MY REVISION NOTES

HODDER EDUCATION

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City & Guilds Level 3 Advanced Technical Diploma (8202-30)

ELECTRICAL INSTALLATION

City & Guilds

Level 3 Advanced Technical Diploma (8202-30)

ELECTRICAL INSTALLATION

- Plan and organise your revision
- Reinforce skills and understanding
- Practise exam-style questions

Peter Tanner

Boost

HODDER EDUCATION
LEARN MORE

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Level 3 Advanced Technical Diploma (8202-30)

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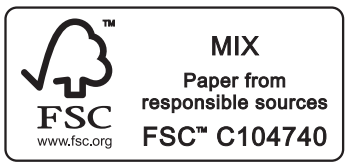


Get the most from this book

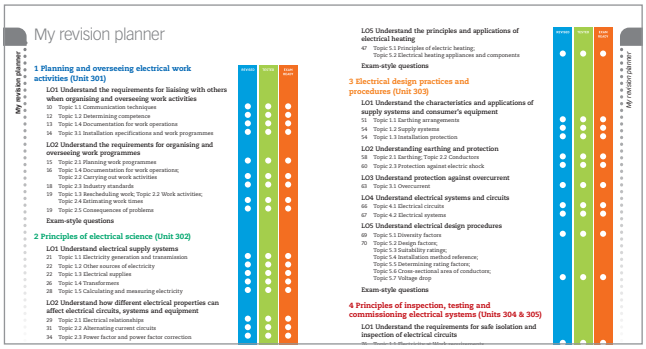
Everyone has to decide his or her own revision strategy, but it is essential to review your work, learn it and test your understanding. These Revision Notes will help you to do that in a planned way, topic by topic. Use this book as the cornerstone of your revision and don't hesitate to write in it – personalise your notes and check your progress by ticking off each section as you revise.

Tick to track your progress

Use the revision planner on pages 4–7 to plan your revision, topic by topic. Tick each box when you have:

- revised and understood a topic
- tested yourself
- practised the exam questions and checked your answers.

You can also keep track of your revision by ticking off each topic heading in the book. You may find it helpful to add your own notes as you work through each topic.


My revision planner

1 Planning and overseeing electrical work activities (Unit 301)

LO1 Understand the requirements for liaising with others when organising and overseeing work activities

10 Topic 1.1 Communication techniques
12 Topic 1.2 Determining competence
13 Topic 1.4 Documentation for work operations
14 Topic 3.1 Installation specifications and work programmes

LO2 Understand the requirements for organising and overseeing work programmes

15 Topic 2.1 Planning work programmes
16 Topic 1.4 Documentation for work operations; Topic 2.2 Carrying out work activities
18 Topic 2.3 Industry standards
19 Topic 1.3 Rescheduling work; Topic 2.2 Work activities; Topic 2.4 Estimating work times
19 Topic 2.5 Consequences of problems

Exam-style questions

2 Principles of electrical science (Unit 302)

LO1 Understand electrical supply systems

21 Topic 1.1 Electricity generation and transmission
22 Topic 1.2 Other sources of electricity
22 Topic 1.3 Electrical supplies
26 Topic 1.4 Transformers
28 Topic 1.5 Calculating and measuring electricity

LO2 Understand how different electrical properties can affect electrical circuits, systems and equipment

29 Topic 2.1 Electrical relationships
31 Topic 2.2 Alternating current circuits
34 Topic 2.3 Power factor and power factor correction

LO5 Understand the principles and applications of electrical heating

47 Topic 5.1 Principles of electric heating; Topic 5.2 Electrical heating appliances and components

Exam-style questions

3 Electrical design practices and procedures (Unit 303)

LO1 Understand the characteristics and applications of supply systems and consumer's equipment

51 Topic 1.1 Earthing arrangements
54 Topic 1.2 Supply systems
54 Topic 1.3 Installation protection

LO2 Understanding earthing and protection

58 Topic 2.1 Earthing; Topic 2.2 Conductors
60 Topic 2.3 Protection against electric shock

LO3 Understand protection against overcurrent

63 Topic 3.1 Overcurrent

LO4 Understand electrical systems and circuits

66 Topic 4.1 Electrical circuits
67 Topic 4.2 Electrical systems

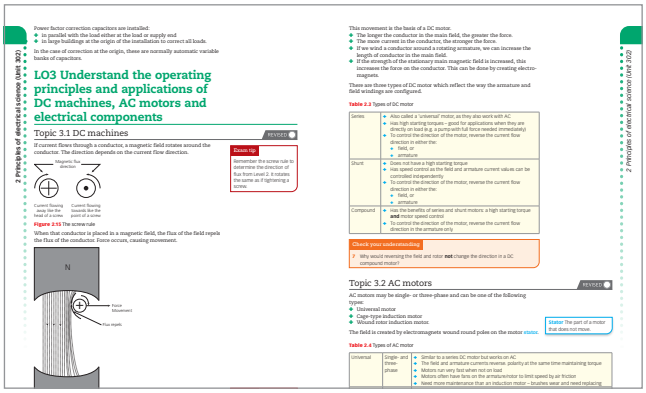
LO5 Understand electrical design procedures

69 Topic 5.1 Diversity factors
70 Topic 5.2 Design factors; Topic 5.3 Suitability ratings; Topic 5.4 Installation method reference; Topic 5.5 Determining rating factors; Topic 5.6 Cross-sectional area of conductors; Topic 5.7 Voltage drop

Exam-style questions

4 Principles of inspection, testing and commissioning electrical systems (Units 304 & 305)

LO1 Understand the requirements for safe isolation and inspection of electrical circuits


LO3 Understand the operating principles and applications of DC machines, AC motors and electrical components

Topic 3.1 DC machines

Topic 3.2 AC motors

Features to help you succeed

Exam tips

Expert tips are given throughout the book to help you polish your exam technique in order to maximise your chances in the exam.

