

Sparks Magazine – Autumn Term 2015 – Answer Sheet

Page 18 - Health & Safety Quiz

Number	Answer letter	Check ✓
1	J	
2	E	
3	G	
4	A	
5	C	
6	I	
7	B	
8	D	
9	H	
10	F	

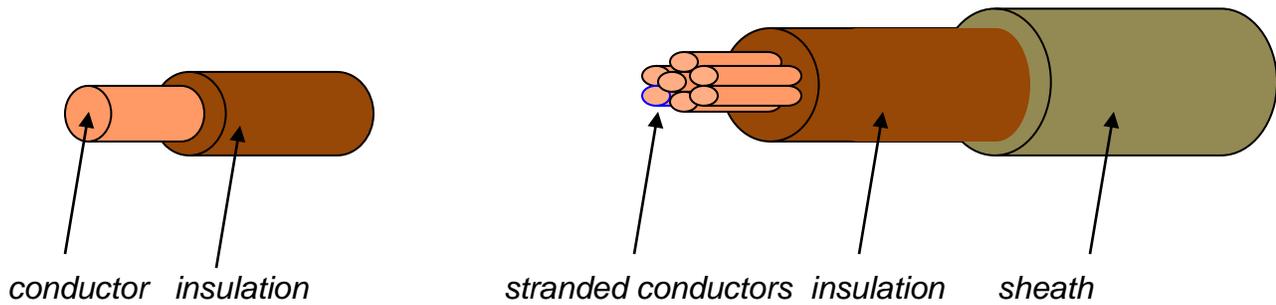
Page 26 - Electric Cables

(Covering Outcome 4 of Unit 304 'Understand the types, applications and limitations of wiring systems and associated equipment' (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent)

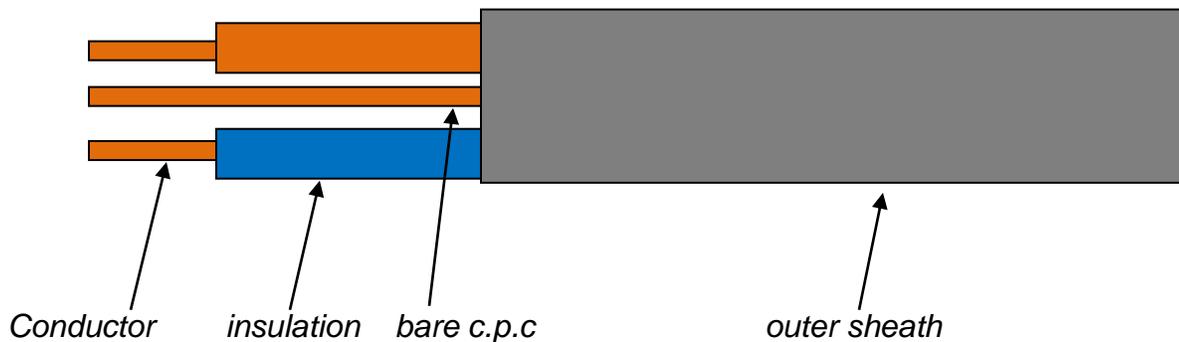
General knowledge questions and tasks for cables:

- 1: An electric cable is designed to safely carry electric current.
- 2: The typical construction of an electric cable will consist of a solid or stranded conductor and a protective layer called the insulation
- 3: Cable insulation is generally a layer of PVC that may be over-covered with an additional layer called the sheath
- 4: The insulating material used in the construction of MICC cable is magnesium oxide
- 5: The current rating of an electric cable depends on the method of installation and the cable cross-sectional-area or c.s.a.
- 6: The cross-sectional-area of an electric cable is expressed in mm² and refers to the area of the conductor.

