

HAND TOOLS AND FILES

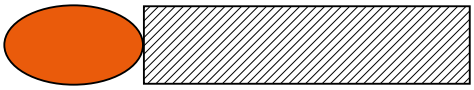
Complete the following questions.

Apart from the generally accepted hand-tools such and pliers, screwdrivers and stripping knife, etc... an electrician will also need a hammer, hacksaw, engineers square, marker and a range of files.

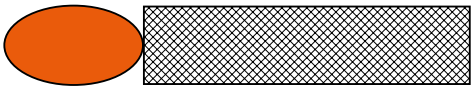
The following tasks refer to files, the various types available and the care needed to ensure they last you a long time.

TASK 1 Identify each of the following files.

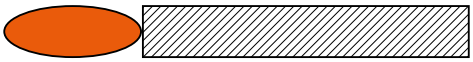
Answers:



SINGLE-CUT FLAT FILE



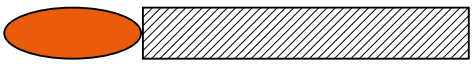
DOUBLE-CUT OR CROSS-CUT



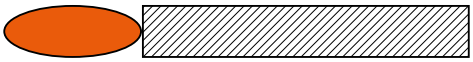
THREE-CORNER OR TRIANGULAR



ROUND OR RAT TAIL



SQUARE



HALF-ROUND

TASK 2 By using two examples describe the purpose of a file.

Answer 1: A file is used to remove excess metal using a physical action. For example the removal of burrs from the cut ends of conduit, trunking and cable tray.

Answer 2: If for example the cut edge of the section of steel trunking is uneven a flat file can be used to remove unwanted metal and thereby make the edge level or straight.

TASK 3 Identify three different surface finishes of flat files.

Answer 1: Rough; these files have very course teeth that are cut across each other and are designed to remove large quantities of material.

Answer 2: Second cut files have teeth cut one way only and are designed to cut equal layers of material with the result the finish is generally smoother than that of the rough cut file.

Answer 2: A smooth file will have shallow cut teeth compared to the other files mentioned above, the resulting cut is a smooth fine finish to the work-piece.

TASK 4 Give two ways in which a file could be damaged.

Answer 1: Files are made from high carbon steel that is heat treated and becomes very hard and brittle. A file can easily be broken if handled incorrectly. Excessive pressure, twisting or levering the file is likely to result in it snapping.

Answer 2: If a file is in contact with another hardened surface the teeth will be damaged. This can occur if files are stored together in a tool-box without protection.

TASK 5 Sometimes the teeth of a file become clogged with metal particles, (swarf); briefly explain how a file can be cleaned and any precautions that must be taken in this procedure.

Answer: To clean out the swarf a tool called a file – card may be used. Alternatively a stiff wire brush can be just as effective. NOTE: Always wear eye protection when performing this task as small metal particles can fly-upwards.

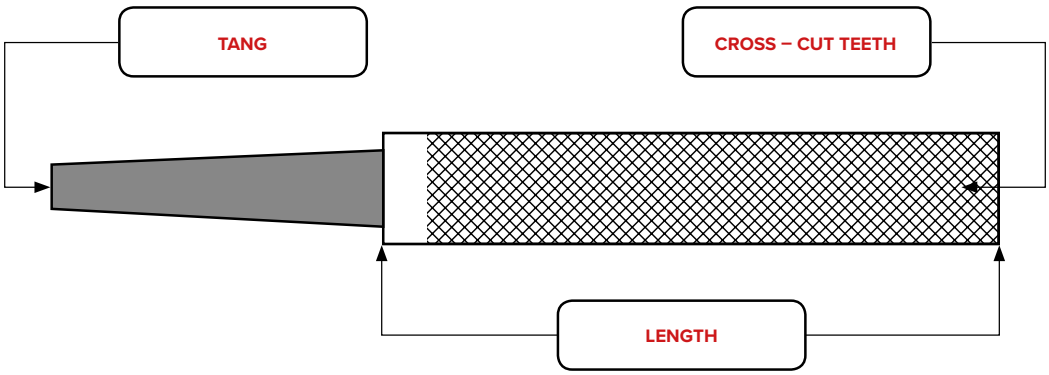
TASK 6 Suggest three safety observations that should be adopted when using hand - files.

