analyse the effectiveness of a database structure and suggest ways in which it could be improved. The 9 marks for this question are split evenly between AO1, AO2 and AO3.

Section 18.2 deals with relationships. Students need to understand why relational structures are needed (Statement 18.2.1), how to use keys to set up relationships between tables and how referential integrity is used to maintain data consistency (Statement 18.2.2).

SAM Unit WIT14/01 Question 1(c) requires students to create a relational database structure to handle equipment loans. It addresses aspects of Statements 18.1.2, 18.1.3, 18.2.2 and 19.1.2. 7 marks are allocated to AO4 and the remaining 3 to AO2.

Section 18.3 focuses on data entry and validation techniques. Students must understand the need to avoid a 'garbage in garbage out' (GIGO) scenario occurring (Statement 18.3.1). The six validation techniques they must be able to apply are listed in Statement 18.3.2.

SAM Unit WIT14/01, Question 1(a)(ii) assesses students' ability to implement a dropdown list. This maps to AO2 because it requires students to apply their knowledge and skills to a particular context.

There is a link here to Section 12.1 of Unit 3 which deals with data integrity.

Students also need to be able to construct error messages and give users appropriate feedback (Statement 18.3.3).

Controlling user input is a crucial element of good database design. Statement 18.3.4 lists six data entry techniques that student must be able to employ in order to facilitate data entry and improve its quality.

SAM Unit WIT14/01, Question 1(d) assesses students' ability to select and use appropriate validation techniques (AO2).

Topic 19: Database solutions

In Topic 19 students learn how database software is used to solve problems and how to select and use appropriate tools and features to create data structures and manipulate data in response to a given problem.

The eight statements in **Section 19.1** spell out exactly what students must be able to do.

SAM Unit WIT14/01, Question 2(a) targets Statements 19.1.3 (queries) and 19.1.5. Students are being asked to design a solution. This maps to AO4.

SAM Unit WIT14/01, Question 2(b)(i) also addresses Statements 19.1.3(queries) and 19.1.5, but in this case students have to construct a calculated field (Statement 19.1.4). Once again, they are being asked to design a solution (AO4).

SAM Unit WIT14/01, Question 1(e) assesses students' ability to import data from an external source – in this case a spreadsheet (Statement 19.1.6).

Section 19.2 identifies what students need to be able to do in order to create effective user interfaces.

Statement 19.2.1 is concerned with data entry.

SAM Unit WIT14/01, Question 1(b) addresses this statement. It requires students to create a data entry form to enter new data. The marks are evenly split between AO2 and AO4.

Statement 19.2.2 lists the system outputs students must be able to create, i.e. data tables, reports, charts and error messages.

Statement 19.2.3 focuses on the creation of system outputs that support users.

SAM Unit WIT14/01, Question 2(b)(ii) requires students to produce a report that has an intuitive layout and incorporates appropriate design features. 3 marks are allocated to AO2 and the remaining 4 marks to AO4.

SAM Unit WIT14/01, Question 3 assesses students' ability to produce a chart and incorporate it into report. The 12 marks are equally split between AO2 and AO4.

Statement 19.2.4 specifies that students must be able to add additional functionality to the user interface by writing macros to automate processes.

SAM Unit WIT14/01, Question 4 illustrates one way in which this Statement could be assessed. Students have to produce a dashboard (Statement 19.2.1) which uses macros to launch the

three options users can select from. The 6 marks are equally split between AO2 and AO4.

Section 19.3 covers testing. Students must understand the importance of testing and be able to design and implement appropriate tests.

Statements 19.1.8, 19.2.5 along with **Section 19.4** all address evaluation and enhancement.

SAM Unit WIT14/01, Question 5 illustrates the sort of question students may encounter. It requires them to evaluate the fitness for purpose of a database. The 9 marks available are split equally between AO2, AO3 and AO4.

Approaches to delivery

Databases are everywhere and have a massive impact on all aspects of our lives. Students should explore how databases are used in a wide range of contexts. Encourage them to become 'database aware', able to recognise a database in action no matter how well disguised it may be. Get them to revisit the IT systems they learnt about in Topic 14 to identify where and how databases are employed. Ask them to take note of good and bad features of the databases they encounter and – where appropriate - suggest improvements.

Remind students what they have learnt in Unit 3 about data dictionaries and normalisation and encourage them to apply this knowledge when designing their own databases.

Testing is often something that students are reluctant to spend a great deal of time on. Encourage them to think of testing not just in terms of whether or not something works, but also how it can be improved. Set up workshop sessions in which students are able to get feedback from their peers, enabling them to identify aspects of the design that can be improved. It is particularly important to involve others in testing usability.

It is important that you work to develop students' practical database design and development skills to the level at which they can respond to the requirements of the paper confidently, under pressure and without assistance.