7: Complete the labels for the following cable samples



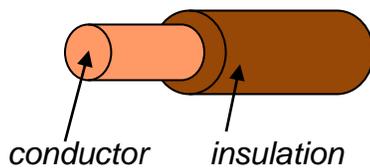
8: Composite cables are cables that can be clipped direct to a surface and consist of two or more cores. One example of a composite cable is twin & earth or T&E



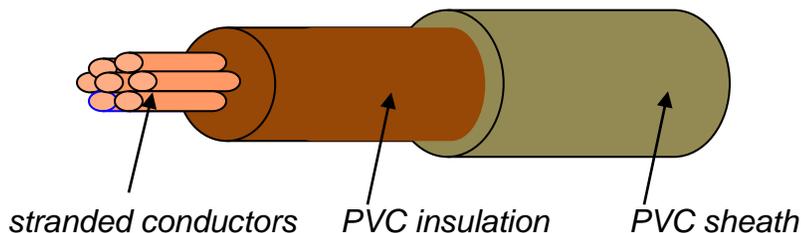
9: The abbreviation **BASEC** is the registered mark for the British Approvals Service for Cables

10: What is the function of the BASEC mark found on electric cables? To indicate that the cable has been tested, approved and certificated

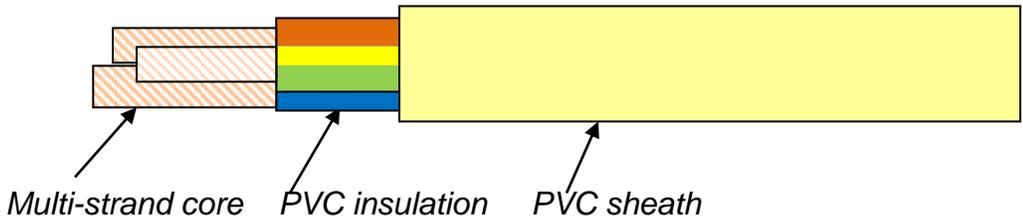
11: The following illustration shows a non-sheathed cable



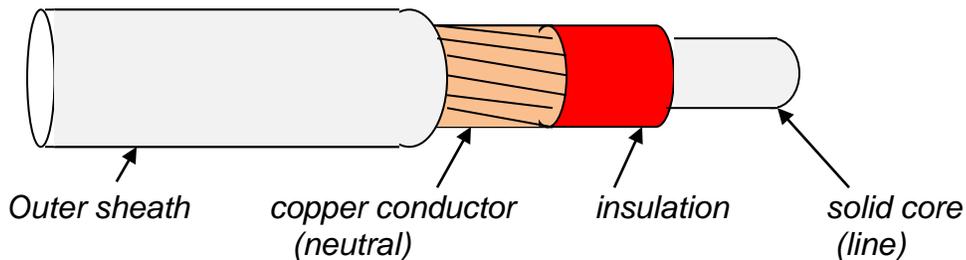
12: The following illustration shows an insulated and sheathed cable



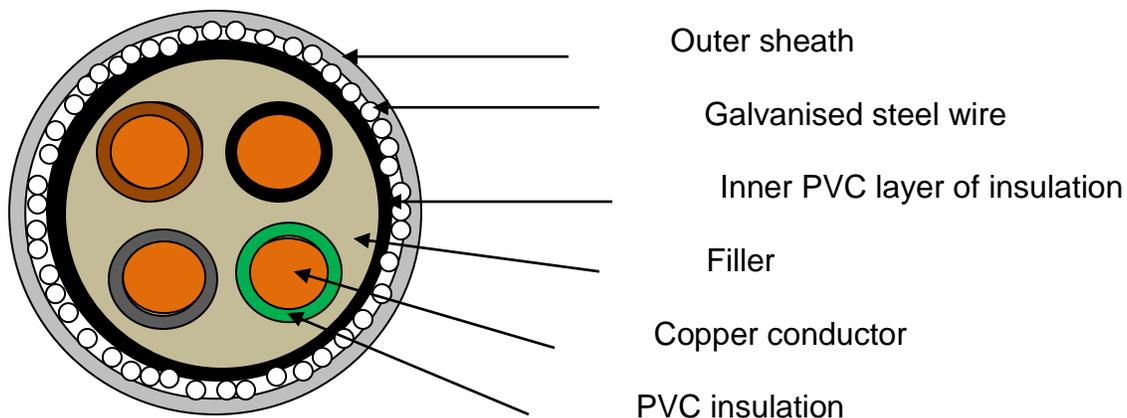
13: Flexible cable has a multi-strand core, (*usually 32 strands of copper conductor*) all cores are insulated with an over-covering of PVC or silicon rubber as shown below. **Task:** Label the parts.