Answer 1: Never us a file without a handle, if the file jambs on the forward stroke the sharp pointed end, called the' tang' is liable to push into your wrist.

Answer 2: If a handle comes off it is best to fit a new one, if this is not possible then try to reuse the old handle but follow the same procedure as fitting a new one.

Answer 3: Never use a broken or blunt file

TASK 7 Label the following diagram of a flat file.



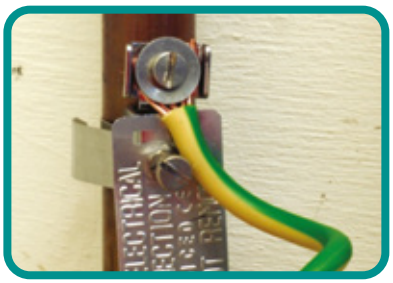
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ELECTRICAL TERMINATIONS

The following exercise concerns cable termination methods for earthing conductors.

In each case examine the image and decide if the method of termination or preparation for termination is correct or not.

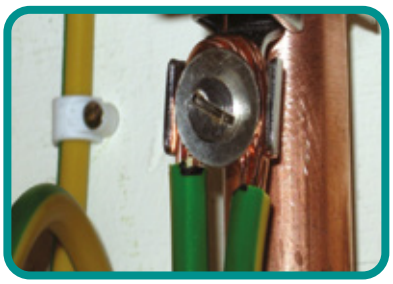
Q1 This is a correct termination?



Yes or No: No

Reason: This termination is incorrectly connected because the conductor strands have been divided so there are four strands one side and three strands the other of the terminal screw, this will result in uneven clamping of the conductor; the termination may loosen over time.

Q2 This is a correct method of termination?



Yes or No: No

Reason: This is an example of a correctly terminated conductor with an equal number of strands each side of the terminal screw.

Q3 The protective bonding conductor is correctly terminated at each clamp?

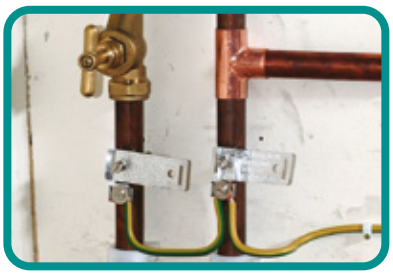


Yes or No: No

Reason: This is incorrect because the protective bonding conductor is not correctly terminated at either bonding clamp. The terminal screws are not clamping the conductors in the manner BS951 requires them to be installed for mechanical integrity.

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Q4 This is an example of terminating a protective bonding conductor to a mains gas and water service. Is it correct?



Yes or No: No

Reason: This installation appears to be correctly installed with a single protective conductor used and the gas bond made before the branch pipework. However, the water service bond is the wrong side of the stop-tap.

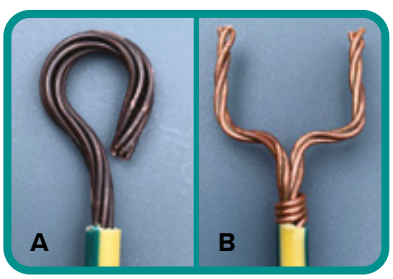
Q5 Each cable has a crimped lug fitted and shows an example of correct termination. Is this correct?



Yes or No: No

Reason: Incorrect, although a suitable crimped lug is attached to each cable, the protective bonding is not continuous as recommended in BS7671:2018.

Q6 Both cable ends have been prepared for termination to a pillar type terminal secured using nut and washers. Are these correct?



A. Yes or No: Yes

B. Yes or No: No

A. Reason: Yes because all conductor strands will be in contact with the termination and all the strands will provide an even mechanical pressure to be obtained when the terminal nut is tightened onto the washer.

B. Reason:

DID YOU KNOW?

BS951 clamps are used for connecting main and supplementary bonding conductors to metallic pipes such as gas and water services.

Covering: Unit 204 Terminate wiring systems (Level 2 2365-02 Diploma in Electrical Installations Buildings & Structures and the EAL equivalent.

Covering: Unit 305 'Electrical System Design' (Level 3 2365-03 Diploma in Electrical Installations Buildings & Structures and the EAL equivalent.

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CABLE SELECTION

The following two case studies can be worked on in pairs. You will need access to BS7671:2018, for this exercise.