Typical mistakes

The author identifies the typical mistakes that candidates make in exams and explains how you can avoid them.

Now test yourself

These short, knowledge-based questions provide the first step in testing your learning.

Definitions and key words

Clear, concise definitions of essential key terms are provided where they first appear.

Exam checklist

The exam checklists provide a quick-check bullet list for each topic.

Exam-style questions

Practice exam questions are provided for each topic. Use them to consolidate your revision and practise your exam skills.

Check your understanding

These questions test your basic understanding of the information as you work through the course.

Exam breakdown

For guidance on how you will be assessed and how to prepare for your exam, see the end of this book (page 133).

My revision planner

1 Planning and overseeing electrical work activities (Unit 301)

LO1 Understand the requirements for liaising with others when organising and overseeing work activities

LO2 Understand the requirements for organising and overseeing work programmes

Exam-style questions

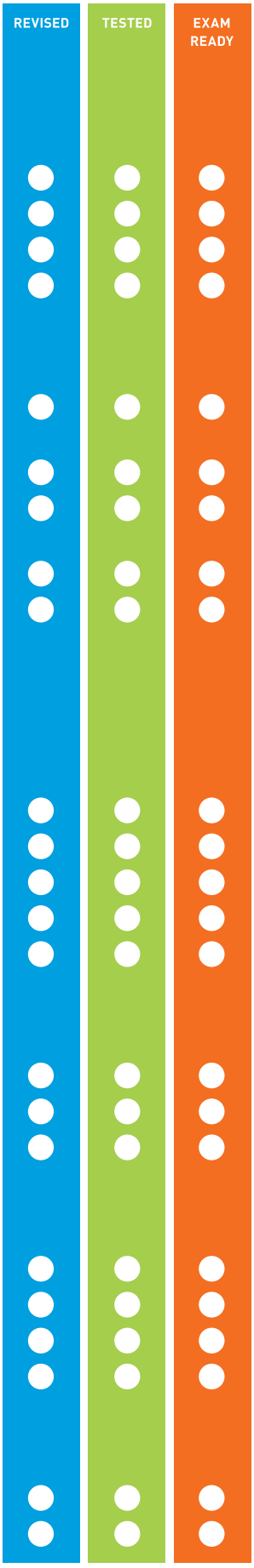
2 Principles of electrical science (Unit 302)

LO1 Understand electrical supply systems

LO2 Understand how different electrical properties can affect electrical circuits, systems and equipment

LO3 Understand the operating principles and applications of DC machines, AC motors and electrical components

LO4 Understand the principles and applications of electrical lighting systems



LO5 Understand the principles and applications of electrical heating

Exam-style questions

3 Electrical design practices and procedures (Unit 303)

LO1 Understand the characteristics and applications of supply systems and consumer's equipment

LO2 Understanding earthing and protection

LO3 Understand protection against overcurrent

LO4 Understand electrical systems and circuits

LO5 Understand electrical design procedures

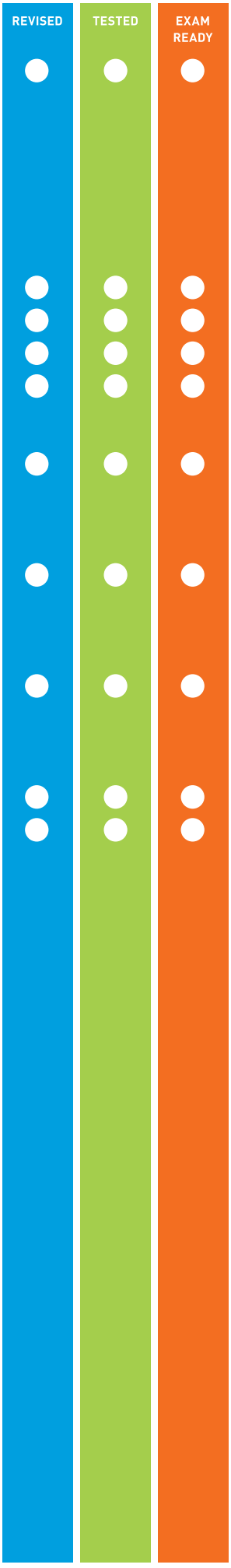
Exam-style questions

4 Principles of inspection, testing and commissioning electrical systems (Units 304 & 305)

LO1 Understand the requirements for safe isolation and inspection of electrical circuits

REVISED TESTED EXAM READY

REVISED | TESTED | EXAM READY



Countdown to my exams

6–8 weeks to go

- Start by looking at the specification — make sure you know exactly what material you need to revise and the style of the examination. Use the revision planner on pages 4–7 to familiarise yourself with the topics.
- Organise your notes, making sure you have covered everything on the specification. The revision planner will help you to group your notes into topics.
- Work out a realistic revision plan that will allow you time for relaxation. Set aside days and times for all the subjects that you need to study and stick to your timetable.
- Set yourself sensible targets. Break your revision down into focused sessions of around 40 minutes, divided by breaks. These Revision Notes organise the basic facts into short, memorable sections to make revising easier.

