

COMPUTER APPLICATIONS TECHNOLOGY

ELABORATION OF TECHNOLOGY CONCEPTS

[2nd EDITION – June 2022]

**PER THE CONTENT IN THE CAT CAPS
AND**

AS PER THE **2021 EXAMINATION GUIDELINES** FOR CAT



NOTE:

- The depth of knowledge required for the existing concepts and terminology should include:
 - Definition – what it is
 - Purpose/Function – what it does, why it is needed
 - Advantages/Disadvantages
 - Benefits/Limitations
 - Applications in an ICT environment
- The yellow highlighted concepts are additions to the previous Examination Guidelines.
- YouTube videos for most of these concepts can be accessed at:

With thanks to:

CAT Officials:

• Ellen Labuschagne (DBE IM), • Estelle Llewellyn (DBE IM/KZN), • Fotiene Avrakotos (Gauteng),
• Vani Pather (KZN), • Shani Nunkumar (KZN), • Yvette Lourens (Northern Cape), • Sibongile Masondo (KZN)

CAT and IT teachers and lecturers:

·Anton van Kampen (Nico Malan High – Eastern Cape), ·Sharon Oelofsen (Ladysmith High, KZN),
·Reginald Govender (UKZN), ·Kooraysha Moola (Maritzburg College) Edward Gentle (Limpopo), Claire Smuts (Gauteng)

Table of Contents

1	SOLID-STATE DRIVE (SSD).....	3
2	MEMORY CARD READER	4
3	MULTI-TOUCH SCREEN	5
4	HDMI (HIGH-DEFINITION MULTIMEDIA INTERFACE)	6
5	3D PRINTING/PRINTERS	7
6	802.11 A/B/G/N.....	8
7	LTE (LONG TERM EVOLUTION).....	9
8	NEAR FIELD COMMUNICATION (NFC)	10
9	VIDEO COMMUNICATIONS	11
10	URL SHORTENER	12
11	INTERNET OF THINGS (IOT)	13
12	AUTONOMOUS VEHICLES	14
13	DRONE TECHNOLOGY	15
14	WEARABLE DEVICES AND WEARABLE TECHNOLOGIES	17
15	SHAPING (NETWORK TUNING)	19
16	THROTTLING (POLICING)	20
17	GEOTAGGING	21
18	CLICK-JACKING	22
19	RANSOMWARE	23
20	SCREEN LOCK PATTERN	25
21	AUTHENTICATION	26
22	CROWD FUNDING	27
23	BYOD: (BRING YOUR OWN DEVICE)	28
24	BIG DATA.....	29
25	CRYPTOCURRENCIES	30
26	E-LEARNING AND M-LEARNING	31
27	VIRTUAL REALITY (VR).....	34
28	AUGMENTED REALITY (AR)	35
29	ARTIFICIAL INTELLIGENCE (AI)	36
30	4TH INDUSTRIAL REVOLUTION (4IR)	38
31	5TH INDUSTRIAL REVOLUTION (5IR)	40
32	BLOCKCHAIN	42
	ACTION VERBS USED IN EXAMINATION PAPERS	45

STORAGE DEVICES AND MEDIA

EXAMPLES OF GENERIC/COMMON STORAGE DEVICES AND MEDIA (CAPS p. 22)

1 Solid-State Drive (SSD)	
Definition/Description what it is	A solid state drive is a storage device that has no moving parts making it silent and more robust than an HDD. Solid state drives operate much faster than traditional hard drives as they store data electronically and not magnetically as with a traditional hard drive.  <i>A solid state drive</i>
Purpose and function - what it does - why it is needed	- Gives faster access to stored files when compared to an HDD. - Used as secondary storage to store data, program files and operating system files. - Improves the general performance of a computer and is often used in combination with a hard drive. The SSD provides very fast access to the most important files, improving performance while the cheaper HDD provides storage to large files such as media, where performance loss is not crucial.
Simple explanation of how it works	- SSD uses microchips – it contains no moving parts like an HDD. - SSD uses 'flash-memory' which is similar to RAM but non-volatile. Data is not lost when the power goes off. - SSD uses a grid of electrical cells to quickly send and receive data. - The essential SSD components includes a host interface meaning there is an interface provided that allows the SSD to communicate with the driver (uses a standard SATA connection)
Advantages/Benefits	- Read/write speed (data access) of SSD is very fast, which leads to a shorter boot time and better performance than an HDD. - SSD is less likely to get damaged because of no moving parts. - SSD is silent due to no moving parts which becomes factor in a data centre with many hard drives. - SSD uses 'flash memory' to store data and is not affected by magnetic interference. - SSD has low power consumption.
Disadvantage	- SSDs are more expensive than HDDs per GB of storage space, but in recent times this price gap is becoming smaller. - Almost impossible to do a data recovery from an SSD.
Limitation	- SSDs have a limited number of write cycles. The SSD can wear out after using it for a long time as data can be written to or erased from the same place in flash memory for a limited number of times. - Limited in availability – not readily available in stores, may have to be ordered in advance
Application in an ICT environment / (Examples of the technology in practice)	- Are found in tablets and PCs, laptops, computer games, etc. - Standard for ultra-thin and high-performance laptops/ultra-books. - Would be preferable for workloads that require higher performance, quick read/write speeds, for example, database applications.

STORAGE MEDIA AND DEVICES (memory cards) (CAPS p. 22)

2 Memory Card Reader	
Definition/Description what it is	A card reader is a device connected to a computer designed to accept and read data from different types of storage media, such as SIM and SD cards and flash drives.  <i>Card reader used to read different sizes of cards</i>
Purpose and function - what it does - why it is needed	A memory card reader is a device, typically having a USB interface, for accessing the data on a memory card such as a Secure Digital (SD) or Multimedia Card (MMC). Most card readers also offer write capability.
Advantages/Benefits	- Card readers transfer images to a computer faster than transferring from a digital camera. - Card readers consume little energy or power. - Data/Photos can be transferred to the PC without the device/camera being present. - A multiple memory card reader allows you to read from or write to many different cards. - An internal card reader on a laptop enables additional storage, without having to carry around an extra device.
Disadvantages/Limitations	- Frequent use of a card reader can damage the memory card if mishandled. - Can be cumbersome to carry an external card reader around to use on a USB port.  <i>Combination card reader and USB drive</i>
Application in an ICT environment / (Examples of the technology in practice)	- Card readers are integrated into most modern laptops and, desktop computers and some medium to high-end printers. - Integrated into almost all mobile devices. - Many portable devices like cameras use memory cards that require a memory card reader for access to media.

INPUT AND OUTPUT DEVICES

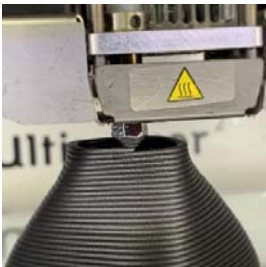
INPUT (Basic concepts, features and uses) (CAPS p. 20)

3 Multi-touch screen	
Definition/Description what it is	A multi-touch screen is a feature of a screen that allows it to register more than one point being touched simultaneously.  <i>Example of a multi-touch screen</i>
Purpose and function - what it does - why it is needed	- Multi-touch technology works with trackpads (or touchpads) and touch-screen interfaces, like those found on laptops, smartphones and tablets. - Multi-touch technology allows users to interact with their devices by expanding the number of interface options. Rather than simply swipe and tap, multi-touch allows the user to zoom, scroll, select, etc. - Multi-touch technology is designed to provide touch-screen interfaces with the same sort of flexibility and usability that a traditional mouse and keyboard provide, while also providing for a more intuitive and seamless user experience.
Advantages	- A multi-touch screen offers more functionality without using menus. - Multi-touch technology can allow multiple users to interact through the same screen, enhancing amusement game applications.
Limitations	There is a limit as to how many physical touches are possible on a small screen.
Application in an ICT environment / (Examples of the technology in practice)	- Use two or more fingers to pinch and stretch to control the zooming on tablets. - Five fingers are used in a pinching gesture/motion to close apps on an iPad. - Some touch screens also respond to finger motions such as sliding your finger to drag an object. - Examples of multi-touch technology include smartphones, tablets, laptops, touch tables and walls (like those found in museum exhibits and commercial spaces). - Accessibility technology on smartphones often uses multi-touch ability to offer particular functionality to people who are sight impaired.

WHAT DETERMINES THE QUALITY OF MONITORS AND PRINTERS (CAPS p. 30)

4 HDMI (High-Definition Multimedia Interface)	
Definition/Description what it is	High-Definition Multimedia Interface (HDMI) is a standard/port for connecting high-definition video devices, such as computer monitors, video projectors and digital television, etc. HDMI carries high quality video and audio signals, and there is no need for separate audio cables as with VGA.  <i>HDMI cables</i>  <i>HDMI ports</i>
Purpose and function - what it does - why it is needed	The HDMI interface allows a port to send high-resolution digital video, theatre-quality sound, and device commands through a connector and down a single cable. There are several types of HDMI cable, each designed to support a video resolution and features in the HDMI specification. A single HDMI cable will carry both the video and audio signal from a device to your display. A HDMI cable is most frequently used to connect a laptop to a data projector or a television.
Advantages	Higher quality: HDMI enables loss-less transmission and better quality video at low brightness scenes at higher resolutions. - HDMI has the ability to transport a high bandwidth of data (video, audio and now 3D and Ethernet) using a single cable. For the average consumer, the ability to connect their TV and DVD player with just one cable certainly makes setting up a home entertainment system less daunting.
Disadvantages	Switching delays: Sometimes, blank screens can be caused due to authentication delays. There can also be screen flashing errors. - Physical cable with a bandwidth limit of 10 GB/sec (4K) is still required.
Application in an ICT environment / (Examples of the technology in practice)	Virtually every TV, AV receiver, DVR, Blu-ray Disc Player, and set-top box today comes standard with HDMI technology. Other examples where HDMI technology is used is: game consoles, soundbars, etc.
Video	https://youtu.be/t4JsatRruuM