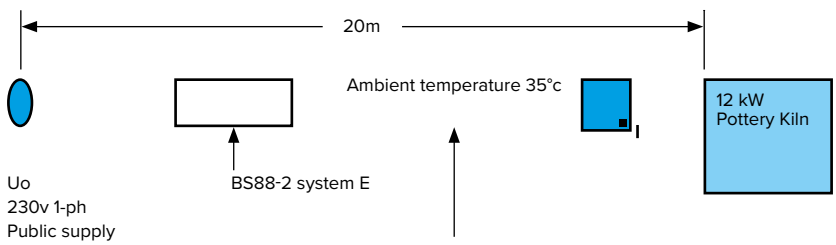
Case study 1:

A single-phase 230V, 12kW pottery kiln is installed in a workshop / studio. The kiln is 20m from the main supply distribution board and can be isolated from the 80A isolator. The main switch-fuse contains BS88-2 HRC fuses.

The circuit is to be wired in PVC SWA clipped direct to the studio wall throughout its length.

The ambient temperature is not expected to rise to more than 35°c

Final circuit requirements can be summarised as shown below:



70°c PVC, thermo-plastic multicore armoured cable clipped direct

Question: Determine the rating of a suitable PVC SWA cable to supply this load.

Answer:

Ib	52.2A
In	63A

Factor

Ca	0.94
Cg	N/A
Ci	N/A
Cf	N/A

Table Reference (BS7671)

Cable installation reference method B Table 4A2 No: 5

Total rating factor: Current Carrying Capacity of cable required: (It)

C = **Ca** ~~x Cg x Ci x Cf~~ Only Ca applies

It = In / C

It = 63 / 0.94 = 67A

Cable size

Table No	4D4A
Column	2
Current rating	67A
Cable size	10.0mm²

Voltage drop

Table No	4D4B
Column	3
Voltage drop	4.4m V/A/m

Actual Voltage drop (AVD) = mV/A/M x Ib x Length of circuit (L) / 1000

= 4.4 x 52.2 x 20 / 1000 = 4.6 V

(Cable size will be suitable as the permitted voltage drop allowed is 5% or 11.5V when nominal supply voltage is declared to be 230V. In this case the voltage drop is 4.6V)

Case study 2:

A 3-phase 400V 25kW 0.75pf induction motor is to be installed to drive a water pump. The motor and its control panel is 45m from a distribution board located in a switch-room. The motor control panel including isolator is located alongside the motor / pump assembly.

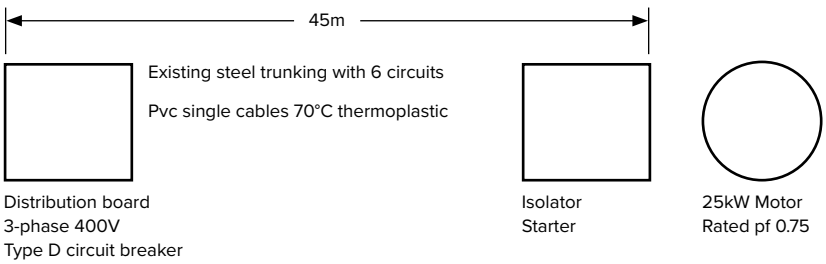
The new circuit is to be wired in 70°C thermoplastic insulated single copper cables utilising an existing steel trunking containing six other circuits. A new galvanised steel conduit is to be terminated into the trunking at the motor location – no other circuits will pass through the conduit other than the motor circuit.

A three-phase Type D circuit breaker is to be installed at the distribution board.

Question: Determine the size of a suitable cable to supply this new pump motor

Answer:

Summarise the new circuit requirements using a drawing.



Motor current rating:

$$IL = \frac{P}{\sqrt{3} \times UL \times pf}$$

$$IL = \frac{25000}{1.732 \times 400 \times 0.75}$$

IL = 48A

Now complete the stages of cable selection:

Ib	48A
In	50A

Factor		Table Reference (BS7671)
Ca	N/A	
Cg	0.54	
Ci	N/A	
Cf	N/A	

Cable installation reference method	**B** Table 4A2 No: 4 & 6

Total rating factor: Current Carrying Capacity of cable required: (It)

C = ~~Ca~~ x Cg x ~~Ci x Cf~~ (Only Cg applies)

$$\textbf{It} = \frac{\textbf{In}}{\textbf{C}} \quad It = \frac{50}{0.54} = 93A$$

