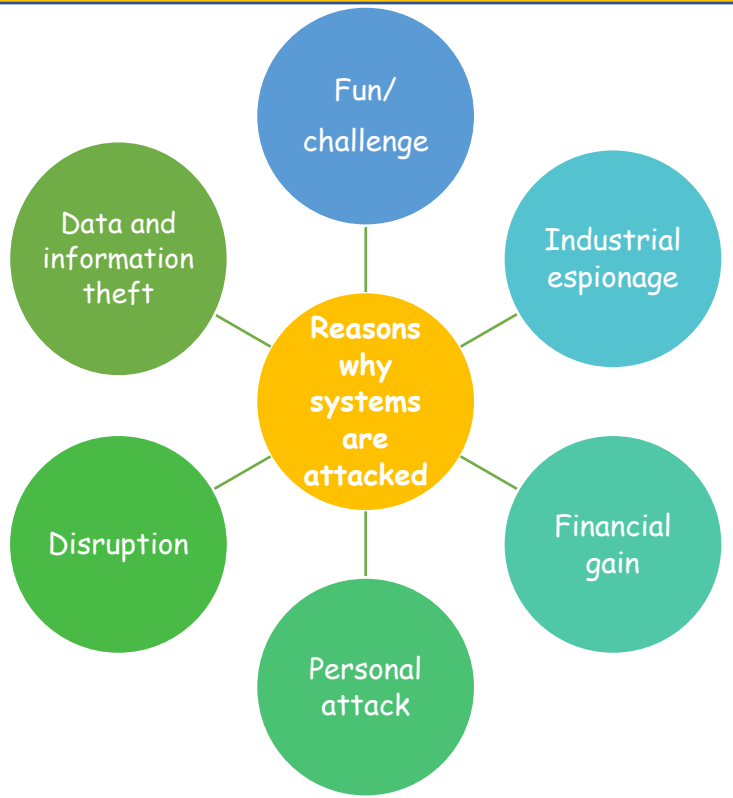
Component 3 Learning Aim B Cyber Security- B1 Threats to Data
Why Systems are Attacked

Key Vocabulary	
Intellectual Property	An idea that you invented that belongs to you, for example, an image that is copyrighted.
Ransomware	A form of **malware,** usually infecting unprotected digital systems, occurring when users open malicious email attachments.
Malware	A malicious form of software that is transferred to, and then executed on, a user's machine to damage or disrupt the system or allow unauthorised access to data.
Denial-of-Service (DoS) attacks	Attack a remote computer by making it unable to respond to legitimate user requests.
Cybersecurity	The combination of policies, procedures, technologies and the actions of individuals to protect from both internal and external threats.

Organisations have become reliant on digital systems to hold data and perform vital business functions.
Many organisations have their digital systems attacked daily.
The reasons these attacks may occur are varied



Data and information theft
Data and information both have value as they can be sold for financial gain.
This can be done by stealing customer payment information and then using it to purchase goods illegally.
Breaches of data and information are a major cause of identity theft.

Fun/ Challenge
- Hackers may attack systems for the thrill, adrenaline rush or a sense of personal achievement.
- They may view increased security as a technical challenge and enjoy trying to get past it.
- They may also get recognition from their peers when they successfully hack into systems.

Disruption
Any attack that prevents an organisation from operating normally causes operational chaos, loss of earnings and reputational damage.
Disruption can be caused in many ways e.g. defacing a website or **Denial-of-service (DoS) attacks**

Motivations may be: financial/social/political reasons.

Industrial Espionage
Intellectual property (designs, business strategy etc) can be stolen through organised cyberattacks.

These types of assets can be highly valuable, leading to cheaper, fake copies of products being sold and the original organisation suffering a loss of income.

Financial Gain
A very simple motive: money.

Extorting money from victims of a cyberattack is common practice.