GENERIC COMMON OUTPUT DEVICES (CAPS p. 20)

5 3D printing/printers	
Definition/Description what it is	3D printers can create three-dimensional solid objects from a digital model of the item by adding successive layers of material on top of one another.   <i>An ORDbot Quantum 3D printer</i> <i>Close-up of a 3D-printer showing how it prints in layers</i>
Purpose and function - what it does - why it is needed	To be able to produce a 3D reproduction, the 3D printer reads the design from a 3D printable file and then fuses layers of liquid, powder, paper pulp or sheet material on top of one another to build the model. These layers correspond to the computer-generated cross sections of a Computer-aided Design (CAD) model.
Advantages	3D printing is much cheaper than other manufacturing methods. 3D printing technology enables home users to have access to machines that can build 3D models. - Parts needed for a project can be made 'on-demand'. - Clients can examine a physical model before manufacturing/building starts (e.g. a miniature of a new mall being developed).
Disadvantages	- It can take a long time to create models for 3D printers. - Limited materials can be used for 3D printing – almost all 3D printers use some form of plastic for their models. - Consumables used in 3D printing are relatively expensive. - Various processes are needed to clean up models before they are useable, such as sanding, curing, etc. It is also time-consuming and costly to assemble multiple parts of a larger model. - Emissions may possibly be toxic (smelly/odour).
Limitations	- Model size is limited to the printer size - Can only print in one material at a time - Not suitable for mass production/It takes long to print objects - Not all objects can be created/printed - Complete re-print is required if any errors occur
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	One can create three-dimensional solid objects (for example, motor vehicle parts, human tissue replacement, jewellery, clothing, buildings, boats, etc.)
Video	https://www.youtube.com/watch?v=uQvN10kGKrK

COMMUNICATION AND COMMUNICATION DEVICES

OVERVIEW OF PORTABLE AND MOBILE INTERNET ACCESS (BASIC CONCEPTS)

(CAPS p. 35)

STANDARDS FOR WIRELESS COMMUNICATION

6 802.11 a/b/g/n	
Description/Definition what it is	802.11 a/b/g/n refers to a set of specifications and protocols used in communication on a wireless network. The letters (a, b, g, n) simply indicate different versions of the Wi-Fi standard (each with different speeds, etc.) 
Simple explanation of how it works	- Devices that have the appropriate wireless capability can communicate with other devices by using Wi-Fi (wireless fidelity), which identifies any network based on the 802.11 standards. 802.11 is a series of network standards that specifies how two wireless devices communicate over the air with each other or put very simply, it is a wireless connection to a physical network or network device.
Application in an ICT environment / (Examples of the technology in practice)	- Wi-Fi communication in hotspots. - This standard will indicate whether a device has Wi-Fi capabilities when you are making a buying decision.

These notes only refer to the Wi-Fi standard – you still need to learn all about Wi-Fi in your textbook.

OVERVIEW OF PORTABLE AND MOBILE INTERNET ACCESS (BASIC CONCEPTS) (CAPS p. 35)

7 LTE (LONG TERM EVOLUTION)	
Definition/Description what it is	LTE (Long Term Evolution) is a standard used in wireless communication which provides for high-speed data transfers between cellular devices (such as smartphones and tablets) and ISPs. It is the next generation of cellular connectivity after 3G, sometimes also called 4G. 
Purpose and function - what it does - why it is needed	- Put simply, it is the next generation (after 3G) of cellular connectivity used for data transfer, such as browsing the internet. - It is a very fast way for mobile devices to connect to the internet.
Advantages	- LTE offers a very fast connection/faster download and upload speeds. - LTE enables users to watch videos, stream a radio station, play online games, and browse the internet.
Disadvantages/Limitations	- LTE is more demanding on mobile device batteries than 3G and 2G. - LTE coverage may be limited to certain areas. - If a user has an LTE connection, videos (e.g. YouTube) will automatically stream in the highest available quality.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	LTE is frequently used for fast internet access.

Every new generation of cellular communication is faster than the previous generation.

*For example,
4G/LTE is faster than 3G.
5G is faster than 4G.*

WIRELESS TECHNOLOGY (PRINTERS) (CAPS p. 30)

Wi-Fi HOTSPOTS, WiMAX, BLUETOOTH (CAPS p. 35)

8 Near Field Communication (NFC)	
Definition/Description what it is	Near Field Communication (NFC) is a standard that allows devices such as smartphones to connect wirelessly simply by touching them together or bringing them into close proximity.
Purpose and function - what it does - why it is needed	NFC is a technology built upon radio-frequency identification, or RFID, which allows a gadget to send radio waves to another gadget or to another RFID-enabled tag and to trigger a certain action. NFC makes tap-and-go services possible and is often used in smartphones and smartwatches.
Advantages/Benefits	- NFC offers a certain amount of security, as a hacker would need to be close to the target to access NFC-data exchange. - NFC can be used to change settings automatically on devices such as smartphones. - Makes quick contactless data transfer by a single tap on a screen possible, for example, contactless tap-and-go card transactions.
Disadvantage/Limitation	NFC has a comparatively low transfer speed – so it is not the best method for transferring large files such as videos.
Application in an ICT environment / (Examples of the technology in practice)  <i>Near Field Communication example</i>	Basically, you can use NFC to do most things in your daily life, for example: - exchange data by just touching two smartphones together - pay and transfer data using NFC technology - launch an app on someone else's smartphone - send directions to someone if you are near to them - use NFC when travelling, for example, manage your trips or to scan your boarding pass at an airport checkpoint - connect with different NFC tags - pair tech accessories like speakers with NFC - log in to your work computer with just a tap of the phone - unlock your car doors - control your car or home (using NFC chips and a smartphone) - keep track of your health and fitness stats, etc.
Videos	https://www.youtube.com/watch?v=64mAcOn444 https://www.youtube.com/watch?v=Wim4TqMzgVQ https://www.youtube.com/watch?v=m6PFtsvpMxA

VIDEO COMMUNICATIONS - (E G 2021)

9 Video communications	
Definition/Description what it is	Video communication is the transmission of data via live video streaming or video sharing. Three main types of video communication are: - Video calling - Video conferencing - Video sharing
Purpose and function - what it does - why it is needed	Video calling: two or more people to communicate using video on their smartphones or personal computers, using the same internet platform/software or smartphone/landline number. Video conferencing: two or more people share a live visual connection from different locations. Each participant is able to see all participants in a grid with multiple screens. It uses Multipoint Control Unit to select and combine the video streams of the participants and allows text chat and file sharing while the conference is active. Video sharing: sharing video during meetings/presentations. This is a feature of most video conferencing software.
Advantages	- Video communication technology is able to connect people/employees, in one meeting, from different locations all over the world. - In business, it can establish real-time connection with clients, suppliers, and partners. - Video communication allows families and friends to have conversations where they can all see each other while they are in different locations.
Disadvantages	- Video communication uses a lot of data. - Fast internet connection is needed for smooth video/Buffering may occur because of a slow internet connection.
Limitations	- Video communication is only possible with an internet connection. - Video communication is best used over an uncapped, broadband connection. - Needs special software/hardware and sufficient bandwidth, video display screen, microphone, webcam etc.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	Video conferencing apps: Zoom, MS Teams, Google Meets Video calling apps: WhatsApp, FaceTime, Google Hangouts, Skype

INTERNET TECHNOLOGIES

WEB PAGE, WEBSITE, HYPERLINK) (CAPS p. 25)

10 URL shortener	
Definition/Description what it is	URL shortener is a tool or service which converts a long URL to a shorter version. This shorter version of the URL will take a user to the same web address but is easier to remember and/or type out.  <i>Examples of URL shortener services</i>
Purpose and function - what it does - why it is needed	- A user can log into the URL shortening site, paste a long URL in and the URL shortening site will then shorten it and allow a user to use the new shortened URL to access the same website. - Shortened URLs can be customised.
Advantages	- A short URL is convenient for messaging communication apps such as Twitter which may limit users to the number of characters they can type in their message. - A short URL is much easier to remember or type without errors. - Using an online tool to shorten a link allows you to track the links that you created
Disadvantages	- Some websites prevent short, redirected URLs from being posted. - Some URL shorteners have unique domain names, which you have to use and may be a problem if you are trying to create a short, simple link. - There are certain URL shorteners, which cannot be customised, and which may make your URL appear as spam.
Application in an ICT environment / (Examples of the technology in practice)	Copy the long URL you want to shorten → Paste URL into URL shortener of choice → Hit the button to shorten URL → Use the short URL on social media From: https://www.fool.com/the-blueprint/url-shortener/ Examples: - TinyURL.com - Bit.ly - Diggbar - Su.pr - Bl.ink

11 Internet of Things (IoT)

Definition/Description what it is	Internet of Things (IoT) refers to the trend whereby all sorts of objects and devices are increasingly being connected to one another via the internet. Various sensors in the devices can produce data for all sorts of purposes including diagnostics and running systems more efficiently.  <i>Example of IoT in a smart home</i>
Purpose and function - what it does - why it is needed	Physical objects are embedded with sensors, software, etc., which connect and exchange data with other devices and systems over the internet, not dependent on human intervention.
Advantages	- Appliances can be started remotely before getting home. - Check on the status of appliance (is it still operational). - Manufacturer can diagnose problems without visiting. - Firmware can be upgraded. - Usage can be monitored (e.g. coffee machine in an office). - Data can be retrieved from these devices.
Disadvantages	- IoT may have negative implications for user privacy. - Cybercriminals can hack into a network via IoT devices and gain access to private information. - IoT may lead to an over-reliance on technology.
Application in an ICT environment / (Examples of the technology in practice)	- This can range from surveillance systems to geysers, washing machines, 'smart' motor cars and traffic lights, etc. - Scenario 1: Smart thermometer on the roof automatically communicates with the smart air conditioner in the building to automatically turn on and off as the temperature drops / rises. - Scenario 2: If you buy products with RFID tags on them, your smart fridge can automatically pick up what items are in it, warn you early when something is close to the expiration date and suggest recipes. Your smart dustbin can also register which items you have thrown away, and automatically update your shopping list on your smartphone. - Biochip transponders on animals. - Wearable health monitors. - DNA analysis devices for environmental/food/pathogen monitoring.