How Unit 4 is assessed

Students' knowledge and understanding of Unit 4 is assessed by means of a three-hour practical examination paper based around a single scenario and marked out of 80.

The paper samples the content of the unit, with full coverage achieved over five series.

Unlike a traditional examination – the evidence students produce is computer-generated, rather than written.

When required to do so, students must screen print their responses to questions and paste them into the evidence template supplied by Pearson Edexcel. It is the student's responsibility to ensure that all their evidence can be clearly see on the screen prints.

Written responses such as the one required for SAM Unit 03, Q2(c) must be keyed into the evidence template in the designated space.

The table below shows the question types used in Unit WIT14/01.

Question type	Description	Example command words	Mark tariff	Examples from SAM Unit 04
Short practical task	Students to write or amend a piece of code.	Amend Apply Correct Create Import Set-up	1 - 6	Q1(a)(ii) Q1(b) Q1(d) Q1(e) Q2(a) Q4
Essay	Students must produce an essay-style written response.	Analyse Assess	9	Q2(c) Q5
Substantial practical task	Students must undertake a substantial piece of practical database work.	Create Develop Extract	9 -12	Q1(c) Q2(b)(i) Q3

Approximately 90% of the marks for Unit 04 are allocated to Assessment Objectives 2 and 4, reflecting its practical nature.

Conducting the examination

Centres are expected to conduct the examination on the date and time specified in the examination timetable issued by Pearson Edexcel. However, in the event of a clash or if the number of students sitting the examination is such that they cannot all be accommodated simultaneously, the centre must apply to Pearson Edexcel for permission to hold another examination session.

Prior to the examination

Centres must set up a separate user area for each student sitting the examination. User areas must be allocated sufficient storage space to allow students to save their work.

The secure data files required for the examination will be made available on the Pearson Edexcel website one week beforehand. An evidence template will also be supplied.

The files should be downloaded, checked for compatibility with the software to be used and then copied into each student's secure user area. **Students must not be given access to the data files in advance of their exam sitting**.

Workstations must be arranged so as to prevent students from viewing each other's work.

Students may not bring portable storage media into the examination.

During the examination

Centres must ensure that appropriate hardware and software is available to students. No extra time can be allowed to compensate for slow machines or networks that run slowly. At least one invigilator should be conversant with the software and IT system to be used by students so that they are able to deal with any technical difficulties that may arise.

No scheduled breaks during the examination are allowed.

Students must answer all questions. They must produce screen prints to evidence their database responses. These must be pasted into the template provided.

Students must only have access to the files required for the examination.

Access to the internet during the examination is not permitted.

Communication between students at any time during the examination is not permitted.

After the examination

Students' digital responses (stored on a USB stick or optical disc) must be sent to the allocated Pearson Edexcel examiner.

Students' user areas should be removed at the end of the examination once their work has been copied to an appropriate storage medium.

Instructions for the Conduct of the Examination (ICE)

An ICE document will be issued ahead of the examination giving detailed instruction on how the examination is to be conducted.

6 APPENDIX A – Transferable Skills interpretation

Sources: Cognitive/Intrapersonal and Interpersonal skills adapted and taken from the NRC framework

NRC framework skill	Skill interpretation in IAL IT	Examples of where this skill is covered	Examples of where this skill is assessed	Opportunity for the skill to be covered in teaching and learning approaches
Cognitive skills				
Cognitive Processes and Strategies				
Critical thinking	Developing a well-supported, clearly articulated argument to support a view and using it to justify one or more conclusions Designing IT systems that meet requirements Evaluating IT systems, considering their suitability for intended audience and purpose and identifying strengths and weaknesses Understanding the potential and impact of IT systems on individuals, organisations and society	Unit 1: 2.3.1 Understand the impact of network security issues on individuals and organisations (threats and solutions, open networks) Unit 1: 4.4.1 Understand the advantages and disadvantages of IT systems for individuals and organisations Unit 3: 1.3.3 Understand the impact of storing big data Unit 3: 3.1.1 Understand the role of IT systems in organisations Unit 3: 4.1.7 Be able to analyse a completed project to identify strengths and weaknesses in project management Unit 4: 1.3.4 Be able to evaluate the effect a database will have on user experience and suggest improvements	Unit 1, Q1(d) Unit 1, Q2(a) Unit 1, Q6 Unit 2, Q6 Unit 3, Q1(b) Unit 3, Q3(a) Unit 3, Q3(b) Unit 3, Q6 Unit 4, Q2(c) Unit 4, Q5	Individual, group and whole class activities can provide opportunities for students to develop/demonstrate their critical thinking skills. For example, students could review their schools' IT systems, assessing their fitness for purpose and suggesting improvements. They could be asked to debate the benefits and drawbacks of storing data in the cloud or produce a report on the causes of the digital divide.
Problem solving	Breaking down a problem into its component parts, establishing their relationship to each other and to the problem as a whole Developing IT solutions that meet specified requirements Evaluating solutions in terms of their fitness for purpose and	Unit 1: 2.2.4 Be able to produce outline designs for networks to meet specified requirements that take account of location of devices Unit 1: 4.1.3 Be able to design IT systems, from individual components and sub-systems, to meet specified requirements	Unit 1, Q3(b) Unit 1, Q5(b) Unit 2, Q4 Unit 2, Q5 Unit 3, Q3(b) Unit 3, Q7 Unit 4, Q1(c) and (d)	Individual, group and whole class activities can provide opportunities for students to undertake problem solving activities. They could be asked to select hardware and software for a specific user or group of users, create a relational database solution or use