14: Single-phase power supplies into domestic premises may be supplied using a **concentric cable**. The central core is the line, and the neutral conductor surrounds it and provides mechanical protection. **Task:** Label the parts.



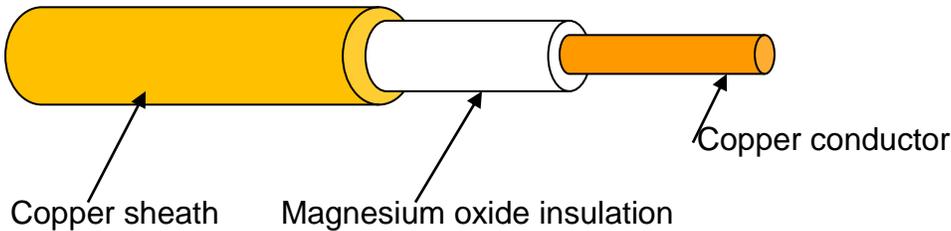
15: PVC insulated Steel-Wire-Armour, (SWA) has galvanised steel wires surrounding the insulated cores providing mechanical protection. Single and multicore versions are available. **Task:** Label the parts



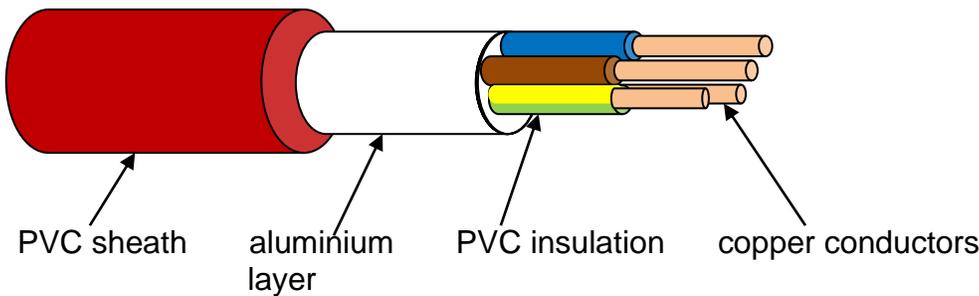
16: In situations likely to have high temperatures present for long periods of time, or a risk of explosion exists, Mineral Insulated Copper Covered (MICC), cable may be selected. What are the **two main advantages** of MICC cable?

Fire resistance and mechanical protection

The illustration shows a single – core non-sheathed or bare copper sheath MICC cable: **Task:** Label the parts

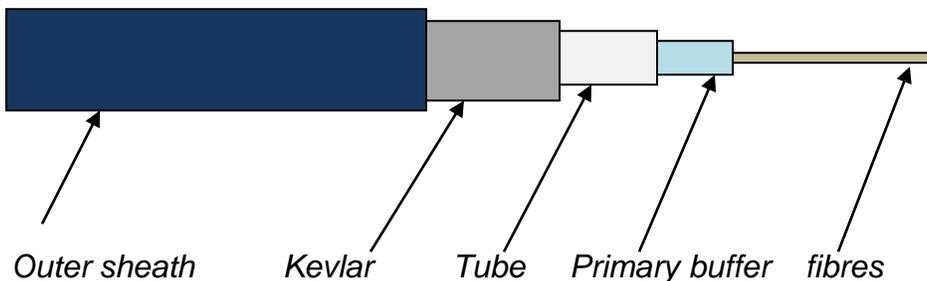


17: Fire – Proof or FP cable is fire resistant and may be used where mechanical protection is required without secondary containment. **Task:** Label the parts shown in the illustration



18: Fibre Optic cable is used for data transmission and electrical signals that need to be protected from electro-magnetic interference. The ‘conductor’ consists of a very fine glass fibre through which energy, in the form of light, is passed. (*There is no solid copper or aluminium conductor and therefore current, as we understand it will not pass through this type of cable*).