12 Autonomous vehicles

Definition/Description • what it is	A self-driving car, also known as an autonomous vehicle, driverless car, or robo-car is a vehicle than can sense its environment and move safely with little or no human input. An autonomous vehicle is one that can drive itself from a starting point to a selected destination in an 'autopilot' mode using various in-vehicle technologies and sensors to navigate on roads.  <i>Autonomous vehicle</i>
Purpose and function • what it does • why it is needed	Autonomous vehicles use various technologies and sensors such as adaptive cruise control, active steering, anti-lock braking systems, GPS navigation technology, lasers and radar.
Advantages	• Reduced accidents. • Reduced traffic congestion (vehicles can communicate with each other). • Lower Fuel consumption/Consumer savings on running costs. • Transportation for people who cannot drive/Increased access to transportation. • Reduced travel times.
Disadvantages	• Security issues due to possible hacking. • Computer/machine may malfunction/possible machine errors may occur.
Limitations	• Potential for loss of privacy as movements of the car can be tracked. • Requires very good network coverage.
Application in an ICT environment / (Examples of the technology in practice)	• Delivery services and taxi services may be more efficient and cheaper. • People with disabilities that prevent them from driving may have the opportunity to be more independent.
Video	https://www.youtube.com/watch?v=fZ102xfmH-Y

13 Drone technology

Definition/Description • What it is https://youtu.be/Cvvjda9y9Gk	A drone is an unmanned aircraft. Essentially, a drone is flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded systems, working in conjunctions with on-board sensors and GPS. A drone is a flying robot that can be remotely controlled, combined with advanced technologies including GPS, sensors, artificial intelligence, and video cameras.
Purpose and function • what it does • why it is needed	The two basic functions of drones are flight and navigation. • To fly a drone needs a power-source such as a battery or fuel, propellers, rotors and a frame (which is made of lightweight materials). • Drones need a controller which is used remotely by an operator to launch, navigate and land it. Controllers communicate with the drone using radio waves, e.g. Wi-Fi. Drones can be used to respond to emergencies but can also be useful during times of natural disasters. For example, unmanned aerial vehicles (UAVs) have been used to assess the damage, locate victims, and deliver aid to victims after a hurricane or earthquake, gathering information via mounted video cameras. Can be used where very slow flying is needed for exploration/scouting/reconnaissance, etc.
Advantages	• Drones are relatively inexpensive compared to manned aircraft, quick to deploy, can work rapidly, and can collect accurate data. • Drones can fly to areas that are difficult/impossible to access in other ways. • Drones can be useful tools for businesses – Drones can be used to do a rapid inspection of construction sites, power lines, or large-scale industrial equipment. They can be used for aerial mapping of topography, or for preparation in building a road or digging a mine.
Disadvantages	• Collateral damage: Although drones can be used precisely, sometimes collateral damages occur. Drones can cause damage to property and people. The possibility of loss of signal from the controller, dead batteries, bird attacks, or even a sudden change in wind direction can easily cause a drone to plunge to the ground. • Invasion of privacy: Drones survey an area through a remote control. The high-power zoom lenses, and its night vision make it easy to capture images or record activities in an area.
Limitations	• Battery life: The battery life limits the flying time of the drone and sometimes you need to have multiple batteries fitted on the drone to extend its flying time. Cold temperatures in an area reduce the battery life.

	• Weather changes: Weather changes in an area affects the use of drones. Most drones are designed to operate at a speed of 30 mph thus you cannot use them in an area with a wind speed of less than 20 mph. Flying drones in rain or snow can damage the electronic components and interfere with the communication between the drone and the controller. • The use of drones may be limited by air space rules/laws. • Some drones require a specific licence to be able to fly them.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	• Agriculture – farmers can use drones to measure and record the growth of their crops, insect infestation, etc. • Disaster management – drones can be used to survey the extent of wild fire damage in a specific area. • Drones can be used in situations where it is too dangerous to send in a manned aircraft. • Photography, filming, journalism – drones are used by television sport networks to capture sporting footage. • Scientific – drones with biological sensors can fly to unsafe areas to take the air quality readings and check for micro-organisms or atmospheric elements. • Nature conservation and game ranging – in combination with geospatial imagery, drones are used to monitor and track animals. • Military – drones are deployed mainly for intelligence, reconnaissance, and surveillance missions. • Security companies use drones to provide surveillance systems for industrial, commercial, and residential properties. • Commercial use – drones are used for parcel deliveries, delivery medical supplies in remote areas, etc. • Insurance companies use drones to assess the damage to buildings, roof damages, etc. • Geographic mapping – drones that use 3D mapping are used to access dangerous coastlines or unattainable mountain tops.
Video	https://youtu.be/Cvvjda9y9Gk

Additional reading:

<https://internetofthingsagenda.techtarget.com/definition/drone>

<https://www.mydronelab.com/blog/drone-uses.html>

14 Wearable devices and wearable technologies

Definition/Description what it is	Wearable devices and technologies are electronic mobile devices worn as accessories or part of clothing that continuously generate data from various environments and communicate with other devices/PC/networks.
Purpose and function - what it does - why it is needed	Wearable devices are used for tracking information on a real-time basis. These devices have sensors which track information such as distance travelled, heart rate, oxygen saturation and temperature which can be transmitted to connected smart devices. The information between the wearables and the smart devices are synchronised.
Advantages	- Wearables are hands free and portable, facilitating mobility and connectivity for users to access online information conveniently and communicate with others immediately while on the move. - Wearables are connected to smart devices to which they transmit information. This allows us to view this information immediately or at a later time. - It allows for tracking of information without confinement to a particular physical location. - Information is collected and analysed, and a report is issued almost immediately. - There are several advantages of wearable devices in the health sector: encourages proactive healthcare, keeps patients engaged, and monitors vulnerable patients.
Disadvantages	- Some wearables have been known to measure data inaccurately on some occasions which can have serious implications. - Privacy concerns regarding wearables – may share information that violates privacy. - Wearable technology may pose security risks as they are always online and may be hacked or allow the wearer to be spied upon.
Benefit	- May allow companies to track employee health and fitness levels. - May help address employee safety – for example, caps worn by long-distance drivers to monitor fatigue or the level of alertness. - Can keep track of how your body reacts to exercise.
Limitations	- Size of the wearables may limit the tasks they are supposed to perform or makes it impossible for these devices to function on their own. - Small size usually results in small batteries, limiting their useful time.
Application in an ICT environment / (Examples of the technology in practice)	Smart watches provide a person with not only the time but notifications of their calls, messages, e-mails, social media updates, etc. Fitness trackers and sport watches keep track on the number of steps/amount of time exercised and monitors heart rate. It can calculate and report on how many calories were burnt, etc. Smart glasses can provide functionality in your peripheral vision like GPS navigation, the ability to easily take a photo, take incoming calls etc.

	• Smart clothing was developed to monitor such things as heart beats, blood glucose levels and fitness levels when worn. • Implantable wearable devices are surgically implanted under the skin and are usually used for medical reasons like tracking insulin levels, symptoms of diseases, etc. • The gaming industry adds more wearables, such as gloves and virtual reality headsets.
Video:	https://www.youtube.com/watch?v=wq2pgkx9DYU https://www.youtube.com/watch?v=NiBMgpUAHt4 https://www.youtube.com/watch?v=noiKR_yWniU

Acknowledgements and further reading:

<https://www.happiestminds.com/Insights/wearable-technology/>

<https://www.investopedia.com/terms/w/wearable-technology.asp>

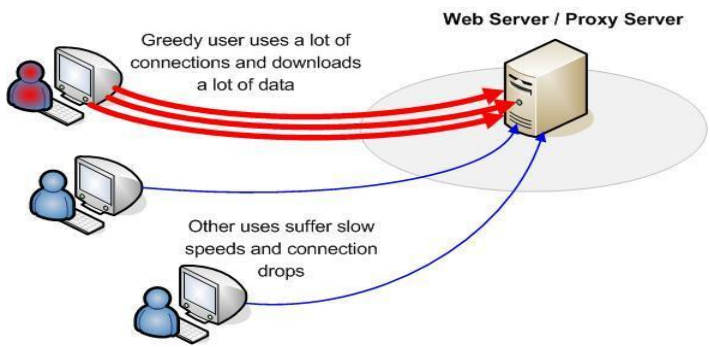
<https://edu.gcfglobal.org/en/wearables/pros-and-cons-of-wearable-technology/1/>

15 Shaping (Network Tuning)	
Definition/Description what it is	Shaping or Network Tuning is a technique where certain network (internet) services, for example, e-mail, are given preference while others such as social networking services are given less priority, so performance is maintained for the more critical services.
Purpose and function - what it does - why it is needed	Internet Service Providers (ISP) to Home Users - Shaping is used on most consumer internet accounts. User will experience reduction of speed on the internet during peak periods. - Certain internet services may slow down to give other services priority. The ISP decides which services to shape. - Often torrent downloads are shaped because it is not seen as a priority service. Businesses/Organisations - The profiles for traffic shaping can be easily changed, to adapt the network to different uses. The network manager can run specific tools to enable the automatic change of network profiles, for instance according to the specific needs of certain hours of the day. - Traffic shaping is used to help organisations with centralized servers that are under heavy traffic manage their resources. - Traffic shaping is a quality of service (QoS) technique that is configured on network interfaces to allow higher-priority traffic to flow at optimal levels even when the link becomes over-utilised (thus, even if the internet usage is high, critical services can still work).
Advantage/Benefit	Shaping allows a service provider to make critical data and essential services available without interruption.
Disadvantages	The user may experience slow internet connection (at peak times).
Application in an ICT environment / (Examples of the technology in practice)	Common uses of traffic shaping include: - Time-sensitive data may be given priority over traffic that can be delayed briefly. - Business-related traffic may be given priority over other traffic. - A large ISP may shape traffic based on customer priority. - An ISP may limit maximum bandwidth consumption for certain applications to reduce costs and create the capacity to take on additional subscribers. This practice can effectively limit a subscriber's 'unlimited connection' (uncapped) and is often imposed without notification. - Traffic shaping is an integral component of the proposed two-tiered internet, in which certain customers or services receive traffic priority for a premium charge (e.g. business clients pay the ISP more, but is never shaped).
Example: <i>If employees within a company download file types that use a lot of bandwidth and that are not related to the day-to-day workings of that company, e.g. MP4 files, the company could shape the network so that important tasks such as sending and receiving company e-mails would be given bandwidth preference.</i>	