Cable size

Table No	4D1A
Column	5
Current rating	110A
Cable size	35.0mm²

Voltage drop

Table No	4D1B
Column	6
Voltage drop	1.10mV/A Inductive

Actual Voltage drop (AVD) = $\frac{\text{mV/A/M x Ib x Length of circuit (L)}}{1000}$

$$= \frac{1.10 \times 48 \times 45}{1000} = 2.38V$$

(Cable size will be suitable as the permitted voltage drop allowed is 5% or 20V when nominal supply voltage is declared to be 400V. In this case the voltage drop is 2.38V)

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ON-SITE GUIDE

How well do you know the On-Site Guide BS 7671:2018+A2:2022?



REVISION GUIDE PROVIDED BY WAYNE TIMMINS
Electrical Lecturer at Lincoln College

Test your knowledge by filling in the answers to these questions. We have answered the first three questions for you.

Q1 Where would you find a list of the building regulations applicable to England?

Answer: Building regulations 1.2 page 14

Q2 Where would you find information concerning clip spacings for 2.5mm2 flat cable?

Answer: Spacings of supports for cables in accessible position Table D1 page 156

Q3 Where would I find information on the use and application of armoured cables?

Answer: Applications of cables for fixed wiring Table C1 page 148

Q4 What table would you use to determine the factor for 100 x100mm trunking?

Answer: Factors for trunking Table E6 page 166

Q5 Where would you find information regarding the rated short-circuit capacities of circuit-breakers?

Answer: Table 7.2.7(ii) page 89



Q6 Where would you look for information on surge protective devices?

Answer: Surge protective devices (SPDs) 3.7 page 42

Q7 What table would you use to help you calculate diversity on a cooker circuit?

Answer: Allowances for diversity Table A1, A2 page 136

Q8 Where would you find the maximum length of a circuit using flat PVC cable?

Answer: Maximum cable length Table 7.1 page 75

Q9 Which table would provide you with information on an installation reference method for cables clipped direct?

Answer: Installation reference methods Table 7.1(iii) pages 84

Q10 Where would you find information on the number of non-fused spurs connected to a final circuit?

Answer: Standard final circuits 7.2 page 86

Q11 Where would you find material on the subject of supporting cables to prevent the premature collapse in the event of a fire?

Answer: Wiring systems in escape routes 7.11 page 101

Q12 Which table would provide you information about supports for cable trunking?

Answer: Spacings of supports for trunking Table D4 page 158

Q13 Where would you find the information on an IP rating of IPXXB?

Answer: Degrees of protection provided by enclosures (IP code) Appendix L page 233

Q14 Where is the information you need to decide on the spacing of supports for conduits?

Answer: Spacings of supports for conduits Table D3 page 158

Q15 Which table will provide you with a rating factor for the ambient air temperature?

Answer: Rating Factors Ca Table F1 page 168

Q16 Which table would you use to find the factor for cables grouped closely together?

Answer: Rating factor Cg Table F3 page 170

Q17 What table stipulates the minimum bend radius of cables?

Answer: Minimum internal bend radii of bends in cables for fixed wiring Table D5 page 159

Q18 Which table would you use to find out the cable factor of 8 2.5mm² stranded cables in a 2m straight run of conduit?

Answer: Cable factors for use in conduit in short straight runs Table E1 page 162

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SPARKS

AUTUMN 2022 P29 ANSWERS

P29 QUICK QUIZ

1. What 2 principles do protective devices operate on?

Answer: Magnetic and heat

2. What is the basic reason for installing protective devices?

Answer: To protect the Installation from Overloads and short circuits

3. What is it called when the fuse nearest a fault operates leaving other fuses intact?

Answer: Discrimination

4. What type of circuit-breaker would be selected for high inductive loads?

Answer: Type D

CIRCUIT PROTECTION

Answer the following short answer questions in pairs. You can refer to BS7671:2018 to help you answer the questions.

Covering: Outcome 2 & 3 of Unit 304 (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent.

Q1 Identify **two generic types** of protective device used in an electric circuit.

1. **Answer:** Fuse
2. **Answer:** Circuit breaker

Q2 State **three types** of fuse found in some commercial electrical installations.