Task: label the illustration for a single –core fibre optic cable



Summary of Cable facts:

Conductor:

Usually made from copper and arranged in solid, stranded or multi-stranded format for a range of cross – sectional – areas.

Insulation:

This is the protective covering surrounding a conductor.

Insulation is usually polyvinyl chloride, (PVC), synthetic rubber or silicon rubber.

Sheath:

This provides the basic protection against electric shock and a mechanical protective layer for the conductors.

Twin and Three – core ‘flat’ cable:

Twin & Earth cables have an over – covering of PVC that provides mechanical protection for the separately insulated line and neutral conductors and the bare circuit protective conductor. This cable is a composite cable insofar as it can be clipped direct to a surface without additional protection or mechanical containment.

Special cables:

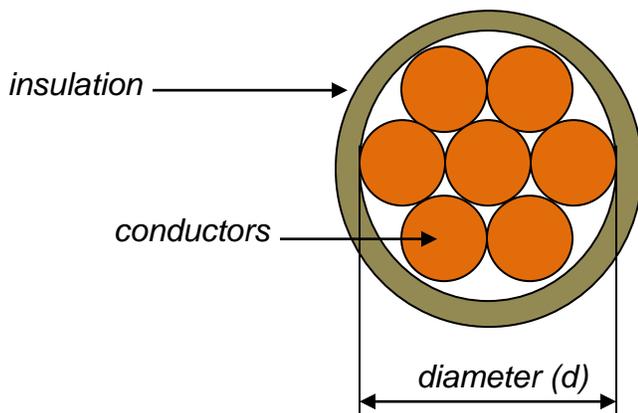
PVC SWA, FP and MICC are composite cables and can be installed using proprietary clips or cleats and cable-ties without the need for secondary containment.

Page 30 - Electric Cables

(Covering Outcome 4 of Unit 309 'Understand the relationship between resistance, resistivity, voltage, current and power' (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent))

Science and Principles:

All cables are identified by the cross - sectional - area of the conductor and not the overall cross – sectional – area of the cable.



The cable size in mm^2 is the total area of the conductors.

To determine the cross-sectional-area, (c.s.a.) of a cable it will be necessary to measure the diameter of the conductor.

Measurement can be made using a ruler, callipers and ruler, or a micrometer

Question 1:

Which one of the instruments listed above provides the most accurate result?

The micrometer

How to calculate the c.s.a:

To calculate the c.s.a having accurately measured the **diameter** of the conductor, it will be necessary to apply a formula.

One of two formulae can be used:

i. $\text{Area (a)} = \frac{\pi d^2}{4}$

ii. $\text{Area (a)} = \pi r^2$ Note: the diameter must be halved for this formula

Try these problems:

Question 2:

A conductor has a diameter of 1.78mm what is the c.s.a.?

i.
$$\text{Area (a)} = \frac{\pi d^2}{4}$$
$$a = \frac{3.142 \times 1.78^2}{4}$$
$$a = 2.5\text{mm}^2$$

Question 3:

A cable has a radius of 1.38mm, what is the c.s.a?

ii.
$$\text{Area (a)} = \pi r^2$$
$$a = 3.142 \times 1.38^2$$
$$a = 6.0\text{mm}^2$$

Manipulating formula:

It may be a good idea to practice manipulation or transposing formulae at this stage:

Worked example 1:

A cable has a c.s.a of 10mm² what is the cable diameter?