Further reading:

<https://itsi.intelligentpractice.co.za/read/cat/grade-12-cat/networks/04-networks?id=sec4-2>
<https://searchnetworking.techtarget.com/definition/traffic-shaping>

16 Throttling (Policing)

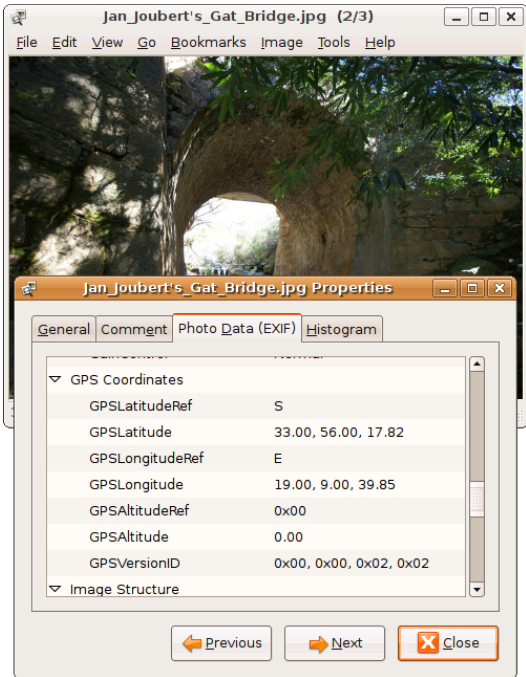
Definition/Description what it is	Throttling or Policing occurs when your ISP slows down your internet connection. This often occurs when your ISP notices that your downloads have used excessive amounts of data. Each ISP has an Acceptable Usage Policy (AUP) which specifies how this is determined and implemented.  http://www.tidyutorials.com/2011/03/bandwidth-throttling-and-connection.html
Purpose and function - what it does - why it is needed	When you exceed the amount of data specified in the FUP or AUP for the month, your ISP will drop your internet speed so that you will not be able to continue your excessive downloading pattern.
Advantages	- A controlled internet access environment can be set up in an organisation. - Limits congestion in the ISP server and prevents crashes.
Disadvantages	- Throttling is inconvenient for user due to the slow speed of the internet – time consuming. - It could be misleading if you pay for uncapped data and then get throttled.
Application in an ICT environment / (Examples of the technology in practice)	Company servers/Networks slows down internet access for the users disregarding the AUP to protect the system.

Examples:

- <https://www.vox.co.za/wp-content/uploads/2016/10/Home-ADSL-and-FTTH-Fair-Usage-Policy-19012017-1.pdf>
- <https://www.vodacom.co.za/vodacom/terms/fibre/vodacom-fibre> (nr. 76)

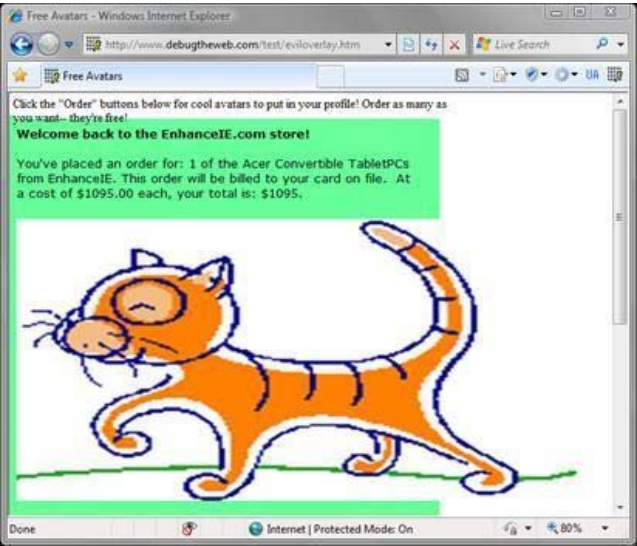
PROPERTIES/META DATA

MANAGEMENT OF FILES (CAPS p. 40)

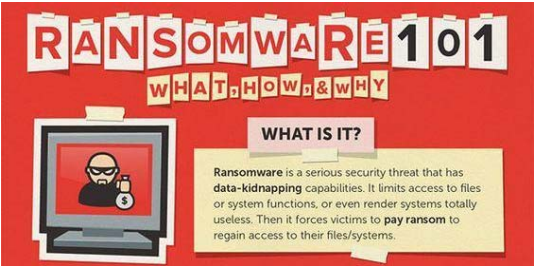
17 Geotagging	
Definition/Description what it is	Geotagging is a process where a geographical position of where a photograph was taken is added to the metadata of a file, such as adding the latitude and longitude. https://en.wikipedia.org/wiki/Geotagging#/media/File:Geotagging_gThumb.png 
Purpose and function - what it does - why it is needed	Geotagging adds a GPS co-ordinate data to any media, such as photograph, map, or details on the geographical position of any object.
Advantages	- People will always know where the picture was taken. - Geotagging allows people to retrace their exact steps later on. - Can help a user to find a specific location, even the location a photograph was taken. - Can be used in law enforcement to track the position.
Disadvantages	- Stalking can be an issue as criminals can use geotagging information on pictures published on the internet to track down people in the pictures. - Items in the background can be “tagged” by criminals
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	'Dropping' a pin – sending a GPS location over social networking. - Geotagging on modern cameras and smartphones. - Geocaching – a game where Geotagging is used in a treasure hunt.
Video	https://www.youtube.com/watch?v=Q5TRU9A1t9k

CYBER SECURITY ISSUES

SECURITY ISSUES (CAPS p. 42)

18 Click-jacking	
Definition/Description what it is	Click-jacking is when users are tricked into clicking on an item on a web page which acts as a concealed link. 
Purpose and function - what it does - why it is needed	Click-jacking is a scam in which a disguised link (which cannot be seen or detected) is inserted above a legitimate link. Users think they are clicking on the link/image/button below, but they are actually clicking on the invisible link above it, which contains a malicious program/rerouting their click/using their click for something they did not agree to.
Disadvantages	- Click-jacking may redirect users to a site (often a fake website) where they do not want to go or that asks them for personal information. - Malware can be Installed on a system when a user is click-jacked.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	May be used to trick a user to click on a link that would potentially reveal confidential information or allow others to take control of their computers, always used with malicious intent.

19 Ransomware

Definition/Description what it is	Ransomware is a type of malware designed to encrypt or block access to your computer system and files until you pay a sum of money ('ransom'). 
Purpose and function - what it does - why it is needed	Ransomware is typically packaged with installation files and camouflaged as official software updates. After infecting your computer system, the malware finds all files on the computer system, including synchronised files in (cloud) storage and quickly encrypts all those files. After encryption, the malware tells you that your data is being held for ransom and gives you a site to access where you can pay the ransom before files are decrypted.
How to protect your computer	- Make/Keep regular backups in a safe place, that does not synchronise the data. - Keep your antivirus program up to date. - Do not download from a site that tells you software on your computer is outdated. Websites are not able to detect outdated software unless you give the website permission to read your hard drive. If you think your software needs an update, go to the official product developer's site and download it directly from there. - Always keep the latest antivirus definitions installed on your computer to defend against all types of malware. Once the system is infected by ransomware, there is nothing you can do to reverse the damage.
Disadvantages	- Ransomware can hinder the economic viability of small businesses. - More money is spent or needed on security software. - Time consuming and costly when attempting to decrypt data.
Application in an ICT environment / (Examples of the technology in practice) Credit: https://www.securitymagazine.com/articles/90618-city-power-hit-by-ransomware-attack https://www.dailymaverick.co.za/article/2021-11-06-cyberattacks-south-africa-youve-been-hacked/	In 2019 City Power (Johannesburg's power supplier) was the victim of a ransomware attack. It encrypted all of their databases, applications and networks. Their website was also down and it caused customers to lose access to a variety of services, such as the ability to buy prepaid airtime, report faults, or upload invoices. South Africa has been the victim of numerous other ransomware attacks lately, among others: - National School of Government (R2-million cost) - Department of Justice and Constitutional Development (all electronic services affected, possibly leaked 1 200 personal files) - Transnet Port Terminals (all systems down causing chaos at the ports of SA where food and other import goods were stuck on ships and trucks)

	You need to buy Bitcoins to pay the hacker. Reports show that many people pay the ransom, because the files are just too important to give up, and there is currently no guaranteed method to decrypt files. Ransomware is cybercrime and, in reality, is a gateway for cyber terrorism between countries.
<i>How to protect yourself against ransomware</i>	• Back up your data and files. • Educate yourself and employees to recognise potential threats. • Limit access to those that need it. • Keep signature-based protections up to date. • Implement multi-layered security, including advanced threat prevention technologies.

20 Screen lock pattern

Definition/Description • what it is	A screen lock pattern is a way of locking a device by setting up a pattern you must draw or trace on the screen to unlock the device. 
Purpose and function • what it does • why it is needed	The screen lock pattern allows the user to draw a simple pattern with a finger to unlock the phone.
Advantages/Benefits	• Provides security on a phone/mobile device. • 5-6 point patterns can be very difficult to copy as they can be randomly created • Some people may find it easier to remember patterns than passwords. • Usually quicker to unlock a smartphone using a pattern than entering a password.
Disadvantage	• A screen lock pattern is not as secure as a password – people can see what the pattern looks like and copy it.
Limitations	• The number of patterns available are limited.
Application in an ICT environment / (Examples of the technology in practice)	• Widely used for security in touch screen devices such as smartphones and tablets.