1. **Answer:** emi-enclosed or rewirable to BS3036
2. **Answer:** Cartridge to BS88-3 – fuse system C
3. **Answer:** HRC or HBC to BS88-2 – fuse systems E and G

Q3 State the circumstances that may result in:

1. a circuit protective device operating instantaneously
2. a circuit protective device operating slowly

1. **Answer:** Instantaneous operation is caused by a short circuit fault
2. **Answer:** Slow operation can be caused by an overload

Q4 What is the term used to describe the reason for a circuit protective device to operate in a live circuit?

Answer: The term 'over-current' describes the reason for a circuit protective device to operate

Q5 Suggest **two reasons** for an overload to occur in an electric circuit.

1. **Answer:** Too many electrical loads connected in a single circuit
2. **Answer:** Too much mechanical demand from an electrical appliance, such as overfilling a washing machine so the motor is unable to drive the drum effectively

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Q6 If a low resistance, e.g. 0.01Ω, exists between the live conductors of a three-phase 400V electrical circuit, what will the result be?

Answer: A short circuit will occur, resulting in the operation of the circuit protective device

Q7 State the difference between a residual current device (RCD), and a residual current circuit breaker (RCBO).

Answer: The RCD provides protection against earth leakage faults. It is not designed to protect against short-circuit or overload faults. The RCBO is designed to protect against earth leakage as well as short circuit and overload faults.

Q8 Identify the following symbols and state how they relate to the coordination between a circuit conductor and its overload protective device.
Symbols: (In); (Ib); (Iz) and (I2).

In.	**Answer:**	Rated current or current setting of a protective device	**In.**	**Relationship:** In must not be lower than Ib
Ib.	**Answer:**	Design current of a circuit	**Ib.**	**Relationship:** In must not be greater than the lowest current carrying capacity Iz of any circuit conductors
Iz.	**Answer:**	Current carrying capacity of a conductor	**Iz.**	**Relationship:** I2 must not exceed 1.45 times the lowest current carrying capacity Iz of any conductors of the circuit
I2.	**Answer:**	Current causing effective operation of the protective device	**I2.**	**Relationship:** (See Regulation 433.1)

Q9 A circuit-breaker designed to provide overload and short circuit protection in an electric pump motor circuit is found to intermittently operate. This occurs when the motor is started. Suggest the most likely cause of this fault.

Answer: The most likely cause is the circuit breaker installed is the wrong type. (Types B, C and D can be specified), it is likely a Type B is installed rather than a Type C or D therefore the starting current of the motor exceeds the operating current of the device and it will trip

Q10 For each of the following electric circuits determine the load current (Ib) and then state the current rating (In) for a suitable circuit breaker to protect the circuit.

1. A 230V single-phase radial circuit supplying a 6kW electric heater protected by a Type–B circuit-breaker.

Answer: Ib = P ÷ Uo Ib = 6000 ÷ 230 Ib = 26A
In = 32A nearest rating (Fig: 3A4 Appendix 3 BS7671:2018)

2. A 400V 3-phase distribution circuit supplying an industrial pottery kiln rated at 25kW protected by a Type–B circuit–breaker.

Answer: IL = P ÷ √3 U IL = 25000 ÷ √3 x 400 IL = 36A
In = 40A nearest rating (Fig: 3A4 Appendix 3 BS7671:2018)

3. A three-phase distribution circuit supplying a 30kW, 400V 3-phase electric air-conditioning plant with a claimed power factor (pf) of 0.85 lagging, protected by Type-C circuit-breakers.

Answer: IL = P ÷ √3 UL pf IL = 30000 ÷ √3 x 400 x 0.85 IL = 51A
In = 63A nearest rating (Fig: 3A5 Appendix 3 BS7671:2018)

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TEST YOUR KNOWLEDGE
HEALTH & SAFETY



HEALTH AND SAFETY FIRST

REVISION GUIDE BY MIKE DAVIES
Electrical Lecturer and Training Consultant

Although electrical work can be incredibly rewarding it can also be hazardous to those who lack health and safety knowledge.

The following quiz has been provided by Mike Davies, who has been working in the industry since the 1970s. Test your health and safety knowledge and see how well you do at his quiz.

Covering: Unit 301 'Understand Health & Safety legislation, practices and procedures...' (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent).