	efficiency and identifying ways in which they could be improved	Unit 2: 2.4.1 Be able to use CSS transitions and transforms to create animations Unit 2: 4.3.1 Be able to design intuitive navigation systems Unit 3: 1.2.3 Be able to normalise a collection of data into first, second, and third normal forms Unit 4: 2.1.1 Be able to construct and amend relational databases Unit 4: 3.4.1 Be able to evaluate the effectiveness and appropriateness of a completed solution and identify whether the solution is 'fit for purpose'	Unit 4, Q2 (b)(i) and (b)(ii) Unit 4, Q4	JavaScript to add interactivity to a website.
Analysis	Examining the flow of documents, information and material in order to understand how an IT system works Using database analysis techniques to identify entities, attributes and relationships Analysing requirements and user needs	Unit 1: 4.1.2 Understand how to decompose a system into smaller sub-systems and components Unit 1: 4.2.2 Be able to interpret and create dataflow diagrams for a given scenario Unit 1: 5.2.4 Be able to interpret and create entity relationship diagrams for a given scenario Unit 4: 1.2.1 Be able to analyse the needs of users in a range of contexts	Unit 1, Q5(a) and (b) Unit 2, Q4 Unit 2, Q6 Unit 3, Q4(b) Unit 3, Q7 Unit 4, Q1(c)	Students will be able to develop and demonstrate their ability to analyse whilst working on problem solving activities.
Reasoning/argumentation	Assessing a number of alternative solutions and selecting the most appropriate Weighing up advantages and disadvantages and making a recommendation Explaining the rationale for decisions made and being prepared to argue your case	Unit 1: 3.2.1 Understand the impact and potential of working in online environments for individuals and organisations Unit 1: 6.2.2 Understand the moral and ethical issues associated with the use of IT	Unit 1, Q2(a) Unit 1, Q6 Unit 3, Q3(a) Unit 3, Q4 Unit 3, Q5(b) Unit 4, Q5	Students should be challenged to explain/justify the choices/decisions they make when producing IT solutions to problems. They should be given opportunities to assess the extent to which existing IT systems are fit for purpose. Class or group helping help students develop critical thinking, reasoning and presentation skills.

Interpretation	Interpreting and using diagrams, models, charts etc. for given scenarios	Unit 1:4.3.2 Be able to interpret and create flowcharts for a given scenario Unit 3: 1.1.3 Be able to interpret and construct a data dictionary Unit 3: 4.1.6 Be able to interpret and use tools of project management	Unit 1, Q5(a) and (b) Unit 2, Q4 Unit 3, Q3(b) Unit 3, Q4(b)	Students should be given repeated opportunities to interpret information presented in diagrams, tables, sketches, charts and wire frames.
Decision making	Considering multiple options or alternatives, in order to select a solution that best fulfils requirements/needs	Unit 1: 1.1.9 Be able to select digital devices to meet the needs and requirements of individuals and organisations Unit 2: 4.1.3 Understand how to use design principles to create effective page layout and design Unit 3: 1.1.5 Be able to interpret and design validation rules for a given situation Unit 4: 3.2.2 Be able to create appropriate system outputs for a database solution that effectively aid users	Unit 1, Q3(b) Unit 3, Q3(b) This skill is also assessed implicitly in the two practical examinations (Unit 2 and Unit 4).	Students will have an opportunity to develop and demonstrate decision-making whilst working on problem solving activities.
Adaptive learning	Adapting prior knowledge, skills and experience of IT to deal with new situations/contexts	Unit 1: 1.1.2 Understand the technologies that are used by digital devices and how these impact the design and use of devices Unit 2: 3.3.4 Understand how to combine JavaScript with HTML and CSS to create page components Unit 3: 3.1.2 Understand the concept of transaction processing (TP) and how and why organisations use TP systems Unit 3: 5.1.2 Understand the impact of and possibilities associated with machine learning Unit 4: 1.2.1 Be able to apply understanding of user	Unit 1, Q1(c) Unit 1, Q3(c) Unit 3, Q1(b) Unit 3, Q3(a) This skill is also assessed implicitly in the two practical examinations (Unit 2 and Unit 4).	Students should be encouraged to adapt what they have learnt in one context to another less familiar one. For example, they could be set the task of researching how and why a chain of supermarkets uses a CRM system and then asked to consider the benefits of a CRM system for a different type of business, such as a healthcare provider.