21 Authentication

Description • what it is	Authentication (internet safety): Two-factor (two-step) authentication: includes the use of CAPTCHA, OTP (one-time pin/password), ApproveIt messages, etc.
Purpose and function • what it does • why it is needed	• Two-factor (two-step) authentication (2FA) is a security process in which users provide two different authentication factors to verify themselves, usually something you know (like a password) plus something you have (like a one-time password – OTP sent to your phone). • An extra layer of security is added to your account to prevent someone from logging in, even if they have your password. • This extra security measure requires you to verify your identity by sending you a randomised 6-digit code – either every time you log in, or only if you log into a new device or from a new location. • 2FA requires an additional login credential other than your username and password to log in. • When you access your e-mail account from a new device a one-time password (OTP) will be sent to your smartphone or e-mail address depending on your setting and what you chose. Only once you enter the OTP will you be able to access your account.
Advantages	• More secure – helps to prevent unauthorised access to your banking account. • Malware will not be able to access your data even if your password has been compromised. • It can alert you to possible fraud attempt on your account if you receive an OTP and have not requested it.
Disadvantages/ Limitations	• OTPs are time sensitive, and it could be delayed due to network congestion or poor signal strength/lack of coverage. • In case of online services, OTPs are usually set to an e-mail address. If you no longer have access to that e-mail address (you might have forgotten or lost that password) it can be difficult to regain access to the service.
Application in an ICT environment / (Examples of the technology in practice)	• OTPs are used for increased security when buying online or making transfers/payments when doing online banking. • Many online services (social media, Gmail, password managers) allows you to switch on 2FA so that there is an extra form of identification before you log in from a new device or from a new location (e.g. an e-mail, OTP, prompt on your smartphone etc.)

HOW TECHNOLOGY CAN BENEFIT SOCIETY/ SOCIAL IMPLICATIONS

HOW TECHNOLOGY CAN BENEFIT OR HARM SOCIETY (CAPS p. 45)

22 Crowd funding	
Definition/Description • what it is	Crowd funding is a process where a single idea or business practice is funded online by multiple small donations from volunteer contributors, usually before the business venture is started. The contributors will then receive the product when it is finally put into production.
Purpose and function • what it does • why it is needed	People or businesses present an initiative/idea they would like to start, for example, anything ranging from an actual product, welfare initiative, etc. The person or business would then do a presentation of their idea on a crowd funding website and invite readers to support their idea. Each person that pledges an amount of money receives a gift in return. This could be as simple as a thank you for a small amount, or an example of the actual product once it goes into production. The money raised will then be used as indicated in the presentation, such as putting a device into production.
Advantages	• Entrepreneurs can start small businesses/projects with crowd funding when they do not qualify for a loan or does not have other means of funding. • Entrepreneurs have a way to test the potential success of an idea – if the crowd funding target is not achieved the idea will probably not work. • It allows the entrepreneur to form part of a larger network of people who may be interested in funding/supporting start-ups. • Allows fundraising for charities where many internet users can be targeted who would otherwise not know about the charity. • Investors from around the world can take part in new ideas. • Potential investors get their money back and the initiative does not get funded if the target amount is not reached
Disadvantages	• A public presentation of an idea can run the risk of others copying/stealing it. • Crowd funding campaigns require significant planning and documents that have to be in place before launching, or the entrepreneur will be seen as unprofessional. • Some investors may be scammed when crowd funding is used as a front.
Application in an ICT environment / (Examples of the technology in practice)	• indiegogo • kickstarter • gofundme • crowdcube • patreon, etc.

THE ROLE OF ICTs IN THE WORKPLACE (CAPS p. 30)

SOCIAL IMPLICATIONS (CAPS p. 32)

23 BYOD: (Bring Your Own Device)	
Definition/Description what it is	Bring Your Own Device refers to a concept where employees/students are allowed to bring and use their own portable devices such as smartphones, laptops, tablets, to work on and access the network instead of a device owned/supplied by the company/institution.  <i>Examples of devices used for BYOD</i>
Purpose and function - what it does - why it is needed	Each user brings his/her own device to work/class and uses it to complete any work. The device may be connected to the network in order to access work files or the internet. Afterwards the device is removed, and the user takes it home with him/her.
Advantages	- Fewer expenses for the company/institution involved as they do not have to buy or maintain as many computers/devices. - Users find it more convenient to work on their own device. - Work can easily be taken home, if necessary.
Disadvantages	- Device theft is difficult to control. - Difficult to control data usage. - Employees/Learners will be easily distracted. - In a school context not all learners have their own devices. - Potential spread of malware. - Not all learners may have their own device. - Security cannot be enforced on all devices (due to different operating systems and software/hardware versions). - Compatibility issues due to different hardware/software configurations/Software incompatibility. - May cause a bottleneck on the network. - Potential for employees/learners to access sensitive data on the network.
Limitations	- BYOD is not suitable in institutions/places where very sensitive/confidential information is handled (e.g. banks). - More expertise is required to support all the different devices. - It is difficult/not possible to enforce security on all the devices (due to different operating systems and software/hardware versions).
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	Some schools allow learners to bring their own mobile devices to school which contain their textbooks in electronic format as well as Office packages on which they can take notes, do homework, etc.

ADDITIONAL CONTENT

The level and depth of knowledge required for these terms is in terms of understanding what these terms represent and a basic understanding of their application(s) in an ICT context.

24 Big data	
Definition/Description what it is	Big data is very large (structured and unstructured) data sets that are analysed using computers to reveal trends and associations.  <i>Big data applications</i>
Purpose and function - what it does - why it is needed	Big data is a collection of data from traditional and digital sources inside and outside an organisation. These extremely large data sets may be analysed to reveal patterns, trends, especially relating to human behaviour and interactions.
Advantages	- Reduces costs and time and leads to smart decision-making - The volume of data gathered provides more insight for decision-making by companies. - Because data is gathered all the time, big data is more relevant.
Disadvantages/Limitations	- Big data presents challenges such as storage, curation, querying and visualisation. - Analysis of data can be misleading. - May make businesses a softer target for cyber-attacks. - Working with such big volumes of data, make analysis more complex. - May be costly for a business to train/hire staff with enough expertise.
Application in an ICT environment / (Examples of the technology in practice)	- Can be used in healthcare, manufacturing, education, etc. - Amazon is an online shopping platform that uses big data to analyse shopping times and behaviours of online shoppers. Examples Mobile road maps depending on GPS systems are informed by big data and shows real time traffic. Medical records – electronic records (and medical histories) of patients inform decisions made by hospitals and doctors. Online shopping – big online retail sites have long used the data contained in this to identify your shopping habits. Store loyalty cards – grocery stores like Checkers and Pick n Pay uses the data they collect by people swiping their loyalty cards with each purchase, to not only offer all people better specials, but also offer clients individual specials based on the items they usually buy. Music – big data analyses listeners' behaviours and downloads to guide the production of new music.

25 Cryptocurrencies

Description • what it is	Cryptocurrencies (e.g. Bitcoin, Ethereum,) are a form of virtual, digital currency. Cryptocurrencies can be exchanged for other currencies, products and services. They have caused concern because they are often used for payment in criminal activities, such as ransomware demands. However, more and more legitimate companies are accepting them as a means of payment.
Purpose and function • what it does • why it is needed	• Users communicate payments through digitally signed messages for the transfer of Bitcoin ownership, from one owner to the next. • A decentralised network of speciality computers verify and stamp timestamps on all transactions through evidence of a processing system. • It is a secure system which allows direct borderless payments/transfers with no middleman.
Advantages/Benefits	• It is very possible to be able to send and receive money anywhere in the world at any given time. • Minimal or no 'banking' charges, as cryptocurrency is completely decentralized from banks and governments. • More companies are accepting cryptocurrency as a means of payment. • Very secure method of payment.
Disadvantages	• Often used for payment in criminal activities, such as ransomware demands because cryptocurrencies are virtually untraceable and do not form part of the formal banking system. • If the private key/wallet is lost the funds can never be recovered/retrieved. • People need to be educated about cryptocurrencies to be able to apply/adopt/trust the use of cryptocurrencies.
Limitations	• Valuation of cryptocurrencies fluctuates – can be a very volatile currency. • Bitcoin mining can use excessive amounts of energy, but some solutions to the consumption of energy are beginning to arise. For example, Bitcoin mining farms have been set up to use solar power, excess natural gas from fracking sites, or power from wind farms.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	• People buy cryptocurrency in the hope to sell it at a future date at a profit. • Cryptocurrency can be used to pay for goods and services. • Spare allows Bitcoin holders to turn their Bitcoin into cash quickly and conveniently. Users request cash and they get a barcode that they can take to a participating shop. The barcode is scanned, and the cash is paid out to the Spare user. • Xapo is a multi-currency digital wallet, providing you with a way to spend, pay, and transfer your Bitcoin worldwide.

26 e-Learning and m-Learning

Definition/Description • what it is	E-learning (Electronic learning) is the creation of a learning environment where individuals use their computers to take part in teaching and learning to further their education.  <i>E-Learning infographic</i> Mobile learning or m-Learning is a form of education and training delivered and conducted via the internet using mobile devices, such as tablets and smartphones. It is designed to be flexible, allowing learners/workers/students access to education anywhere, anytime. It is a subsection of e-learning.  <i>M-Learning devices</i>
Purpose and function • what it does • why it is needed	Delivery of teaching and learning through computing/mobile devices, typically using the internet. However, e-learning can also be intranet based, CD ROM based, or network based. Learners can download applicable apps for mobile learning or for use on a computer.
Advantages/Benefits	• Cost effective way of delivering education – educational institutions save money as they do not need a physical classroom. • Flexibility – accessible from anywhere/anytime that is convenient to you. • Enrichment – digital devices can be used in a class situation to enhance learning. • Personalised learning – you can select parts of lessons only and you are not forced to try and assimilate all the material at the same time. • Repetition – can view learning material/prepared lessons or listen to recordings as many times as needed. • Active and independent learning – learners/students can get assistance from teachers and peers through online chats and discussions. • Encourages collaborative learning – real-time sharing leads to instant feedback and tips. • Learners are more involved in learning, which leads to more learners completing a course and remembering what they have learned. • E-Learning and m-learning apps and materials are usually designed to fit learning patterns of learners. • Many e-learning and m-learning apps are widely/freely available. • Students/Learners do not have to travel to a learning institution.