Personal Attack
The most common type of personal attack is made by ex-employees holding a grudge against their former employer, perhaps feeling they have been unfairly treated or suffered a form of emotional distress.

Component 3 Learning Aim B Cyber Security- B1 Threats to Data
External Threats to Digital Systems and Data Security

Key Vocabulary	
Social Engineering	The act of getting users to share sensitive information through a false pretext (commonly known as 'blagging')
Phishing	A cyberattack that sends spam messages to try and trick people to reply with desired information.
Pharming	A cyberattack that uses malware to direct a user to a fake website that requests information.

External attack methods include:

- Unauthorised access/hacking
- Phishing
- Pharming
- Man-in-the-middle attacks

Pharming

A type of cyber attack

User is directed to a fake website thinking it is real and they then enter confidential details such as usernames and passwords.

The cybercriminal uses these captured details to log into the real website and commit illegal acts e.g. withdrawing money, purchasing goods, downloading personal files or sending fraudulent emails

Unauthorised access/Hacking:

'Black-hat' hacking - users attempt to gain access to remote systems without permission from the owners to do so legally

'White hat' or ethical hacking - Hacking legally performed by paid specialists who are testing the security systems for a company is called

'Grey hat' hacking - hackers test security without permission, but don't exploit any vulnerabilities for personal gain.

Man in the Middle Attacks

A form of cyberattack where the communication between 2 devices, such as a user and a web server, is intercepted and potentially tampered with.

Encryption can protect against this form of hacking as any intercepted data cannot be easily used.
Cybersecurity specialists also suggest that users would be safer if they did not use Wi-Fi.

Phishing

A form of social engineering and a very common form of cyberattack.
Spoof emails are sent that pretend to be from a genuine company.
The user is fooled into thinking its from a legitimate source.
Usernames, passwords and credit card numbers are the most commonly captured personal information.
These can then be sold for profit to other criminals or users to illegally purchase goods or services.

Spear phishing is an attack targeting specific organisations or individuals.

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Component 3 Learning Aim B Cyber Security- B1 Threats to Data
Internal Threats to Digital Systems and Data Security

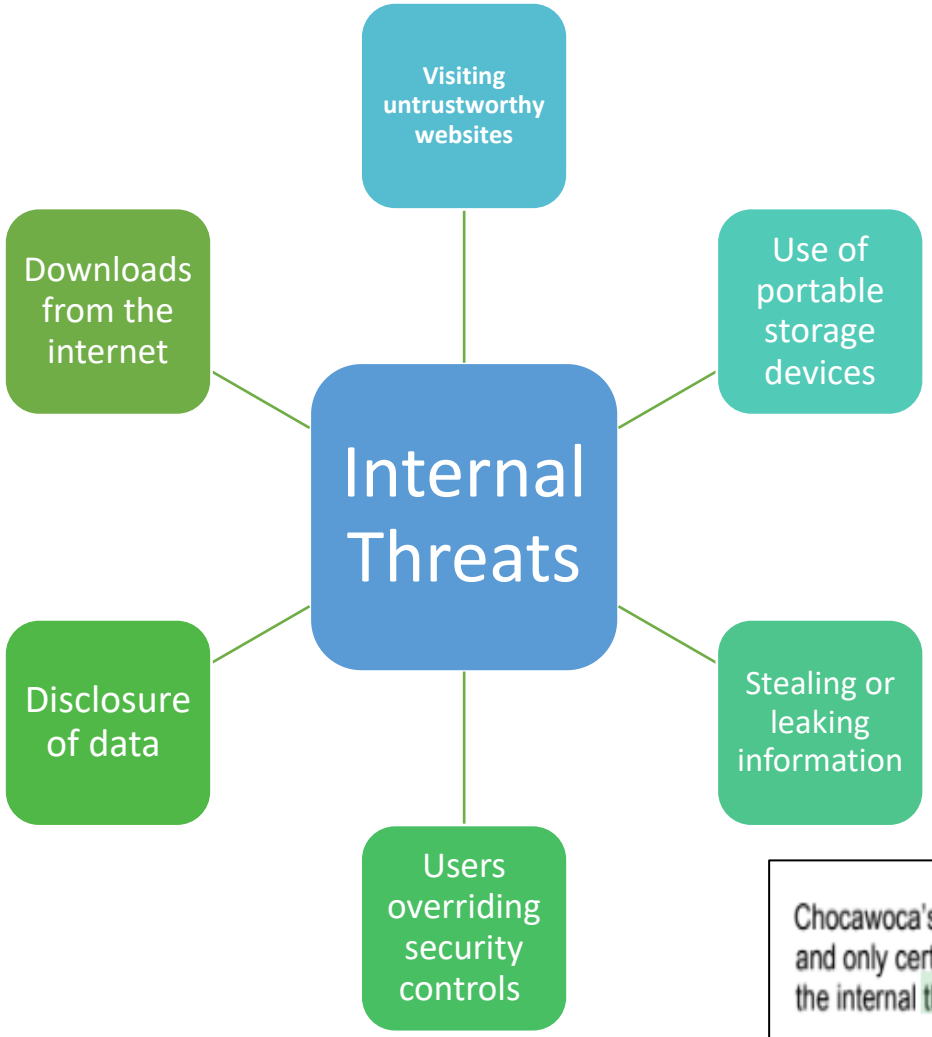
Key Vocabulary	
Productivity	a measure of effectiveness – how long it takes an employee to produce an item for sale.