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2–6 weeks to go

- Read through the relevant sections of this book and refer to the exam tips, summaries, typical mistakes and key terms. Tick off the topics as you feel confident about them. Highlight those topics you find difficult and look at them again in detail.
- Test your understanding of each topic by working through the 'Now test yourself' questions in the book. Look up the answers afterwards.
- Make a note of any problem areas as you revise, and ask your teacher to go over these in class.
- Look at past papers. They are one of the best ways to revise and practise your exam skills. Write or prepare planned answers to the exam practice questions provided in this book.
- Track your progress using the revision planner and give yourself a reward when you have achieved your target.

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One week to go

- Try to fit in at least one more timed practice of an entire past paper and seek feedback from your teacher, comparing your work closely with the mark scheme.
- Check the revision planner to make sure you haven't missed out any topics. Brush up on any areas of difficulty by talking them over with a friend or getting help from your teacher.
- Attend any revision classes put on by your teacher. Remember, he or she is an expert at preparing people for examinations.

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The day before the examination

- Flick through these Revision Notes for useful reminders, for example, the exam tips, typical mistakes and key terms.
- Check the time and place of your examination.
- Make sure you have everything you need – extra pens and pencils, tissues, a watch, bottled water, sweets.
- Allow some time to relax and have an early night to ensure you are fresh and alert for the examinations.

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My exams

8202-531: Advanced Diploma in Electrical Installations

Date: .....

Time: .....

Location: .....

1 Planning and overseeing electrical work activities (Unit 301)

Planning is a major part of any work and must be done before any project or task begins. Poor planning leads to major inefficiencies, unsafe situations and costly mistakes.

Exam tip

If a question relates to planning work, sit and imagine the work and what is involved first. Consider a simple task such as installing a 3-metre length of dado trunking in an office. Spending some time planning before starting work can save a lot of time during the work. As well as time savings and safety considerations, it can reduce inconvenience to others and promote a professional image.

Planning considerations include:

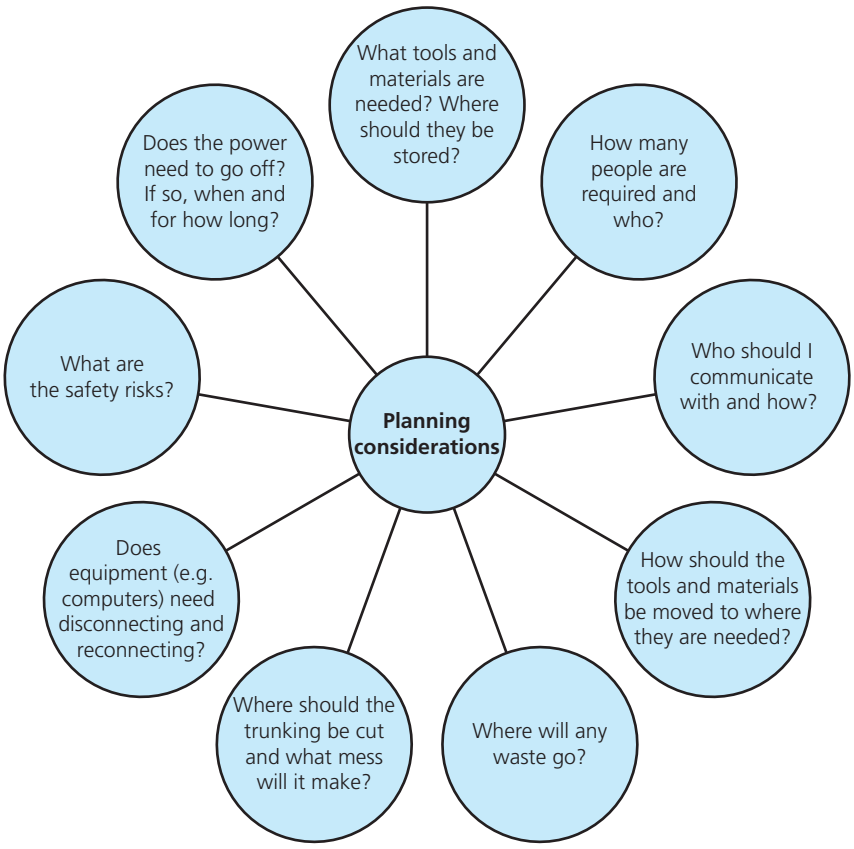

Figure 1.1 Planning considerations

Most of these questions can be answered and acted on quickly. This will lead to much more active work, rather than reacting to unplanned situations. You can plan an entire job or contract, know how to communicate and document each stage and complete an installation or contract safely, on time and in budget.

LO1 Understand the requirements for liaising with others when organising and overseeing work activities

Topic 1.1 Communication techniques

REVISED

Communication between stakeholders is key to good planning and progression of work. When considering how we communicate, we need to consider **who** we are communicating to and **why**.