Disadvantages	• Lacks social interaction as you do not see your teachers and classmates. • Limited hands-on experience in some subjects, although simulations may be possible. • Technical issues may arise, for example, sound/image distortions, staying signed in to a class, may not have devices in line with technical requirements for a course, etc. • Data costs: There are monthly data charges with mobile service providers – large files may be expensive to download. • The storage capacity of some mobile devices may be limited.
Limitations	• Internet access is required. • Dependent on battery of the mobile device being charged. • Some may be excluded/disadvantaged because of the digital divide. • Learners need to be self-motivated and disciplined to successfully use e- and m-learning.
Application in an ICT environment / (Examples of the technology in practice)	• Learning focuses on mobility of the learner, interacting with portable technologies. • Widely used in conjunction with traditional teaching and learning. • Used to deliver teaching and learning for those who wish to improve their education but cannot attend classes full-time for various reasons. • Learning takes place across multiple contexts, through social and content interactions, using personal electronic devices. Examples: • Video streaming lessons – YouTube • Virtual learning environment e.g. WebEx • W3Schools https://www.w3schools.com/ • TedEd. etc.
Video	https://youtu.be/YBzn1-aDvHs

E L E A R N I N G V E R S U S M L E A R N I N G

ELEARNING	MLEARNING
eLearning is a form of education where learning and teaching occur via the internet using electronic devices	mLearning is a form of learning and teaching that involves mobile devices
eLearning occurs through PCs and laptops, it involves operating systems like Windows, Linux and Mac	mLearning occurs through mobile devices like smartphones and tablets and involves OSs like iOS and Android
Can use complex and larger designs and modules	Should be designed with simple screens and simple navigation
Modules are longer, around 30 minutes	Modules are shorter, around 3-10 minutes
Teaches students specific skills or impart in-depth knowledge on a specific field or topic	Supply learners concise pieces of information that can be accessed on the go
	Visit www.PEDIAA.com

From: <https://pediaa.com/what-is-the-difference-between-elearning-and-mlearning/>

27 Virtual Reality (VR)

Definition/Description • what it is	Virtual Reality (VR) refers to using technology to create a simulation of a 3D-environment that can be interacted with by a person in a seemingly real or physical way.  <i>Person wearing VR headset</i>
Purpose and function • what it does • why it is needed	VR deceives your brain into believing you are in a 3D virtual world. VR allows users to be immersed into a virtual world, it can include 4 to 5 senses. This is achieved by using equipment, such as helmets with screens and gloves fitted with sensors.
Advantages/Benefits	• Allows for training in a safe, controlled area in realistic scenarios, improving retention and recall. • Allows for virtual experience, explores places such as travel destinations, museums, art galleries, etc. • The virtual experience helps students to learn faster and remember longer. • Can be used to train employees (for example, pilots, medical doctors, factory workers, etc.) without causing damage or risking lives.
Disadvantages	• Physical effects: motion sickness, balance is affected by changes in the inner ear.
Limitations	• Psychological, moral and ethical concerns, especially for children who may not be able to distinguish between what is real and what is virtual. • Limited access to the special equipment: VR glasses, video cameras, VR gloves, etc.
Application in an ICT environment / Examples of the technology in practice	• Used to train employees (example: pilots, engineers, miners, etc.). • Games – range of Nintendo games. • Media – marketing campaigns creating interactive forms of media (e.g. estate agents). • Education and training – used by trainers to provide learners with a virtual environment where they can develop their skills without the real-world consequences of failing. • Medical personnel are able to train through VR to deal with a wider variety of conditions/operations. • See Oculus, HTC Vive and Playstation VR.
Video	https://www.youtube.com/channel/UCzuqhhs6NWbgTzMuM09WKDQ

28 Augmented Reality (AR)

Definition/Description • what it is	Augmented reality (AR) uses types of technology similar to VR but does not create a totally virtual environment like VR. Instead, AR takes the physical world and adds (augments) objects, such as graphics within the real world.			 AR in action
Purpose and function • what it does • why it is needed	Augmented Reality turns the environment around you into a digital interface by placing virtual objects in the real world, in real-time.			
	Handheld devices such as smartphones and the iPad are other ways to use augmented reality. They contain software, sensors, a compass and small digital projectors which display images onto real world objects.			
Advantages/Benefits	• Highly interactive and operates simultaneously with the real-time environment/enhance personal experiences. • AR is used by marketers to promote products as it allows a user to 'try out' new products in their own environment – the colour of a paint on your wall, make-up on your own face, new furniture in your house.			
Disadvantages	• Lack of privacy - it collects a lot of information about the user, more than other forms of technology. • It is expensive to develop AR apps. • Skills are needed to use AR devices effectively.			
Application in an ICT environment /	• Both VR and AR are used in areas ranging from entertainment (for example, the augmented reality game Pokémon GO), training in aircraft simulators, and healthcare, (for example, an app used to show veins when a drip is inserted or surgeons being able to perform remote surgery on patients). • Entertainment and education applications include cultural apps with sightseeing and museum guidance, gaming apps with traditional games using AR interfaces, and some smartphone apps that make use of AR for an entertainment and/or educational purpose. • AR can be applied so that the surgical team can see the imaging data in real-time while the procedure is in progress.			
Examples of the technology in practice www.augmented-reality-games.com/imact.php	• Medical training • Entertainment • Military training • Marketing/advertising	• Engineering design • Consumer design • Robotics	• Manufacturing, maintenance, and repairs • Hazard detection	

29 Artificial Intelligence (AI)

Definition/Description what it is	AI (artificial intelligence) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions, especially traits associated with a human mind, such as learning and problem-solving. Machine learning is the study of computer algorithms that improve automatically through experience and by the use of data. It is seen as a part of artificial intelligence.
Purpose and function - what it does - why it is needed	The purpose of AI is to enable computers to perform such intellectual tasks as decision-making, problem-solving, perception, understanding human communication. Artificial Intelligence enhances the speed, precision, and effectiveness of human efforts.
Advantages/Benefits	- AI machines are available for work 24/7/365. - AI provides digital assistants such as Siri, Cortana and Alexa. - AI enables faster decision-making. - AI helps with the development of new inventions. - AI apps perform consistently, not prone to error with prolonged use. - AI may help automate repetitive jobs (for example, Chatbots for customer queries). - AI robots may be used in situations that would be risky for humans. - AI devices finish complex and stressful tasks faster than humans.
Disadvantages <i>Interesting facts:</i> Apple spent ± \$200 million on the software for SIRI. In 2013, Amazon acquired Alexa for \$26 million.	- There is a concern that AI may replace humans in repetitive jobs and may disrupt the job market. - AI can perpetuate human bias (e.g. being trained on past court cases, can perpetuate biases instead of removing them) - AI may increase human dependence on technology. - Very expensive to develop – setting up AI-based machines, computers, etc. involves huge costs given the complexity of engineering that goes into building one.
Limitations	- Machines cannot understand legal or ethical concepts and can only respond to situations that they were created for. - They are limited to the tasks they have been designed for.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	- We make use of AI in our daily lives without even realising it. Applications such as Spotify, Siri, Alexa, Google Maps, YouTube, all make use of AI for their functioning. Social media apps, and the facial recognition feature on our smartphones use AI. - In financial institutions, AI techniques can be used to identify which transactions are likely to be fraudulent, adopt fast and accurate credit scoring, as well as automate manually intense data management tasks. - In the retail sector, AI provides virtual shopping capabilities that offer personalised recommendations.

	• Stock management and site layout technologies can also be improved with the use of AI. • AI can provide personalised medicine and X-ray readings. Personal healthcare assistants can act as life coaches, reminding you to take your medicine, to exercise or eat healthier. • Self-driving cars were developed using machine learning (e.g. what a person looks like, what road signs mean) and it now relies on AI for real-time decision making while driving, given the available data (to avoid accidents, take the best route etc.)
Video	Artificial intelligence in customer experience https://youtu.be/HgOYt3cfeLY Artificial Intelligence in 5 Minutes What is Artificial Intelligence? AI Explained Simplilearn https://www.youtube.com/watch?v=ad79nYk2keg Meet Sophia: The first robot declared a citizen by Saudi Arabia: https://www.youtube.com/watch?v=E8Ox6H64yu8

30 4th Industrial Revolution (4IR)

Definition/Description • what it is	4IR (the fourth industrial revolution): 4IR is a way of describing the blurring of boundaries between the physical, digital and biological worlds. It is a blend of advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, genetic engineering, quantum computing and other technologies. It creates many products and services that are fast becoming essential to modern life and is the collective force behind disrupting almost every business sector.
Purpose and function • what it does • why it is needed	'The Fourth Industrial Revolution (4IR) represents a new era of innovation in technology – one that's enhancing human-machine relationships, unlocking new market opportunities, and fuelling growth across the global economy.' https://www.getsmarter.com/blog/career-advice/the-4th-industrial-revolution-will-south-africa-be-ready-for-the-jobs-of-the-future/
Advantages/Benefits Did you know? A knowledge worker "thinks" for a living instead of doing physical tasks, e.g. programmers, researchers, accountants, engineers, etc.	• Higher productivity – It is estimated that productivity will increase by 5 – 8% mainly because of increased automation. • Improved quality of life – Technology has made new products and services possible which increases efficiency and makes life much easier. • New markets – 4IR will create new markets and growth opportunities. It will blend improvements from several fields, that were often previously separated, to create a new product or a new service. Not only there will be more knowledge workers, but there will be knowledge workers in new fields. • Lower barrier to entrepreneurship – We already see that with new technologies such as 3D printing for prototyping, the barriers between inventors and markets are reduced. Entrepreneurs can now establish their companies and test various products with lower start-up costs.
Disadvantages	• Inequality – The largest beneficiaries tend to be the providers of intellectual and physical capital (shareholders, investors, and innovators). The demand for highly skilled workers has increased while the demand for workers with less education and lower skills has decreased. • Cybersecurity risk – When everything is connected, the risk of hacking data and tampering with it or using it for malicious intent is now more prevalent. • Core industry disruptions. Taxis now compete with Uber and Bolt, traditional television and cinema compete with Netflix, Showmax and YouTube, the hotel industry competes with Airbnb, etc. Therefore, this has ramifications in the <u>type</u> of services being offered and the <u>model</u> through which they are offered as well as the <u>jobs</u> associated with them.

