SPARKS – WINTER 2022

EXERCISES ANSWERS:

P40

Special Locations:

(Covering Unit 605 (Level 3 NVQ Diploma in Installing Electro-Technical Systems and Equipment 2357-13 / 91 or EAL equivalent)

True or False:

For each statement related to a **special location** decide if the answer or statement is true or false. You may need to refer to your notes, text books or Part 7 of BS7671: 2018 Requirements for Electrical Installations

1) The installation of switchgear or electrical accessories is not permitted in zone 0 of a room containing a bath or shower.

701.512.3 Erection of switchgear, control gear and accessories according to external influences

TRUE	✓
FALSE	

2) In a room containing a bath or shower Zone 2 extends 0.5m from the vertical boundary of zone 1?

701.32.4 Description of zone 2 item (ii) states that zone 2 extends 0.6m from the vertical boundary of zone 1

TRUE	
FALSE	✓

3) Prefabricated rooms or cabins containing sauna heaters are not covered by Section 703 Special Installations or Locations?

703.1 Scope

TRUE	✓
FALSE	

4) In a room containing electric sauna equipment and cleaning by use of water jets is likely, the equipment must have a degree of protection of at least IPX4?

703.512.2 External influences The equipment shall have a degree of protection of at least IPX5

TRUE	
FALSE	✓

5) A cable buried in cultivated land on a farm must be installed at a minimum depth of at least 1m?

705.522 Selection and erection of wiring systems in relation to external influences. Paragraph 3 Item (ii)

TRUE	✓
FALSE	

6) The selection and erection of electrical equipment used outside in a caravan park should have a degree of protection of at least IPX3?

708.512.1.1 Presence of water (AD)
States a minimum IPX4 is required

TRUE	
FALSE	✓

7) The length of flexible cable used to connect a caravan to a caravan pitch socket-outlet is 22m (+/- 4m)

708.553.1
Note beneath Figure 708 (page 269)
Typical requirements for cable extension sets
Cable requirements are: continuous length 25m (+/- 2m)

TRUE	
FALSE	✓

8) In a medical location functional extra-low voltage (FELV) shall not be used as a method of protection against electric shock?

710.411.7

TRUE	✓
FALSE	

9) Switches and socket-outlets installed below medical gas outlets supplying oxidizing or flammable gases must be at least **0.1m** from the outlet?

710.512.2.1 Explosion risk
Location of socket-outlets and switches must be at least 0.2m

TRUE	
FALSE	✓

10) In exhibitions, shows and stands, additional protection for final circuits other than for emergency lighting can be protected by an RCD?

TRUE	✓
FALSE	

711.411.3.3 Additional protection.

11) In extra-low voltage lighting installations the use of self-resetting overcurrent protective devices is permitted for transformers up to 50VA

TRUE	✓
FALSE	

715.430.104

12) Overhead electrical distribution cables used in onshore units of electrical shore connections for inland navigation vessels is permitted so long as they are installed no more than 3m from ground level?

TRUE	
FALSE	✓

730.521.101.3.3 Overhead cables – not less than 6m in all areas subject to vehicle movements and 3.5m elsewhere. Overhead cables are not permitted over waterways.

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ELECTRIC CIRCUIT PROTECTION

Electric Circuit Protection:

(Covering Unit 305 (C&G 2365 – 03 Level 3 Diploma in Electrical Installations (Buildings & Structures) or EAL equivalent)

The following questions relate to *electric circuit protection* and *protective devices*

1) State **two types** of electrical fault that may occur in an electrical circuit during operation.

Answer:

A) Open circuit fault. B) Short circuit fault

2) Take the two types of fault identified in question 1 and state the effect the fault will have on the circuit in which it occurs.

Answer:

A) An Open circuit fault results in the circuit failing to function or operate.

B) A Short circuit fault results in a larger than expected current to flow and the operation of the circuit protective device.

3) A circuit protective device may operate instantaneously or it may take some time to operate:

a) State the circumstance that will cause instantaneous operation

b) State the reason for a slow operation of the circuit protective device.

Answer:

A) Instantaneous operation is likely to be caused by a short circuit fault

B) Slow operation can be caused by an overload in the circuit

4) Identify the correct term used to describe the cause for the operation of a circuit protective device in a live circuit.

Answer:

The term **'over-current'** describes the cause for a circuit protective device to operate. As current will be flowing in a 'live' circuit then an over-current can flow when the circuit is live.

5) Suggest reasons why an '**overload'** can occur in a 'healthy' electrical circuit.

Answer:

An overload can occur when too many electrical loads are connected in a single circuit.

Or

Too much mechanical demand is made from an electrical appliance, such as overfilling a washing machine resulting in the motor being unable to drive the drum effectively.

6) A very low resistance, e.g. micro-ohms, between line conductors of a 3-phase circuit or between line and neutral conductors of a single-phase circuit or in an item of electrical equipment connected to a supply, can be described as which type of electrical fault?

Answer: Short - circuit fault.

7) State how the (RCD) and the (RCBO) is designed to protect an electrical circuit?

Answer:

The **RCD** is designed to protect 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, short circuit and overload faults.

8) A circuit breaker providing overload and short circuit protection in a motor circuit intermittently operates when the motor is started and needs to be reset. Suggest the most likely cause of this intermittent operation.

Answer:

The most likely cause is the circuit breaker fitted is the wrong type.

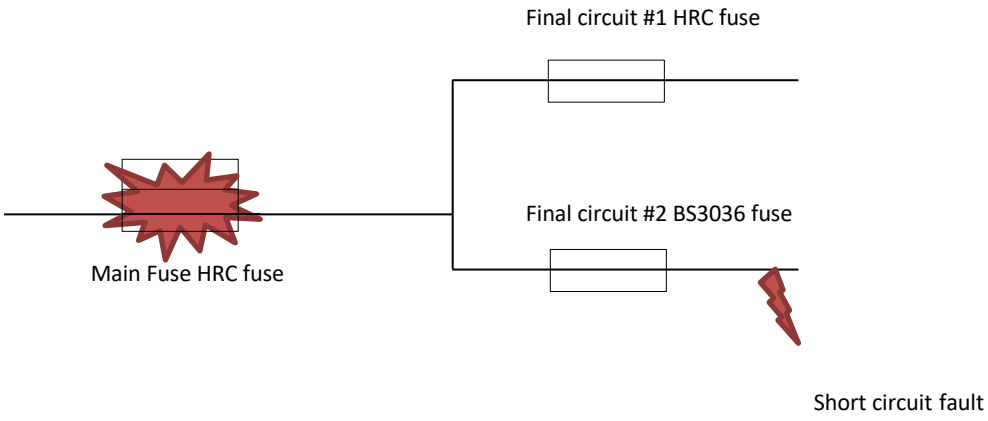
Remember, when a motor is started a larger current is taken for the period of start-up. When the motor has reached near full speed, current falls to the normal running current.

The temporary overcurrent can cause a Type B or, depending on the motor rating a Type C circuit breaker, to operate and therefore cause nuisance tripping.

A Type C or Type D circuit breaker will take longer to operate and therefore the temporary overcurrent is likely to have fallen before it is able to trip.

9) The diagram below shows the arrangement of mixed protective devices in an older industrial electrical installation. It is found that if a fault occurs in final circuit # 2 the main HRC fuse operates.

State the term used to describe this situation.



Answer: Poor discrimination

10) For each of the following electric circuits calculate the load current **(Ib)** and state the current rating **(In)** and **'Type'** for a suitable circuit breaker to protect the circuit supplying the load. *(Refer to the IET BS7671:2018 Appendix 3)*

a) A 230V single-phase **radial circuit** supplying a 4kW electric heater.

Answer:

Ib = P ÷ Uo Ib = 4000 ÷ 230 **Ib** = 17.4A **In** = 20A nearest rating

A **Type – B** circuit breaker will be suitable for this resistive load.

b) A 400V 3-phase distribution circuit supplying an industrial kiln rated at 30kW.

Answer:

I_L = P ÷ √3 U I_L = 30000 ÷ √3 x 400 I_L = 43.3A In = 50A nearest rating

A **Type – B** circuit breaker will be suitable as this is a resistive load.

c) A 400V, 3-phase induction motor with a p.f. of 0.6 and rating of 45kW

Answer:

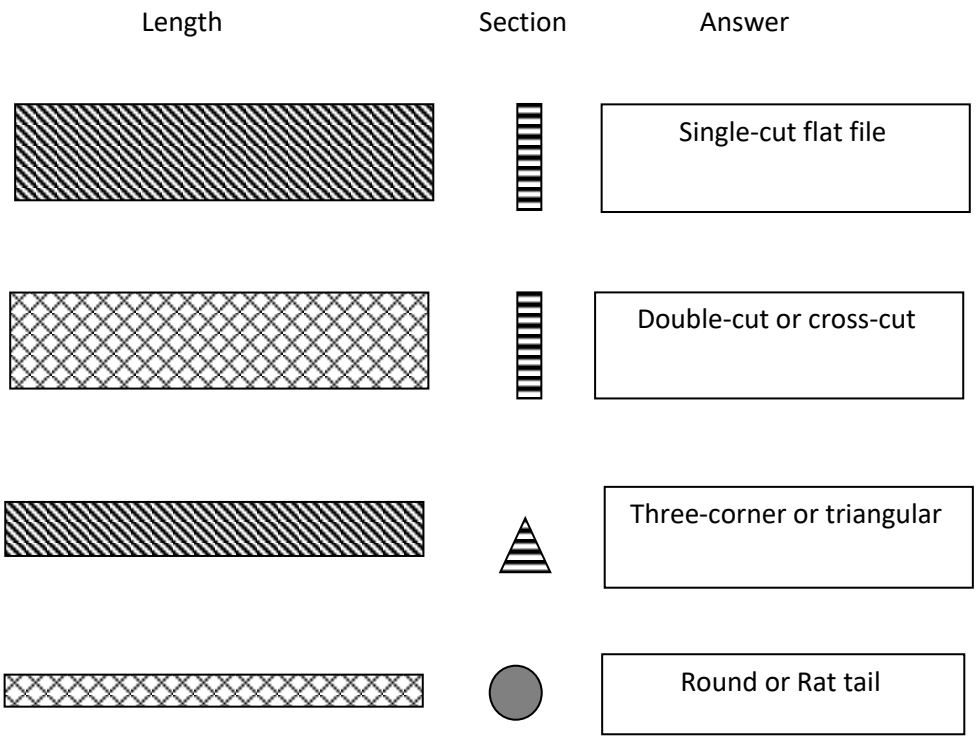
$I_L = P \div \sqrt{3}\ U$ pf $I_L = 45000 \div \sqrt{3} \times 400 \times 0.6$ $I_L =$ <u>108.3A</u> In = <u>125A nearest rating</u>

A **Type – D** circuit breaker will be suitable for this inductive load.

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HAND TOOLS

(Covering Unit 204 (Level 2 Diploma in Electrical Installations (Buildings & Structures) 2365-02)

Question 1: Identify each of the following file surfaces or cuts.



Question 2: Describe the purpose of a hand – file and give examples when it is used in electrical installation work.

Answer:

A file is used to remove excess metal using a physical action.

For example the removal of burrs from cut ends of conduit, trunking, cable tray or ladder rack.

Question 3: Identify **three** different surface finishes obtainable in the flat file range.

Answer:

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

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.

3) **Smooth** files will have shallow cut teeth compared to the other files mentioned above, the result is a smooth fine finish to the work-piece

Question 4: With respect to file care give **two** ways in which a file could be damaged

Answer:

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

When a file is in contact with another hardened surface, such as another file, the surface teeth will be damaged. This can occur if files are badly stored together in a tool box.

Question 5: The teeth of a file can become clogged with metal particles, (called 'swarf'), explain how a file can be cleaned and the safety precautions that must be taken

Answer:

To clean out the swarf from the surface of a file a tool called a **file – card** may be used. (Alternatively a stiff wire brush can be just as effective).

The safety precautions to be taken are to wear eye protection when performing this task as small metal particles can fly-up and make sure the file is held securely – but not in a vice.

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ELECTRICAL SCIENCE & PRINCIPLES

1) A portable convector heater has a heating element that has a resistance of **17.7Ω** and is to be connected to a standard **230V** a.c. supply, calculate the current flow when the heating element is switched ON?

Formula:

$I = U \div R$ $I = 230 \div 17.7$ Note: 'U' is used to represent Voltage

$I = 12.99A$ (13A)

2) State the recommended rating of a non - rewirable BS1363 protective device suitable for the convector heater in question 1 above and state its location in the circuit.

The convector current is 12.99A therefore a suitable BS1363 protective device will be rated at 13A and will be located in the plug-top

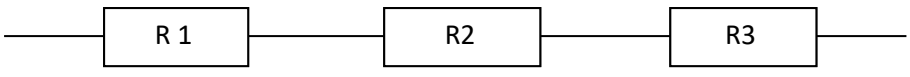
Note: If the convector heater is fixed then the protective device would be located in the fused-connection-unit.

3) A fault occurs in an electrical distribution cable between the line conductor and earth. The resistance of the fault is **0.2Ω** and the line voltage is **230V**. Determine the fault current that is going to flow.

$I = U \div R$
$I = 230 \div 0.2$
$I =$ **1150A or 1.15kA**

4) Determine the total resistance for the string of resistors shown in figure 1 below.