Table 1.1 shows suitable and unsuitable methods of communicating, depending on the reason for communications and what needs to be communicated.

(NB: The table doesn't cover all methods available, but the considerations given should provide questions to guide your choice in each situation that arises.)

Stakeholder A person or organisation that is involved, or has an interest in, what is going on in a project or situation.

Table 1.1 Suitable and unsuitable methods of communicating

Reason for communication	What is being communicated or why	What needs to be considered when choosing how to communicate	What would be an unsuitable method and why	What would be a suitable method and why
Co-operation and teamwork	Site meeting between contractors and sub-contractors	+ Do parts of the site need to be seen? + Will every stakeholder understand issues and agree resolutions? + Will every stakeholder have an opportunity to communicate?	Any technique involving written text (e.g. email or text messaging) as you cannot know for certain that other people have understood, leading to missed opportunities.	Face-to-face discussion (e.g. around a table – on site if aspects need to be seen – or video conferencing). You can see people's reactions and understanding can be confirmed.
	Informing the public of inconveniences	+ How can the relevant people be targeted? + What method will use up fewer resources? + Are there planning requirements?	Face-to-face types of communication, as these are time consuming and labour intensive.	Signage, posters or leaflet drops, using simple language, giving key facts.
	Who does what and when, while performing a specific task	+ Where are the relevant people? Are they in remote locations? + Will everyone understand the tasks? + Will responses be quick?	Any technique involving written text (e.g. email or text messaging) – you cannot know for certain that other people have understood and responses can be slow.	Verbal communication (e.g. face-to-face or using radio sets) so discussions and instructions are quick and understanding can be confirmed.

Reason for communication	What is being communicated or why	What needs to be considered when choosing how to communicate	What would be an unsuitable method and why	What would be a suitable method and why
Monitoring	Conflict between equipment location with other services	+ Is the issue simple to resolve? + Does this impact on other stakeholders?	Text messaging (or similar) where it is harder to explain technical information – but photos can help.	**Building information modelling** or face-to-face meeting to discuss the issue.
	Informing the customer/client of progress	+ How detailed does this need to be? + How quickly is a response needed? + Who is the client, e.g. homeowner; main contractor; or technical representative of the client, such as a contract manager?	Text messaging may not be professional. Telephone conversations may not give evidence, but a text may be suitable if a simple message such as 'We will be finished tomorrow' is needed.	Email (or similar documented information), especially if there is graphical information, e.g. progress charts.
	Planning plant and materials delivery	+ How large is the contract? + Is expensive specialist equipment needed? + How much storage space is there? + How many other stakeholders are involved in the works?	Verbal communication – instructions or details can be forgotten or misunderstood. This could lead to incorrect materials or wrong timings.	Visual methods (e.g. critical paths and bar/Gantt charts) to show progress and indicate stages for delivery of equipment and materials.
Instructions	Informing a co-worker of the requirements of a task	+ Is a lot of technical information needed, e.g. dimensions or locations? + Is the co-worker working remotely or close by?	Text-based communications as they are poor at setting out detail such as dimensions or procedures.	If working remotely, use email for key details with attached drawings etc. If working closely, use verbal communication with drawings or other data.
	Informing a site manager of a problem or issue that could lead to delays and/or additional costs	+ How quickly does this information need to be given? + Are there implications for other stakeholders? + Are there contractual implications, such as costs?	Verbal communications can quickly describe the problem. But for contractual reasons, a documented trail is needed for evidence.	Emails or site meetings with recorded minutes (to keep records) as cost implications will need to be allocated to those responsible.
	Ordering the correct materials	+ How detailed is the order? + Is official documentation needed for proof of purchase when on account? + Are the materials bespoke, i.e. specific to this work?	Verbal communications can be used for small orders or where cash sales are made, so the suitability of the equipment is confirmed on collection.	Written orders on official documents (e.g. email) as they can contain very specific quantities and material details, such as part numbers.
	Instructing customers on the use of installed equipment	+ Does understanding need to be confirmed? + Does manufacturer's information need to be handed over?	Any remote method of communication, as it is essential that a customer understands how to use the system.	Face-to-face demonstration to check understanding and handover all necessary documentation.

Reason for communication	What is being communicated or why	What needs to be considered when choosing how to communicate	What would be an unsuitable method and why	What would be a suitable method and why
Motivation	Uncertain or confused workforce	+ Is the issue technical or relating to planning, such as timings? + Where did the confusion originate from?	Telephone call (or similar) can help with simple issues but all stakeholders need to be involved to quickly resolve conflicting information.	Face-to-face or video conferencing to understand where the confusion arose and resolve it more quickly.
	Conflict between co-workers	+ What is the nature of the conflict: personal or professional? + How many people are involved?	Text-based communications are not good at conveying feelings. Official documents are required if there are disciplinary proceedings	Face-to-face communications to check feelings or reactions. Official documented methods, such as email or letter.

Exam tip

Methods of communicating may feature in the synoptic assessment as well as in the exam. The exam may require advantages and disadvantages of the different methods, or choosing suitable methods based on a scenario. The synoptic assessment may require the use of communicating information such as a critical path or bar chart.

Now test yourself TESTED

1 You have completed a new installation and are at the handover stage. Part of the handover includes making sure that the client knows how to operate controls and timers, and what regular maintenance should be carried out. Which communication methods are best for this?