Internal Threats

Some internal threats happen because of accidents, mistakes or poor choices made by an organisation's employees. However, a disgruntled employee could do something malicious.

For example:
- Delete customer records
- Steal confidential information
- Create fake invoices that will be paid to their own bank account
- Install malware

Protecting an organisation against internal threats is as important as protecting against external ones.



Impacts of security breach	
Immediate Impacts	**Longer-term Impacts**
•Data loss •Lost sales •Downtime •Reduction in productivity	Damage to the organisation's public image which could lead to: •Financial loss •Potential legal action

Example Exam Question

Chocawoca's recipes are kept on secure servers in their secret recipe rooms and only certain staff have access to these recipes. They are concerned about the internal threats to this vital data.

(b) Explain **two** possible internal threats to Chocawoca's recipes.

(4)

Component 3 Learning Aim B Cyber Security- B2 Prevention and Management of Threats to Data

User Access Restriction

Physical Security

Benefits	Drawbacks
Act as a deterrent and deter attackers.	Often more expensive to purchase
Stop attackers from gaining direct and physical access to locations where data is stored.	Building work may be required.
Automatically and secretly call the police if an attacker is detected,	Some methods of physical security, such as CCTV, do not stop data from being stolen

Example Security techniques:

- Electronic Swipe Lock
- Secure Device
- CCTV Camera

Biometrics

Requires individuals to use part of their body to prove their identity.

- Common biometric examples include:
- Eye (retina or iris pattern) scan
- Fingerprint identification
- Hand geometry (shape of user's hand)
- Voice analysis
- Facial recognition
- Gait analysis (how a user walks)
- Handwriting analysis

Benefits	Drawbacks
•Users don't need to remember lots of different passwords or keep updating them. •More secure as they cannot be guessed, lost or forgotten. •Can take less management because users are less likely to be 'locked out' or need to have their user accounts reset.	•More expensive as you need specialist hardware devices to set them up. •They can easily spread germs, e.g. if lots of users are using the finger print scanner then germs can be easily spread. •Some users may feel that it is an invasion of their privacy by having their biometric data stored.

Passwords

The use of passwords is a traditional security measure to control access to digital systems.

There are other forms of passwords:

- Patterns that can be drawn connecting a series of dots
- Gesture passwords - can be used with touchscreen devices where the user draws a shape.