We could use either formula, but let's keep things fairly simple:-

Using formula (ii) $\text{Area (a)} = \pi r^2$

Remember we are looking for the diameter so the answer will need to be doubled so the formula can be adjusted as shown:

1st rearrange the formula to make r^2 the subject:

$$\frac{a}{\pi} = \frac{\pi r^2}{\pi} \text{ divide by } \pi \text{ on both sides of the equal sign}$$

Next rewrite the formula the right way round

$$r^2 = \frac{a}{\pi}$$

Finally to remove the (2) from r² square – root the opposite side like this:-

$$r = \sqrt{\frac{a}{\pi}}$$

So

$$r = \sqrt{\frac{a}{\pi}} = \sqrt{\frac{10}{3.142}} = 1.78\text{mm} \times 2 = \text{a diameter of } \underline{\underline{3.57\text{mm}}}$$

Worked example 2:

Rearrange formula (i) and make **d** the subject.

i. $a = \frac{\pi d^2}{4}$

Multiply both sides of equal sign by 4

$$a \times 4 = \frac{\pi d^2}{\cancel{4}} \times 4$$

Now divide both sides by π

$$\frac{a \times 4}{\pi} = \frac{\cancel{\pi} d^2}{\cancel{\pi}}$$

Next rewrite the formula the right way round

$$d^2 = \frac{a \times 4}{\pi}$$

Finally remove the square from d and square-root the opposite side

$$d = \sqrt{\frac{a \times 4}{\pi}}$$

Try this:

A conductor has a c.s.a of 4.0mm² what is the conductor diameter?

$$d = \sqrt{\frac{a \times 4}{\pi}}$$

$$d = \sqrt{\frac{4 \times 4}{3.142}}$$

$$d = \sqrt{5.0}$$

$$d = 2.26\text{mm}$$

Page 34 - Steel containment systems

(Covering Outcome 4 of Unit 304 'Understand the types, applications and limitations of wiring systems and associated equipment' (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent)

Identify the correct name for each of the following steel cable containment systems and suggest one application:

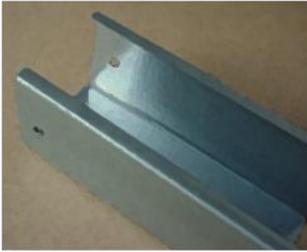
1



Cable basket

Supporting multi-core cables; for inside use

2



Galvanised steel trunking (*no lid shown*)

Enclosing single and multi-core cables; for inside use

3



Galvanised heavy duty cable tray

Supporting PVC SWA cables; for inside or outside use

4



Black enamel steel conduit (*Seam welded*)

Enclosing single insulated cables; only for use indoors in dry, corrosion free environments

Page 36 - Practice multiple-choice questions for wiring containment

(Covering Outcome 4 of Unit 304 'Understand the types, applications and limitations of wiring systems and associated equipment' (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent))

No 1	20mm, 25mm and 32mm are diameters of	Answer
a	Standard power cables	
b	Standard conduits	X
c	Ducting	
d	MICC cables	

No 2	Stainless steel, galvanised and enamel are surface finishes for	Answer
a	Conduit, trunking and cable tray	X
b	Conduit only	
c	Trunking only	
d	Cable tray only	

No 3	The cable capacity rating for a conduit allows for	Answer
a	Additional cables to be installed at a later date	
b	Expansion of cables when in use	
c	Sufficient cable temperature rise without damage	
d	Circulating air space allowing cables to shed heat in use	X

No 4	Joints in trunking, cable tray or metal ducting will require	Answer
a	Sufficient set-screws and nuts to secure the joint	
b	The ends of the containment to be pushed together	
c	Protective bonding straps across each joint	X
d	Labels to indicate the position of the joint	

No 5	The accessory used to join lengths of metal conduit is a	Answer
a	Connector	
b	Screwed sleeve	
c	Joiner	
d	Coupler	X

No 6	The device used to prevent undue strain on cables in a vertically mounted trunking is a	Answer
a	Clamp	
b	Pin - rack	X
c	Support block	
d	Off-set	

No 7	The best practice method for connecting fixed metal conduit to a motor terminal box is	Answer
a	PVC SWA	
b	PVC conduit	
c	Direct connection of the conduit with the box	
d	Flexible conduit	X