Building information modelling A method of sharing 2D or 3D images and plans of a building between stakeholders – some systems allow for real-time changes to be seen or made between stakeholders.

Topic 1.2 Determining competence

REVISED

Competence is a term used to describe, within the electrical industry, someone who has sufficient knowledge and experience and is able to apply these skills to undertake the work or task as needed.

BS 7671

The IET Wiring Regulations recently replaced the term 'competent' with the following:

+ **Skilled person**: This is someone who has adequate education, training and practical skills, and who is able to perceive the risks and avoid hazards that electricity can create.
+ **Instructed person**: This is someone who has been adequately advised or supervised by a skilled person to enable that person to perceive the risks and to avoid the hazards that electricity can create in that given situation.

The level of competency can be determined in many ways, such as competency cards and qualifications, but one of the most common methods is by informal monitoring on site. Can that person actually do the work required? This is one of the reasons why probation periods are common in construction related jobs. A person is given a probation period of, for example, three months to prove they have the right skills to carry out the job properly.

Competency cards

These are a good way to determine the level of competency as well as currency. These can include:

- **Electrotechnical Certification Scheme (ECS) cards**: A specific competency scheme for those working in the electrical sector. There are several different levels of card depending on the experience and qualifications of the individual. Gold cards are for fully qualified, skilled electricians.
- **Construction Skills Certification Scheme (CSCS) cards**: These show that an individual has the correct level of training to work on site. CSCS cards are an alternative scheme where a specific trade has no card-issuing body.
- **Joint Industry Board (JIB) cards**: For electricians working for a JIB-registered company. They are graded in a similar way to ECS cards.

Currency The person is up to date with practices and regulations, such as BS 7671. Some card schemes (e.g. ECS) display the recent qualifications for the individual, showing how up to date they are.

Electrotechnical Assessment Specification (EAS) A body made up from industry organisations that set the standards that competent persons and scheme operators must work to.

Competent persons scheme registration

Electrical organisations register with the scheme operator, but they could be sole traders or companies employing many electricians.

Organisations registered with scheme operators must employ fully qualified electricians, as set by the Electrotechnical Assessment Specification (EAS). The scheme operator regularly inspects work done by the organisation to ensure it meets industry standards. Examples of current scheme operators include:

- NICEIC
- NAPIT
- STROMA
- ELECSA.

Organisations registered on the competent persons scheme can self-certify work undertaken under Part P of the Building Regulations in England and Wales (or similar regulations in Scotland and Northern Ireland).

Exam tip

Exam questions will use requirements for England (unless specified) where they differ across the regions of the UK.

Topic 1.4 Documentation for work operations

REVISED

The process of undertaking a contract includes an initial enquiry and a handover, involving particular documentation, special considerations and set procedures. The procedures should be followed and documents used to ensure the work is both financially successful and meets the requirements of all stakeholders.

Now test yourself

2 Put yourself in the position of a client who wants some electrical work carried out. How would you, as the client, know if the electrician was competent?

TESTED

Initial enquiry

Potential clients contact an electrical contractor to say they want work to be done, and wanting to know when it can be done and how much it will cost. The contractor can respond in several ways depending on the request, including the following:

- **Tender**:
  - Where the client sends details of work to several potential contractors and asks them to provide a cost for the work in very fine detail.
  - The client will choose a contractor based on best price and best overall long-term costs, should additions or delays affect the work.
  - Tenders are normally undertaken for large or long-term contracts.
- **Quotation**:
  - This is a fixed price for the work to be undertaken no matter what.
  - Care must be taken by the contractor to ensure they have planned the work – any unseen costs due to unexpected problems or delays will have to be met by the contractor (unless they were caused by the client).
- **Estimate**:
  - This is a projected cost of the work but may change if anything unexpected arises during the work.
  - Contractors will still need to take care in being accurate with the estimated price. It needs to reflect the final price as much as possible.

Check your understanding

1 What actions by the client could lead to changes in a quotation?

- Within an estimate, a contractor should state what factors could affect the estimated cost (e.g. delays by others or initial lack of detail, such as drawings or detailed specifications).

It is very important at this stage for a contractor to identify if the work is within their level of competence or specialism. The work may be in hazardous locations, such as a petro-chemical installation, which requires specialist qualifications like COMPEX and specialist equipment.

Work may be outside the scope of BS 7671 so more detailed regulations or licensing requirements may need to be followed. If not researched, this might compromise costs and completion of the work.

COMPEX A certification scheme to show a contractor or individual is trained and competent to work in explosive locations (e.g. oil rigs, fuel-filling stations and gas storage installations).

Topic 3.1 Installation specifications and work programmes

REVISED

Costing work and planning allocations

Before submitting a tender, quotation or estimate, a contractor must study the work required to understand and plan the work. Information may be provided in the form of prelims for large contracts, or a simple client specification, which can be written or verbal.