Benefits	Drawbacks
•They are simple and easy to use. •There are no costs involved as they require no specialist hardware to setup.	•They are only effective if users keep their passwords secret. •A strong password can be hard to remember. •Specialist software can be used by attackers to try and guess the user's passwords. •Users can find it hard to remember lots of different passwords.

Two-factor Authentication

A popular form of multifactor authentication and is used when just a password or PIN is not considered sufficient.
It works by asking the user to supply two forms of identification.

Benefits	Drawbacks
•It is more secure. •No extra equipment is needed as users can use items they already have to authenticate themselves, e.g. their mobile phones.	•It is possible that some factors may get lost e.g. you may lose your swipe card. •The recovery options that are used to reset your account are easy to get through, which could be exploited by attackers. •It can take longer to gain access

Component 3 Learning Aim B Cyber Security- B2 Prevention and Management of Threats to Data
Data level protection: firewalls and anti-virus software (part 1)

Key Vocabulary	
Firewall	A device that protects an IT system (or network) from unauthorised access by blocking 'bad' network traffic.
Local Area Network (LAN)	A network based on geographical location, such as an office or a school
Access Control List (ACL)	A list that tells the network which data can be sent and received.
Shoulder Surfing	Obtaining sensitive personal information from a user by literally looking over their shoulder while they use digital devices e.g. computers or cash machines.
Session Cookies	Data stored by the web browser until it is closed
Worms	Small computer programs that can spread to other programs.
Trojans	Types of malware disguised as legitimate programs.
Rootkit	Collection of tools or programs that allow an unauthorised user to obtain undetected control of a computer system.
Spyware	Software that is installed on a device without the user's knowledge. It can gather information about their computer activities by transmitting data secretly from their hard drive.

Firewalls

- Form the first line of defence in protecting digital systems from external threats such as cyberattacks and viruses.
- Can be hardware or software based
- Work by using a set of rules that filter and reject unwanted or suspicious network packets arriving from a remote network.

Hardware firewall	Software Firewall
Sit between an external network and an internal connection e.g. the internet and a local area network (LAN)	A digital system can host its own firewall service, which blocks network data travelling in and out. Applications can also be stopped from sending and/or receiving certain packets of network data. They do this by creating a set of rules that determine which packets of data are sent and received – an access control list (ACL).

Benefits of firewalls	Drawbacks of firewalls
They can stop attackers from gaining unauthorised access to a device.	Firewalls can block legitimate things.
You can customise the firewall settings to meet the needs of your organisation.	Can make the performance of a computer or network a lot slower.
Software firewalls are easy to install.	Highly effective firewalls can be very expensive.

Component 3 Learning Aim B Cyber Security- B2 Prevention and Management of Threats to Data
Data level protection: firewalls and anti-virus software (part 2)

Modern software design aims to make applications easier to use, often including various tricks that can assist user inputs.
Some techniques can improve security; others can cause issues.

Common techniques used to make applications easier to use

Obscuring data entry	Common technique to solve **shoulder surfing** when using secure logins in a public place is to obscure the entry of sensitive data e.g. passwords.
Autocomplete	Autocomplete is a technique where an application will recognise a familiar input and make suggestions from previous inputs. If used on a publicly accessed IT system it can be a security risk.
"Stay logged in"	Web applications often use **session cookies** to keep a user logged in, even if they leave a page and later return to it. Can be a security risk if a different user gains access to the IT system before the web browser is closed and the session cookie is cleared.

Anti-Virus Software

Anti-virus software monitors a digital system, attempting to identify and remove malicious software before it can cause damage.
Most viruses infect a digital system when the unsuspecting user opens infected email attachments.
Worm viruses can replicate themselves from device to device via the network.

Different types of viruses include:
- Ransomware
- Worms
- Trojans
- Rootkit
- Spyware

Benefits of anti-virus software	Drawbacks of anti-virus software
Can stop files that contain viruses from accessing your computer system.	Needs to be continually updated to ensure it can detect new viruses.
Some anti-virus software is free to download.	Can make the performance of a computer or network slow.
If a virus is not yet known, anti-virus software is able to monitor the behaviour of files to see if they are showing any virus characteristics	Highly effective anti-virus software can be very expensive.

Example Exam Question

At present, staff who work at Chocawoca use a card entry system to gain access to their secret recipe rooms, cards are swiped at the entrance. They are considering changing this to use a biometric system as they think this will improve security.

(c) Explain **two** benefits of biometric systems to Chocawoca.

(4)

Component 3 Learning Aim B Cyber Security- B2 Prevention and Management of Threats to Data
Data level protection: device hardening and encryption

Key Vocabulary	
Vulnerable	Describes a flaw of weakness in the design, implementation or configuration of a system. Known vulnerabilities can be exploited by 'black hats' to attack a digital system.
Security patches	Additional settings or program codes that fix vulnerabilities in applications, operating systems and device firmware, and are usually downloaded from the manufacturer.
Privilege	A set of rules that allows users to use specific components or access data folder or files.

Device Hardening

Digital systems may have default settings or weaknesses that can make them (and their data) **vulnerable** to attack.
The process known as 'device hardening' attempts to resolve these issues.
Device hardening techniques:

- Installing a firewall
- Installing anti-virus (and anti-spyware) software
- Applying **security patches** and updates
- Using encryption
- Closing unused network ports
- Removing non-essential programs or services
- Restricting user access (called the principle of 'least **privilege**')

Encryption

It is common practice to encrypt data when it is stored and when it is being transmitted between IT systems.
Stored data is a popular target for cyberattacks and unencrypted (plaintext) data is considered insecure and a security risk. - One solution is to encrypt this stored data.

Vast quantities of personal data are transmitted from web browsers to web severs and back again, especially in web applications e.g. social networking and online banking.

Organisation web servers can use a digital signature that can be transmitted to a web browser to prove its identity and encrypt data transmissions between them.

You can tell if a connection is secure when you see a padlock and the HTTPS prefix on a website address.

Benefits	Drawbacks
•Scrambles data so that others cannot easily read it. •Ensures that organisations comply with data protection laws.	•Does not stop data from being stolen. •Encrypting a large amount of data can take time. •Encryption methods need to continually 'evolve' and change as attackers find new ways to access data.

Component 3 Learning Aim B Cyber Security- B2 Prevention and Management of Threats to Data
Finding weaknesses and improving system security

Organisations have responsibility to secure their IT systems to protect the personal and sensitive data they store and process.
Assessing the security of IT systems objectively can be difficult to do, so sometimes external help is required

Ethical Hacking

A process where an individual or a team of penetration testers are asked by an organisation to simulate an attack on its IT system to highlight any weakness and vulnerability.

To start with, the hackers are given little information about the system and will identify weaknesses and then exploit them to see if sensitive data or services can be accessed.

White hat hacker – an IT specialist who is invited to discover vulnerabilities in a system and report them to the organisation or author.

Grey hat hacker – an IT specialist who discovers vulnerabilities in a system, typically without invitation, but does not exploit them for personal gain (although they might make the information publicly known).

Benefits	Drawbacks
Can see if the security of your network is able to withstand the skills of expert attackers.	Can be very expensive to hire professionals with the necessary skills.
Can help to find 'loopholes' in your network security in order to make it better.	Depends on the trustworthiness of the ethical hacker. Some may abuse their position.
The security of a system can keep evolving when loopholes in the network security have been found.	Some people may view ethical hacking as an invasion of privacy if others are able to view their data.

Penetration Testing

Aka 'pen' testing.
A systematic process used by ethical hackers to determine how secure an IT system is.

Frequent vulnerabilities that ethical hackers uncover when attacking a system:
- Unpatched operating systems and applications.
- Web applications that have not been well programmed, leaving them insecure.
- Data that has not been encrypted.
- Poor security practices

Stages of penetration testing:

1. Authorisation to penetration test
2. Discover vulnerabilities and weaknesses
3. Exploit weaknesses (without disruption)
4. Document weaknesses
5. Recommend security improvements

Penetration Testing Report

The findings of penetration testing are presented to the organisation as a formal report, including recommendations that may resolve the issues found.

The report is used to harden the security, addressing the issues found.

The process may then be repeated until the organisation is sufficiently confident in its systems

Component 3 Learning Aim B Cyber Security- B3 Policy
Security Policies

Security Policies

To make sure that all employees in all locations follow the same code of conduct organisations create policies that set out the responsibilities of staff.

These policies detail how staff are expected to behave and what procedures they should follow in the event of a disaster.

Most security policies are implemented by IT and technical staff..

Examples of security policies include:
- System security
- Data security
- Compliance (with regulations and legislation)
- Environmental (including disposal of old equipment and waste products)
- Disaster recovery
- Data recovery
- Infrastructure (updating and replacing hardware and software)
- Responsible use policies (including email and internet use policies)

Planning for disaster recovery

Policies exist to increase the robustness of IT systems and data and to plan for what should happen in the event of a disaster.

Disasters can come in many forms:
- Theft of data (having systems hacked or laptops/devices stolen)
- Virus or other malware infection
- Data loss (accidental deletion or intentional sabotage)
- Fire or flood
- Mechanical failure of equipment

To ensure the organisation can become operational again as quickly as possible, a detailed plan is created.

Disaster Recovery Plan

Consideration	Description
Identifying potential risks	Identify potential risks to the system and how each risk will affect the computer system and data
Who is responsible for which actions in the event of a disaster	Staff are given specific recovery tasks to avoid anything being duplicated or forgotten.
What staff should and should not do	Ensure that all staff know the procedures even if they do not have any direct tasks
How the systems will be backed up (including what will be backed up, how often and which media will be used)	Ensure that regular backups are taken. Decide where the backups will be stored and which media will be used to store the data e.g. cloud, magnetic tapes.
A timeline to establish how quickly the systems will need to be backup and running	After a disaster not all operations will be needed immediately. A plan should be made to define how long the organisation can be without each system. Critical systems must be identified and will need to be recovered first.
An alternative location for operation (hardware, software and personnel).	After disaster the organisation may need to move quickly to another location. Hardware, software and personnel should also be available (along with the backups) so that the organisation can function again quickly.

Component 3 Learning Aim B Cyber Security- B3 Policy
Passwords

Key Vocabulary	
Parameter	A parameter is a set of rules to be followed or behaviours that need to be demonstrated.
Default password	A password that is automatically allocated when your account is set up. Users are always advised to change default passwords on first use.

Password Policy

Organisations that take data security seriously usually have a comprehensive password policy that they ask employees to follow.

This policy usually covers the creation and protection of passwords.

Passwords should be suitably complex. Ccomplexity is increased by:

- Greater password length
- Combination of upper and lower case characters, numbers, punctuation and other symbols
- Passwords SHOULD NOT use words found in a dictionary, familiar names (family or pets) or be easy to crack
- Using initial letters from a memorable phrase, mixing lower and upper case letters and numbers

Protection of Passwords:

Passwords are out first point of defence for our files and personal information.

Usually an organisation's software will prevent the creation of passwords that:

- Don't match the organisation policy, have been used before or are in a dictionary.

Password Strength	Description	Examples
Weak	An obvious password using either standard letters or numbers, often personal to the user (e.g. family name, birthday) so can be easy to guess	PASSWORD,12 3456
Medium	Uses a combination of letters and numbers, but could use more special characters and less recognisable words to make it more difficult to guess.	LiverPool5
Strong	Makes use of special characters, numbers and upper/lower case letters, making it very difficult to guess.	A?vEr8gS!