	• Ethical issues – With improved AI, genetic engineering, and increased automation, there are new ethical concerns and questions. With access to more data about an individual and a group of individuals, the risk of using it for personal gain and manipulation is even greater. There was a case in early 2018 where a company had harvested the personal data of millions of peoples' Facebook profiles without their consent and used it for political advertising purposes. • Lack of job security: workers with less education and fewer skills are at a disadvantage as the Fourth Industrial Revolution progresses.
Limitations	• Machine automation is not suitable for creative, collaborative, and complex problem-solving tasks. • Demand for tech skills in South Africa is soaring, but too few people have the necessary training.
Application in an ICT environment / (Examples of the technology in practice)	AI is responsible for driving many 4IR technologies. Nowadays, ordering a taxi, booking a flight, buying a product, making a payment, listening to music, watching a film, playing a game, and even controlling the lights and temperature in our homes can be done remotely. A smart city is an ideal example of the merging of 4IR technology: Modern cities have several IoT devices that receive, collect and transmit data (e.g. traffic lights, people's smartphones with GPS tracking, even garbage cans). The data collected from these IoT devices is known as Big Data (due to the overwhelming volume) and Artificial Intelligence is needed to analyse it quickly enough and make meaningful decisions accordingly - e.g. to change the route of the rubbish truck and clean specific stops, or to keep traffic lights green longer so that traffic congestion can be reduced. 3D printing has also been used by some cities (such as in Amsterdam, Netherlands) to print bridges for small water channels. They embed sensors in these bridges to count the number of people and bikes that cross it daily. By analysing that data, the city can then make an informed decision on whether that area has enough bridges, or whether they need to get more.
Videos	What is the Fourth Industrial Revolution? CNBC explains https://www.youtube.com/watch?v=v9rZOa3CUC8 What is Industry 4.0 and what does it mean for you? https://www.youtube.com/watch?v=b9mJrzdIfR8

31 5th Industrial Revolution (5IR)	
Definition/Description what it is	The fifth industrial revolution (5IR) runs and develops alongside 4IR and uses the advantages 4IR brings to put the focus back on humans and human endeavour, defining the ethics and impact of technology developed in the 4IR.
Purpose and function - what it does - why it is needed	- The Fifth Industrial Revolution (5IR) can be summarised as the combination of humans and machines in the workplace. But this explanation is vastly oversimplified and does not even begin to explain the magnitude and complexity of the change. - The Fifth Industrial Revolution (5IR) will bring about innovation, purpose and inclusivity and we will see a deeper understanding and co-operation between people and machines.
Advantages	5IR will create employment opportunities for creative thinkers and AI specialists. 5IR will help companies make the most of existing resources helping management teams to focus on more strategic tasks. 5IR will free up human resource teams from routine administrative tasks and give them time to find employees by matching profiles for their organisation. This will allow them to focus on the growth and productivity of their organisation. - As 5IR will offer greener solutions/paperless technology. - The Fifth Industrial Revolution will see much more advanced collaborative interactions between humans, machines, processes and systems for maximum performance optimisation. - Though 5IR will take away routine and repetitive tasks, it opens the way to curiosity, creativity, empathy, and judgment ensuring a balance between people and technology.
Disadvantages/Limitations	Refer to the disadvantages/limitations of 4IR.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	It is time for us to rediscover the value of uniquely human capabilities to enable profits, purpose, and people to thrive together in the 5IR. In the 5IR, we will face more ethical questions than we have ever faced before. Should we give machines embedded intelligence? From: https://www.processonline.com.au/content/business/article/will-the-5th-industrial-revolution-be-the-next-renaissance--1123020588

Additional watching:

Alibaba's Hema grocery stores are changing retail | CNBC Reports

<https://youtu.be/UDivWdwVZMg>

Additional reading:

<https://www.powerengineeringint.com/event-news/achieving-5ir-by-using-business-for-good/>

'The fear of Industry 4.0 is that it is taking humans out of industry, and technology is replacing them in the workforce. The 5th Industrial Revolution wants to put humans back in. Instead of asking how we can improve efficiency and productivity, this revolution asks how we can make the world better.

It's important to note that this new revolution will take place concurrently with Industry 4.0, altering as new technologies emerge. The 5th Industrial Revolution will have to react to how Industry 4.0 changes and advances. However, its purpose is to integrate these new technologies into the way we live to create new opportunities and improve life.' <https://aryunetworks.com/what-will-the-5th-industrial-revolution-look-like/>

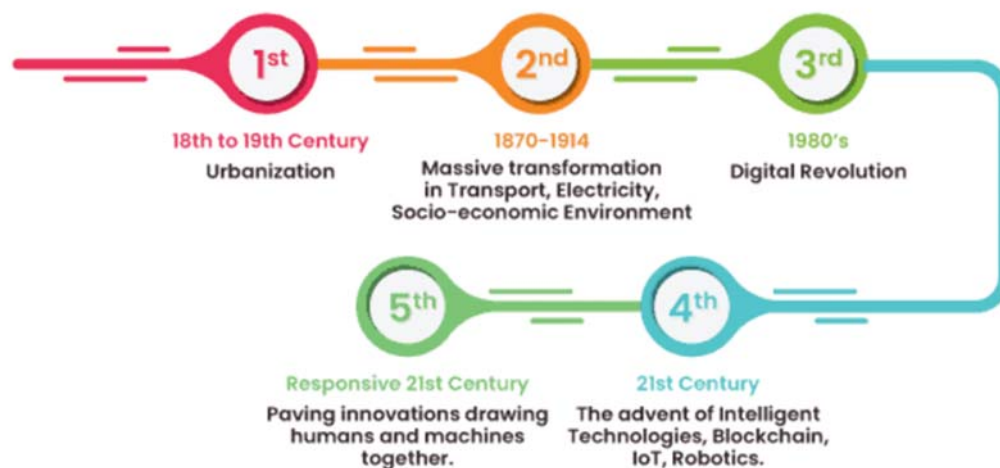
The table below shows the sequence of the five industrial revolutions. You will see how each revolution sets the scene for the next one. Also note the time period of each revolution.

1 st Industrial Revolution	2 nd Industrial Revolution	3 rd Industrial Revolution	4 th Industrial Revolution	5 th Industrial Revolution
Mechanisation	Electrification	Automation and Globalisation	Digitalisation	Personalisation
Occurred during the 18 th and 19 th centuries, mainly in Europe and North America	From the late 1800s to the start of the First World War	The digital revolution occurred around the 1980s	Start of the 21 st century	2 nd decade of the 21 st century
Steam engines replacing horse and human power	Production of steel, electricity and combustion engines.	Computers, digitisation and the internet,	AI, robotics, IoT, blockchain and crypto.	Innovation purpose and inclusivity.
Introduction of mechanical production facilities driven by water and steam power	Division of labour and mass production, enabled by electricity.	Automation of production through electronic and IT systems	Robotics, artificial intelligence, augmented reality, virtual reality	Deep, multi-level cooperation between people and machines. Consciousness.

The sequence of the five industrial revolutions

<https://insights.regenesys.net/the-fifth-industrial-revolution-5ir/>

A Phenomenal Journey Towards the 5th Industrial Revolution:



<https://www.fingent.com/blog/how-the-5th-industrial-revolution-is-advancing-humanity-at-workplace/>

32 Blockchain

Definition/Description

- what it is

Adapted from:

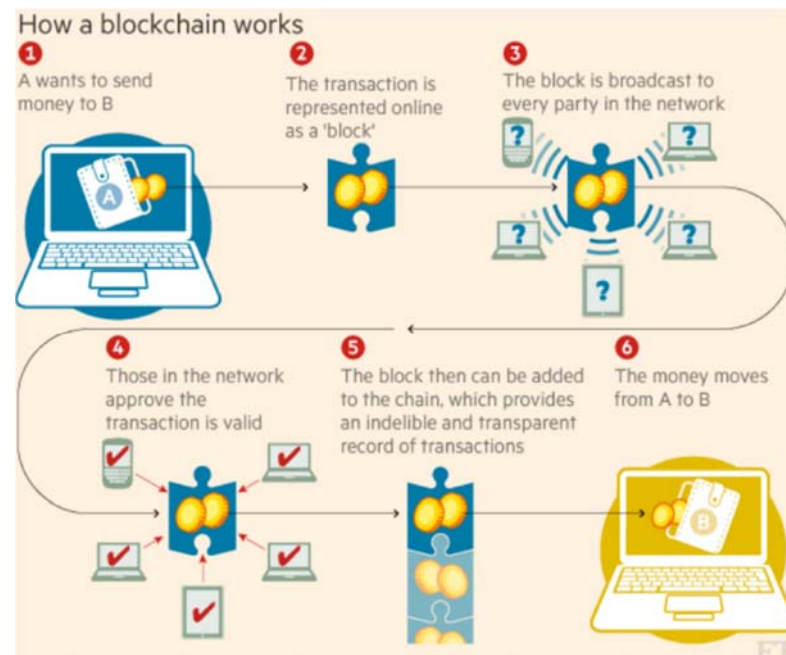
<https://medium.com/swlh/blockchain-for-dummies-d3daf2170068>

Blockchain is the name of a whole new technology. It is a sequence of blocks or groups of transactions that are linked or 'chained' together and distributed among the users.