To cost and plan the work, consider the following:

- **Materials and components needed**:
  - Materials (e.g. accessories) are usually estimated from drawings using take-off sheets. Other materials like cables and wiring systems will need to be estimated using scaled drawings and planned wiring routes.
  - Components (e.g. fixings, cable supports, etc.) will need to be estimated and are normally based on the quantity and types of materials.
- **Equipment needed**:
  - An estimate of the equipment needed for a task and if these items are available or need to be purchased. These include power tools, conduit benders, etc.
- **Labour requirements**:
  - An estimate of how many operatives are needed for each task (e.g. their necessary level of competence such as electrician, trainee, etc.). This information will also be required to form a work schedule.
- **Specialist plant**:
  - Check if any of the work requires specialist equipment (e.g. access equipment, core drills, or lifting equipment).
  - Can be hired or purchased.
- **Welfare facilities**:
  - Including toilet facilities, office requirements and first aid facilities. Also, any PPE provision.
- **Site storage**:
  - Check if there is a room or facility for secure storage of plant and materials.
  - This will impact on frequency of deliveries and the risk of damage or theft of materials.
  - Check if a container is needed or if there are secure facilities within the building.
- **Delivery and transportation restrictions**:
  - Check restrictions on parking, access, vehicle size or delivery times.
  - Consider how to transport equipment and materials within the site, such as high-rise buildings.
- **Waste disposal**:
  - Check how (or if) you need to dispose of hazardous waste or recycling materials.
  - Waste collection services or skip hire might be needed.

Prelims (preliminary information) Includes information such as the terms of the contract, who is acting as main contractor and client representative, contract period, scope of works, detailed specification for the works, materials and workmanship expectations, drawing schedules, and the schedule of costs for specific items.

Client specification Contains details of what a client wants. This can be very simple or detailed, with a specific materials schedule stating particular manufacturers, specific finishes of accessories (e.g. brass or chrome) and details of function or operating requirements. Materials schedules should always be checked to ensure the materials specified are suitable for safety and function.

Now test yourself

3 Imagine you want some electrical work done in your home. What would you specify as part of your client specification?

TESTED

- **Services:**
  - Includes the need for electricity/water supplies and drainage for the site during construction work.

Other considerations for the cost of a project are company overheads. These are the day-to-day costs of running an organisation and the office-based support for the work, such as:

- office personnel and office costs
- vehicle maintenance, insurance and tax
- holiday pay, personal tax and National Insurance
- cost of issued equipment such as test instruments, conduit benders, etc.
- insurances, such as public liability and indemnity.

Exam tip

Many of the considerations may feature as part of the synoptic assignment. For example, you may be required to create and complete a take-off sheet.

LO2 Understand the requirements for organising and overseeing work programmes

Topic 2.1 Planning work programmes

REVISED

When planning for the work on site:

- It is always best to plan the stages of the work using various work programmes. This is to minimise wastage of labour and to ensure specialist plant, machinery and all materials are on site when needed.
- Do a critical path analysis. This helps you to understand which tasks depend on other tasks being completed. You can create a graphic indication of labour and plant resources by drawing up a table of tasks.
- Once a critical path has identified the order of tasks, when equipment is needed and what tasks may clash, labour resources can then be determined from a bar chart or spreadsheet. When a bar chart is being completed, careful consideration is given to the labour needed on any given day.

Critical path analysis

Looks at all the tasks that are to be carried out and places them in order. It can also identify any problems with labour requirements and materials, as well as any tasks that depend on work by other trades or organisations.

Worked example

The table shows fifteen tasks. The right-hand column indicates which tasks depend on others:

	Task	Special equipment	Duration	Operatives	Dependent on
1	Install lighting cable basket	Cherry picker	2 days	2	-
2	Builders to chase walls and floors		1 day	N/A	-
3	Install floor trunking		2 days	2	-
4	Builders screed floor around trunking (no other works allowed during period)		4 days	N/A	3
5	Install wall dado trunking		0.5 days	1	4
6	Install conduit drops in wall chases		0.5 days	1	2
7	Pull power cables into floor trunking		1 day	2	3
8	Fix distribution board (DB)		0.5 days	1	-
9	Terminate DB		0.5 days	1	7, 8 and 10
10	Pull in lighting cables ceiling basket/ conduit drops		1 day	2	1 and 6
11	Install luminaires	Cherry picker	1 day	1	10
12	Terminate all luminaires and switches	Cherry picker	0.5 days	1	11
13	Install and terminate wall sockets and switches		0.5 days	1	5
14	Install and terminate floor socket-outlets		1 day	1	7
15	Initial verification		1 day	2	all

From the table, a critical path can be drawn and analysed to maximise resources, as shown in Figure 1.2.