Component 3 Learning Aim B Cyber Security- B3 Policy
Security Policies

Key Vocabulary	
Software Audit	A manual or automated process that lists the name, version and installation date of all software found on a digital device. The process may be carried out remotely, for example, across a network, or in person.

Acceptable Use Policies

Unapproved software could contain malware that might infect the organisation's systems and network.

It may conflict with the hardware or other software on the digital system.

An acceptable software policy explains what will be done to help prevent any attempted installation and use of unapproved software.

Use of unapproved software

The use of unapproved software is usually disallowed by an acceptable software policy. Breaching the policy may result in disciplinary action e.g. verbal or written warning even if the employee did not install the software.
Most operating systems can prevent the use of certain software applications.
Preventing the use of unapproved software helps to protect the organisation from malware and potential external threats.

The AUP reinforces the need for the installed software to be used responsibly and legally.
It also usually prohibits unauthorized duplication of the software for home use unless permitted by the software's licence.

Installation

- Users are usually forbidden from installing unapproved software or updates.
- Users may ask for approval for new software or be asked to select from an approved list.
- Users may need support from their manager or another department for their request to be considered.
- Users will need to justify why this new software is required for their job.

Security policy statements may state the following:
You may ***not*** install software on digital systems used within the organisation.
All software requests ***must*** be justified and approved by a manager and then sent to the IT department or Help Desk in writing or by email.
New software ***must*** be selected from the IT department's approved software list unless no match can be found that meets your needs.

Enforcing AUPs

The operating system applies the safeguards that prevent the installation of software if the user does not have sufficient administrative rights.

Other techniques that prevent unwanted installation of software:
- CCTV monitoring of employees
- Software audit of digital systems

Example Exam Questions:

1. Identify the risks of installing and using unapproved software.

2. Describe how an acceptable software policy might be enforced.

3. Describe what a software audit is.

4. Give two reasons why employees are not automatically allowed to duplicate software for home use.

Component 3 Learning Aim B Cyber Security- B3 Policy
Actions to take after an attack

Key Vocabulary	
Data Protection Controller	The named person in an organisation who takes responsibility for the safety and security of the organisation's data.
Remedial Action	An action taken to fix something that has gone wrong; a remedy

Actions to take after an attack

After an attack it is crucial that an organisation and its employees have a clear idea of the actions to take to resolve the situation and reduce the likelihood of it happening again.

1. Investigate
2. Respond
3. Manage
4. Recover
5. Analyse

Investigation

The organisation will investigate the nature of the attack. It will want to find out the following:

- **The type of attack** e.g. malware, network attack, data theft, phishing
- **The severity of the attack** e.g. Level 1 (low risk) to Level 5 (severe risk
- **Which processes or services are affected**.
- **When it happened**.

The information gathered at this point is vital to help the organisation determine how to respond, manage and recover from the incident.

Response

The type of response will vary depending on the severity of the attack.

An organisation will inform:

- Stakeholders (employees, shareholders, customers, suppliers, business partners etc)
- Appropriate authorities (law enforcement including police, National Crime Agency, **Data Protection Controller**, etc)

Notifying stakeholders

This is important as data breaches might include confidential details (usernames and passwords) that customers might use for other services.

Informing stakeholders may lead to a damage to public image.

Not telling the authorities could result in legal action and potential fines.

It is also important that interested parties are kept updated as more information becomes available from the investigation.

Manage

The priority is to isolate the problem by containing the threat as close to the source as possible.
e.g. disconnecting an infected computer from the network or blocking unauthorised network traffic by using a firewall.

Recover

The organisation will have a separate disaster recovery policy that it will follow in the event of an attack.
This will include:

- Employees responsible for specific tasks
- The expected timeline
- The **remedial action** involved.

Analyse

Analysis will focus on the following:

- What went wrong,
- How it happened (internal or external threat),
- How it could have been prevented,
- How effectively the organisation responded to the attack
- What lessons have been learned.