Fig: 1 2Ω 4Ω 6Ω



$R_T = R1 + R2 + R3$
$R_T = 2 + 4 + 6$
$R_T = 12\ \Omega$

5) If a 120V supply is connected across the circuit shown in question 4 above, **(a)** determine the current that will flow and **(b)** the measured voltages, (potential difference, p.d.), across each resistor.

a)

R_T = 12 Ω and the supply voltage is 120V

$I = U \div R$

$I = 120 \div 12$

$I = 10A$

b)

The potential difference, (p d) across each resistor can be shown as:

pd1 = I x R_1, pd2 = I x R_2 and pd3 = I x R_3

pd1 = I x R_1 pd1 = 10 x 2 pd1 = **20V**	pd2 = I x R_2 pd2 = 10 x 4pd2 = **40V**	pd3 = I x R_3 pd3 = 10 x 6 pd3 = **60V**

Note the sum of the potential differences adds up to the total applied voltage in this case 120V

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Electro-Technical Science Revision Quiz: Basic Electronics

(Covering Unit 202 of C&G 2365-02 or EAL equivalent)

1) One of the most commonly used components in electronic circuits is the fixed value carbon resistor?

TRUE	✓
FALSE	

2) A carbon resistor with three red bands at one end and a silver band at the other end means it has a value of 222kΩ +/- 5%?

The resistor value is 2.2kΩ +/- 10%

TRUE	
FALSE	✓

3) Polyester, mica and ceramic represent types of capacitor?

TRUE	✓
FALSE	

4) A capacitor that has a (+) symbol at one end is an electrolytic capacitor?

TRUE	✓
FALSE	

5) The material used to separate the 'plates' of a capacitor is called

the 'dielectric'

TRUE	✓
FALSE	

6) The electronic component that controls current flow in opposite directions is called a semiconductor diode?

The component that can control current to flow in one direction only is the thyristor. The device that controls flow in either direction is called a 'Triac'

TRUE	
FALSE	✓

7) The component that is able to ‘amplify’ very small currents is called a transistor?

TRUE	✓
FALSE	

8) A thermistor is a component that has a fixed value of resistance?

A thermistor is a semiconducting device in which its resistance varies with temperature.

TRUE	
FALSE	✓

9) A component with multiple connecting pins is generally identified as an integrated circuit component?

TRUE	✓
FALSE	

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ELECTRICAL SCIENCE

Q1	Four 48Ω resistors are connected in parallel the combined resistance of this arrangement is?	Answer
a	192 Ω	
b	48 Ω	
c	36 Ω	
d	12 Ω	X

Q 2	The force on a 2m long conductor is 25N. If the conductor is lying at right-angles to a magnetic field of 50T what current is flowing in the conductor?	Answer
a	0.25A	X
b	0.50A	
c	1.50A	
d	1.75A	

Q3	A capacitor has a reactance of 68Ω, if a current of 5A flows in the capacitor, the voltage across its terminals will be?	Answer
a	340V	X
b	230V	
c	13.6V	
d	73.5mV	

Q4	A light source produces 400lx on a surface 4m immediately beneath the source, what is the light intensity?	Answer
a	2500lm	
b	5000cd	
c	6400cd	X
d	7500lx	

Q5	A conductor cuts a magnetic field at right angles and at a speed of 100m/s. If the conductor is 50M and the flux density is 0.03T, what is the value of voltage generated?	Answer
a	25V	
b	75V	
c	100V	
d	150V	X

Q6	A resistor of 25Ω is connected in series with an inductor that has a reactance of 55Ω. What is the impedance of this combination?	Answer
a	60.42Ω	X
b	80Ω	
c	105Ω	
d	225Ω	

Q7	A motor delivers 15kW at an efficiency of 78%, what is the input power to the motor?	Answer
a	15.75kW	
b	19.23kW	X
c	21.35kW	
d	24.75kW	

Q8	A single-phase double wound transformer has 1000 primary turns and 250 secondary turns. If a 230V supply is connected to the primary, the secondary voltage is?	Answer
a	50V	
b	55V	
c	57.5V	X
d	110V	

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ELECTRO-TECHNICAL SCIENCE QUIZ

Clues	Hidden Word									
1	R	O	T	A	T	I	N	G		
2	M	O	T	O	R					
3	C	O	N	T	A	C	T	O	R	
4	P	O	T	E	N	T	I	A	L	
5	R	E	S	I	S	T	A	N	C	E
6	W	A	V	E	F	O	R	M	S	
7	P	H	O	T	O	M	E	T	E	R
8	P	O	W	E	R					
9	T	H	E	R	M	I	S	T	O	R
10	M	A	G	N	E	T	I	C		
11	N	E	U	T	R	A	L			

Clues:

1 – A three-phase induction motor operates by producing a what type of magnetic field?
2 – A machine that converts electrical to mechanical energy is called a?
3 – An electro-magnetic switching device often used in motor control.
4 – Another word for voltage.
5 – The opposition to current flow.
6 – What an oscilloscope can show.
7 – The device that measures light lux levels.
8 – The rate of doing work.
9 – The name for an electrical temperature sensitive device.
10- What the North and South poles are?
11- The common name for the supply network reference conductor.

The hidden word is **‘Transformer’**