No 8	Which one of the following containment systems may be used to support fluorescent luminaires?	Answer
a	Trunking	X
b	Cable tray	
c	Conduit	
d	Ducting	

No 9	Spacer-bar, distance and hospital, are all types of	Answer
a	Conduit	
b	Trunking support mechanisms	
c	Saddle	X
d	Support bracket	

No 10	Which one of the following wiring systems requires the introduction of fire barriers where it penetrates floors or ceilings?	Answer
a	Conduit 25mm and above	
b	Trunking with an area of over 710mm ²	X
c	Cable tray	
d	Cable basket	

No 11	Cable basket is designed to support all of the following cable types except	Answer
a	Single PVC insulated cables	X
b	PVC SWA	
c	PVC insulated MICC	
d	CAT 5 data cable	

No 12	A running – coupler is sometimes used in	Answer
a	PVC conduit systems	
b	Trunking installations	
c	Underground ducting	
d	Steel conduit installations	X

Page 38 - Selecting and using power tools

(Covering Unit 305 'Understand the procedures for selecting and using, tools, equipment...' (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent))

The following questions concern the selection and use of power tools. It may be necessary to refer to the Health & Safety at Work Act 1974, Management of Health & Safety at Work Regulations 1999, and other resources as may be helpful.

Question 1:

What is the requirement for an employee regarding his/her employer when using or about to use power tools?

HSAWA:

Employees must co-operate with their employers and take care of themselves and of others who may be affected by their actions.

MHSAWR

Employees must use equipment properly and report dangerous situations to their supervisor

This includes receiving instructions from the employer on the safe use of power tools.

Question 2:

Hand-held power tools can also be referred to as?

Portable electrical equipment

Question 3:

The majority of reported accidents involving the use of portable electrical equipment are most likely to be?

Electric shock

Question 4:

Identify four reasons why portable electrical equipment may develop a fault

- Damaged
- Misused
- Lack of maintenance
- Incorrect power tool for the environment in which it is used

Another could be:

- *Use of unauthorised equipment*

Question 5:

You have been issued with a new electrically operated drilling machine by your employer, what do you need to do before using it?

- Check that it is in good condition and not damaged (*casing, leads and plug*)
- Ensure it is suitable for the work to be undertaken (*Is it the correct voltage rating for the work-site*)
- Make sure you understand how to use it (*Ensure you have had suitable training in the use of this equipment*)

Question 6:

You are about to use an electrically operated chasing machine that is approximately two years old, what checks will you need to carry out before using it?

- Check the casing for any damage (*visible cracks or missing covers*)
- Check the lead for damage (*damaged outer sheath, exposed cores, exposed conductors*)
- Check the lead is suitably secured into the equipment and the plug
- Check that the switches operate correctly
- Ensure the equipment is the correct voltage rating

Question 7:

Portable electrically operated equipment used on construction sites must be what voltage rating?

110V a.c (55V ac to earth) or less

Question 8:

List five examples of portable electrically operated equipment that may be found on a large construction site?

- Drilling machine
- Chasing machine
- Rotary saw
- Jig - saw
- Hand-lamp

Question 9:

Identify the **three** main colours used to identify voltages of plugs and socket-outlets on a construction site.

- 110V Yellow
- 230V Blue
- 400V Red

Question 10:

Identify **four** items of 110V electrical power distribution equipment that may be found on a large construction site.

- Supply intake unit (SIU) – *this is the point at which the mains public supply or generator supply is connected to form the site distribution*
- Main distribution unit (MDU) – *this is normally adjacent to the SIU and is the distribution point from which 110V / 230V or 400V supplies to equipment or outlet units are fed from. The MDU will contain circuit-breakers for the outgoing circuits)*
- Outlet unit (OU) – *this is the unit from which electrically operated equipment may be connected via the colour coded plugs and sockets to BS EN 60309-2. Circuit – breakers may be provided to protect each outlet at this unit).*
- Extension outlet unit (EOU) – *this is an extension outlet containing one or more BS EN 60309-2 outlets, no circuit-breakers are located in the EOU)*