		characteristics to develop appropriate database solutions		
Executive function	Managing self and own resources in order to achieve a goal	This skill is covered implicitly in Unit 2 and 4, which require students to work independently to produce solutions that are fit for purpose.	This skill is assessed implicitly in the two practical examinations (Unit 2 and Unit 4).	Students will have an opportunity to develop and demonstrate executive function whilst working on complex projects independently or as part of a group.
Creativity				
Creativity	Producing effective IT solutions to problems	Topic 4 of Unit 2 is about creative use of the web coding skills students have acquired to create effective web pages. Topic 3 of Unit 4 deals with creating effective database solutions that are fit for purpose and meet user needs.	This skill is assessed implicitly in the two practical examinations (Unit 2 and Unit 4).	Practical problem solving tasks give students an opportunity to develop and demonstrate creativity and innovation.
Innovation	Thinking 'outside the box', looking for ways to raise the bar and having the courage to try something new	In Unit 3 students are encouraged to consider how the use of big data and adoption of emerging technologies can lead to innovative ideas, practices and operational applications.	Unit 3, Q3(b)	
Intrapersonal skills				
Intellectual openness				
Adaptability	Adapting to changing circumstances by amending plans and making refinements	This skill set is not covered in the subject content.	These skills are not explicitly assessed.	Students' intrapersonal skills can be formatively assessed through observation of how they behave when undertaking developmental activities, such individual challenges and group projects.
Personal and social responsibility	Recognising how own behaviour affects others, and being accountable for own actions			
Continuous learning	Continuously striving to extend own knowledge, understanding and skill set. Planning and reflecting on own learning, setting goals and reviewing progress regularly			

Intellectual interest and curiosity	Seeking to broaden understanding and explore new concepts			
Work ethic /conscientiousness				
Initiative	Using own judgment and doing things without needing to be told what to do	This skill set is not covered in the subject content.	These skills are not explicitly assessed, although they are implicitly assessed in the two practical examinations (Unit 2 and Unit 3).	Students' work ethic/conscientiousness skills can be formatively assessed through observation of their approach to tackling challenging/complex tasks.
Self-direction	Setting own goals and working independently to achieve them			
Responsibility	Taking ownership of own work, acting independently and making own decisions			
Perseverance	Overcoming setbacks and responding to challenges			
Productivity	Using project management tools to plan and manage IT projects			
Self-regulation (metacognition, forethought, reflection)	Monitoring and controlling own actions, altering behaviour in accordance with the demands of the situation			
Ethics	Demonstrating awareness of moral and ethical issues associated with the use of IT	Unit 1: 6.2.2 Understand the moral and ethical issues associated with the use of Information Technology systems	Unit 1, Q2(d)	
Integrity	Behaving honestly and doing the right thing	This skill is not covered in the subject content.	This skill is not explicitly assessed.	
Positive Core Self Evaluation				
Self-monitoring/self-evaluation/self-reinforcement	Planning and reviewing own work as a matter of course	This skill is not covered in the subject content.	This skill is not explicitly assessed.	Development logs/diaries can be used to develop and formatively assess self-evaluation.
Teamwork and collaboration				
Communication	Communicating ideas to peers and teachers verbally or in writing	This skill set is not covered in the subject content.	These skills are not explicitly assessed.	Teamwork and collaboration skills can be formatively assessed by observing students taking part in a

Collaboration	Working with others to carry out a shared task			group activities and peer mentoring others.
Teamwork	Working in a team to complete an IT project, encouraging and giving appropriate feedback to fellow team members			
Co-operation	Working cooperatively on a team project, sharing expertise and know-how			
Interpersonal skills	Communicating effectively with others			
Empathy/perspective taking	Being aware and taking account of the feelings of others			
Negotiation	Discussing with others in order to reach an agreement			
Leadership				
Leadership	Leading a team to complete a group activity	This skill set is not covered in the subject content.	These skills are not explicitly assessed.	Leadership skills can be formatively assessed by giving every student an opportunity to lead a team to carry out a project.
Responsibility	Taking responsibility for the progress and outcomes of a group task			
Assertive communication	Chairing a meeting, allowing/ encouraging other attendees to contribute and directing the discussions to a conclusion			
Self-presentation	Conveying a positive image of oneself to others			

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REGISTERED OFFICE: 80 STRAND, LONDON WC2R 0RL
VAT REG NO GB 278 537121

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