'The blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value.'

– Don & Alex Tapscott.

It works as **an indisputable record of transactions that do not require reliance on an external authority** to validate the authenticity and integrity of the data. Transactions are typically economic, but **can store any kind of information** in the blocks



How a blockchain works

Purpose and function

- what it does
- why it is needed

Blockchain is the record-keeping technology behind the Bitcoin network.

By spreading its operations across a network of computers, blockchain **allows Bitcoin and other cryptocurrencies to operate without the need** for a central authority. This not only reduces risk but also eliminates many of the processing and transaction fees.

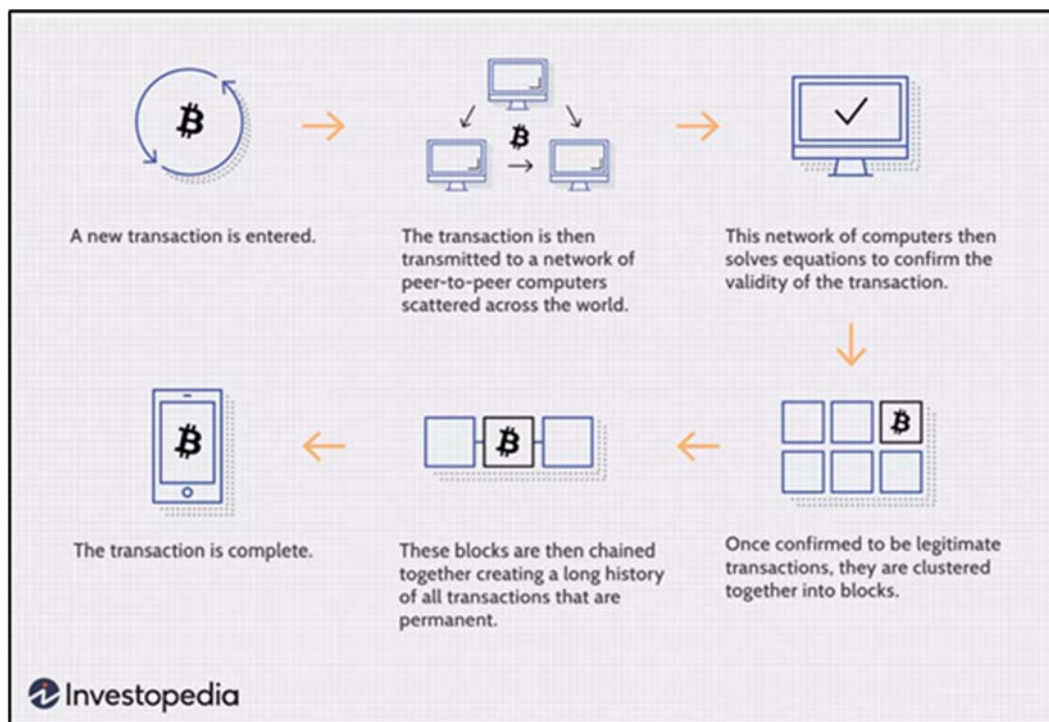
Simple explanation of how it works

- Blockchain is a specific type of database.
- It differs from a typical database in the way it stores information; blockchains store data in blocks that are then chained together.
- As new data comes in it is entered into a fresh block. Once the block is filled with data it is chained onto the previous block, which makes the data chained together in chronological order.
- Different types of information can be stored on a blockchain, but the most common use so far has been as a ledger for transactions.

	• In Bitcoin's case, blockchain is used in a decentralized way so that no single person or group has control – rather, all users collectively retain control. • Decentralized blockchains are immutable, which means that the data entered is irreversible. For Bitcoin, this means that transactions are permanently recorded and viewable to anyone.
Advantages/Benefits	• Transactions on the blockchain network are validated by a network of thousands of computers. This means accuracy is improved as human involvement/error is removed in the verification process. • Reduces costs by eliminating third-party verification, i.e. banking fees. • Decentralisation makes it harder to tamper with – The blockchain is copied and spread across a network of computers. Whenever a new block is added to the blockchain, every computer on the network updates its blockchain to reflect the change. By spreading that information across a network, rather than storing it in one central database, a blockchain becomes more difficult to tamper with. • Transactions are secure, private, and efficient. Blockchain works 24/7/365. Transactions can be completed in as little as ten minutes and can be considered secure after just a few hours. (Once a transaction is recorded, its authenticity must be verified by the blockchain network. Thousands of computers on the blockchain rush to confirm that the details of the purchase are correct. After a computer has validated the transaction, it is added to the blockchain block.) • Transparent technology. Most blockchains are entirely open-source software. This means that anyone and everyone can view its code. This gives auditors the ability to review cryptocurrencies like Bitcoin for security. • Provides a banking alternative and way to secure personal information for citizens of countries with unstable or underdeveloped governments.
Disadvantages	• Significant technology cost associated with mining Bitcoin. Although blockchain can save users money on transaction fees, the technology is far from free. The '<i>proof of work</i>' system that Bitcoin uses to validate transactions, for example, consumes vast amounts of computational power and electrical energy. • Low transactions per second. Bitcoin is a perfect case study for the possible inefficiencies of blockchain. Bitcoin's '<i>proof of work</i>' system takes about ten minutes to add a new block to the blockchain. • History of use in illicit activities. While confidentiality on the blockchain network protects users from hacks and preserves privacy, it also allows for illegal trading and activity on the blockchain network. • Regulation. Many people in the crypto space have expressed concerns about government regulation over cryptocurrencies. Over time this concern has grown smaller as large companies like PayPal begin to allow the ownership and use of cryptocurrencies on its platform.

Application in an ICT environment / (Examples of the technology in practice)	Blockchain stands to make business and government operations more accurate, efficient, secure, and cheap with fewer middlemen. Blockchains of the future are also looking for solutions to not only be a unit of account for wealth storage, but also to store medical records, property rights, and a variety of other legal contracts.
Videos	https://youtu.be/yubzJw0uiE4 https://www.youtube.com/watch?v=3xGLc-zz9cA

The transaction process:



Additional reading:

<https://www.investopedia.com/terms/b/blockchain.asp>

https://www.simplilearn.com/tutorials/blockchain-tutorial/what-is-blockchain?source=sfrs_nav_playlist_video_clicked

Action verbs used in examination papers

Words such as define, describe, discuss, explain, name and state are used for a reason; different cognitive levels are tested. A much higher cognitive level is tested when you have to *discuss* something than when you merely have to *name* or *make a list of items*.

Action verbs in an examination paper may guide learners in exactly what to include in their answer. Knowing the meaning of the action verbs in the questions will guide learners to know what is required from the questions. The list below is comprehensive, but not exhaustive and gives a general guideline as to what is expected when these action words are used.

Action Verb	Meaning	Example	Notes
Analyse	Find the main ideas, how they are related and why they are important.	Analyse the correct use of word processing features in the following screenshot:	Break into parts/sections. Study each part – look at the detail.
Arrange	Order the items by listing several items (terms or events) in the correct sequence.	Arrange the storage media according to their capacity	Arrange from small to large, few to many, slow to fast, write down the steps in order, etc.
Categorise/ Classify	Group concepts/ideas that are similar/have the same characteristics/functions or belong together.	Categorise the following computer devices: keyboard, CPU, printer, mouse, hard drive, SSD according to their main function.	Which categories can describe the function/features? Understand relationships.
Compare/ Differentiate	Show both the differences and the similarities of specific concepts.	Compare ROM with RAM	Find a relationship between two concepts. Which features/functions/uses are alike/differ?
Define	Give a clear, concise formal meaning of a term or concept.	Define the term phishing.	Use short, concise description of main features, focus on facts – sentence or two.
Describe	Give the main features by expanding the statement.	Describe spoofing	Show your understanding of the concept.
Diagram	Make a graph, chart or drawing. Be sure to label it and add a brief explanation if necessary.	Use a diagram to illustrate a generic ICT system.	Visual representation of the main ideas/concepts/parts of something.
Discuss	Present arguments for and against a point of view and reach a conclusion	Discuss the use of a PAN in a home office.	Look at the advantages and disadvantages, decide what will work/not work, explain why it will be a good idea or not a good idea.

Action Verb	Meaning	Example	Notes
Evaluate	Give an opinion; Show the advantages and disadvantages.	Evaluate the merit of buying computer X for person Y	Why would computer X be better than computer A? Judge the value of a situation/advice/concept.
Explain	Give full reasons or justifications for something, or how and why something happened or works.	Explain how phishing works.	Explain things about the topic such as: What is it? Where/When is it used/found? Why is it used/needed? How is it used? Explanations should be brief and will not necessarily require technical details
Give	Give one or more reason(s) or example(s) in a full sentence	Give two reasons for using an ISP	Used when reasons or examples are required.
Identify	Recognise and name or provide a fact. Single out from other information.	Identify the port used to connect the printer.	Similar to name
Justify	Give a statement of why you think something is the way it is. Give reasons for your statement or conclusion.	Justify the use of a table instead of tab stops in the following instance:	What is the situation? Why is the one better than the other?
Name/ List	Name - give one word for a term or concept. List - when two or more items are required	Name one storage device. List the types of information sources one could use when doing research.	Used for all one-word answers or answers consisting of lists of items.
Motivate	Provide a reason or justification for an answer or statement.	Motivate the use of line and paragraph spacing when working in Word.	Why do you say so/suggest something? Why did it happen? Why is this better than that?
State	Use brief, clear sentences.	State the functions of the operating system.	The answer should be given in the form of a statement.
Suggest	Analyse or examine a problem/case and give possible reasons/ideas/solutions	Suggest a computer configuration for Mr X.	What is the situation/what is given? What is needed? What would be the best? Why this?