Page 40 - Electricians Hand tools

Identify the correct name of each tool:



Flat – blade

Terminations and other fixing devices



Combination pliers

Gripping, twisting, bending and cutting cable or wire
Flat and circular gripping points
Parallel cutting edges



Wire strippers

Adjustable cutting - notch that fits over cable insulation with a twisting and pulling motion the insulation is cut and pulled off of the conductor



Wire strippers

Combination of wire strippers and crimping tool for cable lugs



Wire strippers / crimpers

Cutting cable or wire
Parallel cutting edges and crimping facility for small lugs



Side cutters

Cutting cable or wire
Parallel cutting edges



Cross-head or 'posidriv'

General fixing devices



Long-nose pliers

Gripping and cutting

Used in crowded electrical control panels where access to parts may be restricted

Page 42 - BS7671:2008 Requirements for Electrical Installations incorporating A3: 2015

(Covering Outcome 7 of Unit 304 'Know the regulatory requirements which apply to installation of wiring systems, associated equipment and enclosures' (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent)

The third amendment to BS7671: 2008 Requirements for Electrical Installations came into effect on 1st July 2015; this means that all installations designed from this date must comply with BS7671: 2008 incorporating Amendment 3: 2015.

Task requirements:

The following tasks will require you to have access to BS7671: 2008 + A3 2015

◀ Task 1: Finding specific regulations

Complete the following table giving a brief description of the Regulation.

Regulation number	Description of the Regulation
134.1.1	Good workmanship , proper materials used, and account taken of manufacturers' instructions Page 21
332.1	Electrical equipment to meet appropriate EMC requirements Page 49
424.1	Protection against overheating of forced air systems, space heating and appliances producing hot water or steam Page 80
512.1.5	Compatibility of electrical equipment with other equipment Page 11

521.11.201	Wiring systems in escape routes Page 127
557.1	Auxiliary circuits scope Page 180

◀ Task 2: Application of BS7671: 2008 +A3

The Regulations do not apply to all situations in which electrical systems are installed. For each of the following consider whether BS7671 applies or not and complete the table using ticks or crosses

Example	Yes	No
A veterinary practice	✓ 710.1 Note 2	
Electric vehicle charging station at a supermarket	✓ 110.1.1(xxxiii)	
Life safety and firefighting applications	✓ 110.1.3 (x)	
Lightning protection systems for buildings and structures		✓ 110.2 (ix)
Permanent electric fences erected in a dairy farm		✓ 110.2 (xii)

◀ Task 3: Use of Appendices & Tables

For each question complete the answer and state the reference and page it can be found on.

Question	Answer	Table reference / Page No:
1) BS951:2009 concerns?	Specification of earthing / bonding clamps	Appendix 1 Page 297
2) The permitted voltage tolerance for a public 230V supply is?	+ 10% / - 6%	Appendix 2 Page 316
3) The C _{min} factor for a low voltage supply to ESQCR 2002 is?	0.95	Appendix 3 Page 317
4) The fault current to achieve a 0.4 second disconnection time for a 400A BS 88-2, fuse to	5000A	Appendix 3 Table 3A3(c) Page 324

system E is?		
5) A 25mm ² , multicore SWA with 70°C thermoplastic insulation installed to Method C supplying a d.c load has a rating of?	118A	Appendix 4 Table 4D4A Column 2 Page 362
6) The equation used to determine a Zs maximum <u>measured</u> value is?	$Z_s = 0.8 \times \frac{U_o \times C_{min}}{I_a}$	Appendix 14 Page 452

◀ Task 4: Symbols used in BS7671

Complete the following table of symbols and their meanings

No	Symbol	Meaning	Page reference
1	C	Rating factor - general	Page 38 left column
2	I _n	Rated current or current setting of a protective device	Page 38 right column
3	mV/A/m	Voltage drop per ampere per metre	Page 39 left column
4	U	Voltage between lines	Page 39 left column
5	U ^{oc}	Open-circuit voltage	Page 39 right column
6	Z _s	Earth fault loop impedance	Page 39 right column