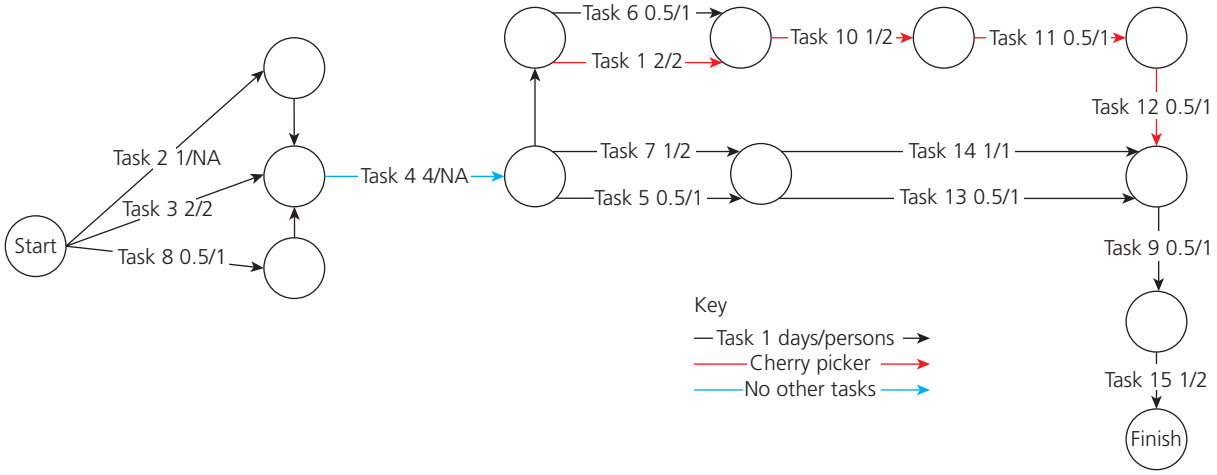

Figure 1.2 The critical path created from data in the table

	Task	Days													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Install lighting cable basket														
2	Builders to chase walls and floors														
3	Install floor trunking														
4	Builders screed floor around trunking (no other works allowed during period)														
5	Install wall dado trunking														
6	Install conduit drops in wall chases														
7	Pull power cables into floor trunking														
8	Fix distribution board (DB)														
9	Terminate DB														
10	Pull in lighting cables ceiling basket/conduit drops														
11	Install luminaires														
12	Terminate all luminaires and switches														
13	Install and terminate wall sockets and switches														
14	Install and terminate floor socket-outlets														
15	Initial verification														
	Cherry picker needed														
	Task needing 1 person	People needed per day													
	Task needing 2 people	2	2	0	0	0	0	3	4	2	2	2	2	-	-

Figure 1.3 A bar chart created from data in the table

Using the critical path, a bar chart can be used to illustrate what labour is needed and when. Providing certain tasks are carried out after others, as identified using the critical path, tasks can be arranged to maximise labour.

From the bar chart and critical path in the worked example, you can see that delays in one area can lead to problems in others. For example, if the cherry picker has been organised and arranged to arrive on day 7, but the floor takes an extra day to dry, the cherry picker will be needed on site for 5 days, since it cannot be used on the first day. This extra day will need to be paid for. Also, what if the hire company needs it back after four days? Overtime will be needed to complete the high-level work before the cherry picker must be returned.

On large sites, the above information across all trade specialisms is often circulated to all parties involved. This ensures that all parties co-ordinate with each other. It also ensures not too many people or trades are trying to work in one area at the same time, which would lead to overcrowding and delays.

Check your understanding

2 Think of an everyday or common string of events such as catching the train to college (or similar) and consider a critical path for this.

Topic 1.4 Documentation for work operations; Topic 2.2 Carrying out work activities

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Site documentation

During a contract, many official documents are used for different reasons and stages of the work. These include the following:

- **The contract**:
  - Sets out the extent of the works, the specification and cost.
  - Includes a completion date and a handover date.
- **Variation order**:
  - This is issued if there are any changes to the contract.
  - It gives the contractor the ability to charge extra for the altered or additional works.
- **Day work sheets**:
  - Can be used when a contractor is held up or additional work is required – labour is charged at a set daily price using the day work sheets to record hours over the original contract.
- **Purchase orders**:
  - Are a written record of purchases (e.g. of materials or equipment) during a contract.
  - It is common to allocate each purchase order an order number, which has reference to a particular site or contract.
  - This is so all invoices from the supplier can be allocated to a particular contract or job to ensure it remains on budget.
- **Delivery notes**:
  - These normally accompany a delivered order and outline the contents of the order.
  - These should be checked against the original purchase order to check the correct items have arrived, including the correct quantity.
- **Time sheets**:
  - Used by employees to record the time worked.
  - Given to the employer who will use them to work out how much to pay the employee.
- **Site diaries**:
  - Used to record daily activities on site.
  - May include conflicts with other trades, requests by the client or weather conditions.
  - Purpose is to keep a record of anything that could lead to delays or additional costs, with reasons.

Health and safety documentation

The worksite needs to operate safely to protect people's welfare. It needs to be efficient and requires planning.

Documents used to keep a site safe include the following:

- **Risk assessments**:
  - Used to identify the risk associated with hazards. It requires updating as risks change.
- **Method statements**:
  - Task-based instructions usually written to follow a risk assessment.
- **Control of Substances Hazardous to Health (COSHH) data sheets**:
  - Relate to the way any hazardous substance is used or stored on site.
  - The safe storage, use, disposal and what to do in the event of contamination/contact must be available.
- **Permit to work**:
  - Used when working in or on hazardous locations or systems.
  - Normally undertaken by a responsible person and the person doing the task.

- It is a way of checking a system (e.g. an electrical supply) is safe and suitable to work on and all steps of a risk assessment and method statement have been followed.
- Once the work is complete and it is safe to turn power back on, the permit to work is signed off and is no longer valid.

Check your understanding

3 What are the five steps for creating a risk assessment?

4 State **two** substances that an electrician may need to use that are covered by COSHH Regulations.

Topic 2.3 Industry standards

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Carrying out the work

Everyone on site needs to follow health and safety legislation to keep everyone safe. They also need to follow the work plan to keep costs and disruption to a minimum.

Not following statutory and guidance documents can lead to disruption on site. For example, if you do not follow health and safety documents, you may cause an accident, leading to delays due to staff absence. In extreme cases, the site could be shut down, stopping all work activities. Statutory documents to be followed include the following:

- **Management of Health and Safety Regulations**:
  - Detail the **Health and Safety at Work etc. Act** and set out information on managing safety at work.
  - Include the need for risk assessments and method statements, as well as co-operation with others.
- **Electricity at Work Regulations**:
  - Are specific to working with electricity and electrical systems.
  - State that electrical systems must be safe, maintained, suitable, secure and that dangers of working with electricity must be minimised by working on dead systems (unless otherwise unreasonable).
- **Construction (Design and Management) Regulations (CDM)**:
  - Outline the need for co-ordination between trades during the work programme.
  - A principal designer or contractor should manage health and safety on site.
  - If the work takes longer than 30 days involving 20 or more workers, or more than 500 worker days (1 worker for 500 days, 2 workers for 250 days etc.), then this contract must be notified to the HSE, which may choose to inspect the site.
  - When the works are completed, a safety file is handed to the client. It outlines the required work and procedures for maintenance. It must be updated regularly.
- **BS 7671 Requirements for Electrical Installations**:
  - A non-statutory document which sets out detailed technical requirements for wiring systems and electrical equipment.
  - Wiring systems covered by BS 7671 include any type of wiring such as data, signal, telecoms, as well as electrical power and lighting.
- **Data Protection Act and GDPR regulations**:
  - Set out the need for protecting people's personal data.
  - Data can be accidentally given out to other people very easily (e.g. copying in a client's email address or leaving sensitive paperwork out on a desk).
  - Store data safely and securely and delete or destroy it once it has no further purpose.

- **Other Acts:**
  - There are many other Regulations and Acts that must be observed while at work. For example, all people have the right to be treated fairly and with respect. These include the:
    - Equality Act
    - Employment Rights Act
    - Human Rights Act.

Typical mistake

Just knowing that the Electricity at Work Regulations exist is not enough for the exam! Some questions relate to the detail in the Regulations, such as planning suitable lighting or space for work activities, as well as the requirements for working on or near live equipment. Make sure you know your legal responsibilities.

Topic 1.3 Rescheduling work; Topic 2.2 Work activities; Topic 2.4 Estimating work times

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Delays and their implications

No matter how well planned a project is, delays can happen. Common causes of delays include the following:

- **Weather conditions** – can be disruptive, such as heavy rain, sustained cold or high winds. Some materials, such as PVC, should not be installed during extreme cold conditions.
- **Supply chain issues** – a particular item or material might require different components or processes in the chain to manufacture and deliver them.
- **Labour availability** – due to sickness, other commitments or holidays.
- **Tools and equipment availability** – specialist equipment (e.g. a crane) breaking down, or equipment and tools being used somewhere else.
- **Vehicle availability** – affects the transportation of people and tools/equipment. Restrictions can also impact on vehicle use (e.g. small towns not allowing vehicular access; emissions control zones; local parking restrictions).

Topic 2.5 Consequences of problems

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If delays happen, it can have a knock-on effect to other trades or services and lead to changes to the work schedule. The client might impose a **penalty clause** for reimbursement if project deadlines are missed. This could be a fine or a reduction in payment for services. Late delivery can also damage reputations, leading to loss of future work.

Table 1.2 shows the possible consequences of common problems, which will all result in the loss of income.

Penalty clause A clause, usually in a contract for the work, that states that those responsible for delays to the agreed completion date have to pay a fee for every day the contract runs over the specified time.

Table 1.2 Possible consequences of common problems

Problem	Consequence
Failure to complete work within the estimated time	A penalty clause, meaning additional costs to compensate the client.
Failure to meet the requirements of the programme of work	This could cause other trades or contractors to be late to complete, meaning a penalty clause would be applied to those who did not complete to the programme causing the delay.
Failure to use the specified materials	This will result in the client either: + requesting the materials be changed to the correct ones at no expense to them + insisting on reducing payments as a result of the incorrect items.
Failure to install materials and equipment as specified	This could lead to the installation not complying with BS 7671 and as a result, an Electrical Installation Certificate cannot be issued until the correct materials and equipment are used. This will add to the cost of the work, which the client will not pay for.

Exam checklist

- Methods used to communicate and liaise with others
- How to check for competency
- Purpose of the competent persons' scheme
- Methods of providing quotation or an estimate
- How to cost work and what to allow for
- Producing and presenting a work schedule
- Implications of not following a work schedule
- The documents used on site
- Health and safety documents
- Regulations relevant to work activities
- Causes of delays and the implications of delays

Exam-style questions

1 List **two** methods used to show a programme of work. (2 marks)

2 Describe **two** factors that can affect the completion date of a contract. (4 marks)

3 List **three** statutory regulations that affect the rights of employees at work. (3 marks)

4 Explain the purpose of a variation order. (4 marks)

5 State what a client may impose if work runs over the agreed completion date. (1 mark)

6 Describe the term 'competent', including how it can be demonstrated. (4 marks)

7 State **one** suitable method of communication for providing **each** of the following items of information. (2 marks)

a) To tell a colleague you are running late.

b) To provide a technical specification from the office to someone on a site many miles away.