"MAKE SURE YOU KNOW YOUR HEALTH & SAFETY FOR YOUR EXAMS"



Q1	The statutory Health & Safety at Work Act 1974 applies to which one of the following groups?	Ans.
A	Employers only	
B	Self- employed persons only	
C	Maintenance staff in medical locations	
D	Employers, employees and self-employed persons	✗

Q2	An employer does not have to provide an employee with which one of the following?	Ans.
A	Hard hats on construction sites	
B	Operatives hand tools for their specific trade	✗
C	Suitable guards for angle grinders	
D	Operatives eye protection	

Q3	The recommended maximum voltage to earth for hand-held electrical equipment used on a construction site is?	Ans.
A	400V	
B	230V	
C	110V	
D	55V	✗



Q4	On a construction site a prohibition sign indicates?	Ans.
A	What must not be done	✗
B	What must be done	
C	Danger	
D	Applicable general information	

Q5	The Electricity at Work Regulations 1989 is classed as which type of document?	Ans.
A	Guidance document	
B	Statutory document	✗
C	Non-statutory document	
D	Guide to best practice	

Q6	The letters SWL located on the side of lifting equipment represents which one of the following?	Ans.
A	Safe working limit	
B	Safe working level	
C	Safe working load	✗
D	Safe working lights	

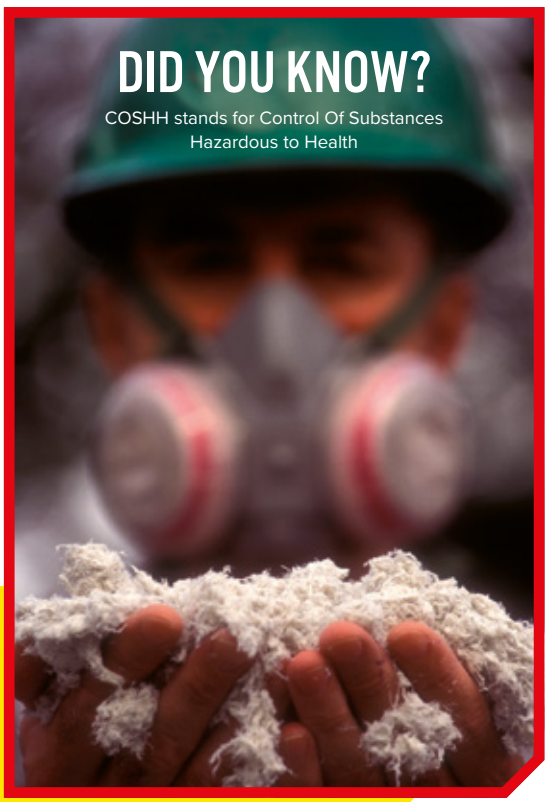
Q7	The colours used in a fire exit sign are?	Ans.
A	White on green	✗
B	Green on white	
C	Red on white	
D	White on red	

Q8	Which of the following statements best describes the term 'Hazard'?	Ans.
A	Something with the ability to cause harm	✗
B	Something likely to go wrong	
C	An accident waiting to happen	
D	A location where an accident will happen	

Q9	PASMA is the lead body and authority for matters relating to which of the following?	Ans.
A	Platforms	
B	Step-ladders	
C	Fixed scaffolding	
D	Mobile access towers	✗

Q10	The HSE inspector can issue which one of the following?	Ans.
A	An improvement notice	✗
B	Court summons	
C	Press release in the event of a serious accident	
D	On the spot fines	

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SAFETY SIGNS

It's time to test your knowledge of safety signs, something you'll see a lot of on construction sites in particular.

Name the four categories of safety signs:

1. PROHIBITION
2. WARNING
3. MANDATORY
4. EMERGENCY ESCAPE OR FIRST AID

Label each safey sign illustrated below:



1 EYE PROTECTION MUST BE WORN



2 EAR PROTECTION MUST BE WORN



3 WASH YOUR HANDS



4 NO CHILDREN ALLOWED



5 DO NOT USE AEROSOLS



6 DO NOT USE LADDER



7 CORROSIVE



8 HIGH NOISE LEVEL



9 FLAMMABLE MATERIAL OR HIGH TEMPERATURE

SPARKS

AUTUMN 2022 P41 ANSWERS

P41 WORD SEARCH: HEALTH AND SAFETY

Answers:

