You should have the following for this examination:

- a multiple-choice answer sheet
- a pen with blue or black ink
- non-programmable calculator

Permitted reference material:

- BS 7671
- IET On-site Guide

Read the following notes before you answer any questions:

- You must use a pen with black or blue ink to complete all parts of the answer sheet.
- Check that you have the correct answer sheet for the examination.
- Check that your name and candidate details are printed correctly at the top of your answer sheet.
- Inform the invigilator if your name or examination details are not correct.
- Each question shows four possible answers (lettered ‘a’, ‘b’, ‘c’ and ‘d’); only one is correct.
- Decide which one is correct and mark your answer on the answer sheet with your pen.

For example if you decide ‘a’ is correct, mark your answer like this:

101 [●] [ ] [ ] [ ]

If you want to change your answer, cancel your first choice by filling in the ‘cancel’ box below the circle like this:

101 [●] [ ] [ ] [ ]

Then mark the answer which you have now decided is correct. For example if you now decide ‘c’ is correct, mark your answer like this:

101 [ ● ] [ ] [●] [ ]

Any other marks on the form may invalidate some of your answers.

- Any calculations or rough working can be done on the question paper.
- Attempt all questions. If you find a question difficult, leave it and return to it later.

This paper contains 60 questions. Answer them using the ‘boxes’ numbered 1 to 60 on the answer sheet.
1. Why is a risk assessment carried out?
   a. To make sure work is completed quickly.
   b. To make sure work is carried out safely.
   c. To make sure all PPE is always worn.
   d. To make sure BS 7671 is followed when working.

2. What is the **most** appropriate procedure for dealing with a request to clean a light fitting that is attached to a suspected asbestos insulating board?
   a. Refuse, unless specific training has been given.
   b. Use a damp, lint-free cleaning cloth to contain the dust.
   c. Use an appropriate vacuum cleaner to remove any dust.
   d. Refuse, unless planning permission has been granted.

3. What asbestos survey type **must** take place before an office block, constructed in the 1960s, is totally refurbished?
   a. Type 1.
   b. Type 2.
   c. Type 3.
   d. Type 4.

4. What is the correct colour of a 230 V extension lead used on a construction site?
   a. Red.
   b. Yellow.
   c. Blue.
   d. Violet.

5. What is the role of an architect?
   a. To meet the needs of the quantity surveyor.
   b. To meet the needs of the clerk of works.
   c. To meet the needs of the site manager.
   d. To meet the needs of the customer.

6. Which industry organisation represents the interests of consumer?
   a. Electrical Safety First.
   b. Joint Industries Board.
   c. JT Ltd.
   d. UNITE.

7. What defines Current?
   a. The flow of electrons in a given time.
   b. The energy consumed by a resistance.
   c. The force opposing the flow of electricity.
   d. The force pushing the flow of electricity.

8. The current in a circuit is 16.5 mA. What is this value in amperes?
   a. 1.65 A
   b. 0.165 A
   c. 0.0165 A
   d. 0.00165 A

9. What is the unit of measurement for Energy?
   a. Joule.
   b. Amp.
   c. Volt.
   d. Hertz.

10. What is the correct transposition of the formula shown below to make V the subject?
    \[ P = \frac{V^2}{R} \]
    a. \[ V = \sqrt{\frac{R^2}{P}} \]
    b. \[ V = \sqrt{P \times R} \]
    c. \[ V = \frac{P}{R} \]
    d. \[ V = P^2 R \]

11. What is the value of side A in Figure 1.
    a. 14
    b. 28
    c. 30
    d. 56
12. What is the unit of measurement for resistance?
   a. Amp.
   b. Volt.
   c. Watt.
   d. Ohm.

13. Which law states that voltage and current are directly proportional to each other?
   a. Kirchoff’s Law.
   b. Ohms Law.
   c. Watts Law.
   d. Tesla’s Law.

14. What is the csap of a copper conductor, having a resistivity of 0.0172 μΩ/m, a measured resistance of 0.55 Ω and a length of 80 m?
   a. 1.0 mm².
   b. 1.5 mm².
   c. 2.5 mm².
   d. 4.0 mm².

15. What is the resistance of 150 m of a single copper conductor, having a csap of 10 mm²? The resistivity of copper is 1.72 x 10⁻⁸ Ω/m.
   a. 2.58 Ω
   b. 0.258 Ω
   c. 0.0258 Ω
   d. 0.00258 Ω

16. What instrument would be used to measure current?
   a. Voltmeter.
   b. Ammeter.
   c. Ohmmeter.
   d. Wattmeter.

17. What value of resistance would draw a current of 2.5 A when connected across a 200 V DC supply?
   a. 60 Ω
   b. 80 Ω
   c. 100 Ω
   d. 500 Ω

18. Which two meter connections, shown in Figure 2, could be used to calculate the total circuit power?
   a. 4 and 2.
   b. 4 and 3.
   c. 1 and 3.
   d. 1 and 2.

19. A circuit contains three resistors of 1.5 Ω, 4 Ω and 12 Ω, connected in parallel across a 10 V supply. What is the total current flowing in the circuit?
   a. 0.83 A
   b. 2.5 A
   c. 6.67 A
   d. 10 A

20. What is the actual direction of electron flow?
   a. Negative to positive.
   b. Left to right.
   c. Positive to Negative.
   d. Right to left.

21. What is the unit of measure for magnetic Flux?
   a. Weber.
   b. Tesla.
   c. Kelvin.
   d. Hertz.

22. What is the induced EMF in a conductor, with a length of 0.25 m, moving at a velocity of 5 m/s through a magnetic field having a flux density of 1.6 Tesla?
   a. 6.85 V
   b. 3.15 V
   c. 2 V
   d. 0 V
23 What is the **minimum** number of windings used by a single generator supplying a three-line, four-wire system?

a 1  
b 2  
c 3  
d 4

24 What is the peak voltage of a sine wave having an RMS value of 11 kV?

a 19.1 kV  
b 15.5 kV  
c 7.7 kV  
d 3.6 kV

25 What is represented by the first finger, in Figure 3, when applying Fleming’s right hand rule?

a Field.  
b Motion.  
c Current.  
d Velocity.

26 What is the operating principle for a single-loop, AC generator?

a Electromagnetic reduction.  
b Electromagnetic radiation.  
c Electromagnetic interference.  
d Electromagnetic induction.

27 What is represented by the area marked X in Figure 4?

a Primary Winding.  
b Secondary Winding.  
c Laminated Iron Core.  
d Laminated Cable Core.

28 What is the full load, secondary current of a 60 kVA transformer having a ratio of 8.25:1 and a primary voltage of 3.3 kV?

a 18.1 A  
b 150 A  
c 181.1 A  
d 272 A

29 What is the electronic component shown in Figure 5?

a LDR.  
b DIAC.  
c TRIAC.  
d LED.
30 What does the VDE standard on a screwdriver apply to?
   a Torque value.
   b Voltage rating.
   c Current setting.
   d Weight ratio.

31 What component must be used to secure metallic conduit to a normally damp wall?
   a Cleat.
   b Crampet.
   c Distance saddle.
   d Spacer bar saddle.

32 What is the most important reason for selecting a particular wiring system in a riser?
   a Ease of installation.
   b Longevity.
   c External Influences.
   d Aesthetics.

33 What is the first task when terminating a PVC/SWA cable into a consumer unit?
   a Remove the steel wire.
   b Tighten the brass gland.
   c Remove the outer sheath.
   d Strip back the inner sheath.

34 What is the correct method for securing cables onto a horizontal cable tray?
   a Ties.
   b Saddles.
   c Brackets.
   d Crampets.

35 What is the space factor for a trunking system?
   a 60%
   b 55%
   c 50%
   d 45%

36 What is the purpose of intermediate switching?
   a To control a luminaire from a single point.
   b To control a luminaire from a minimum of 3 points.
   c To control multiple luminaires from a single point.
   d To control multiple luminaires from a maximum of 2 points.

37 What is the purpose of Grommet strip?
   a To support cables inside trunking.
   b To make trunking air tight.
   c To protect the cable insulation.
   d To provide earth continuity.

38 What cable is used for data transmission systems?
   a SY.
   b SWA.
   c MIMS.
   d Cat 5.

39 What type of termination requires a ratchet type tool?
   a Crimp.
   b Solder.
   c Brazed.
   d Welded.

40 What termination method is used in a standard socket-outlet?
   a Brazed.
   b Crimped.
   c Screwed.
   d Soldered.

41 What is a general category of external influences as given in BS 7671?
   a Environment.
   b Method of supply.
   c Earthing arrangements.
   d Method of installation.

42 What is the most suitable position for a wind turbine in order to maximise power output?
   a A town centre.
   b A wooded site with tall trees.
   c Close to the coast on high ground.
   d Close to the coast below cliff level.

43 What voltage is supplied to heavy industry?
   a 230 V
   b 400 V
   c 33 kV
   d 400 kV
44 How is the number and type of live conductors for a supply to a new building determined?
   a Consultation with the local distributor.
   b Enquiry to the local council offices.
   c Reference to BS 7671.
   d Reference to ESQCR.

45 What must all consumer control units need to be within, in a dwelling?
   a A plastic enclosure.
   b A see-through enclosure.
   c A metallic enclosure.
   d A compartmentalised enclosure.

46 What is the $U_0$ when three-phase is supplied by a DNO in the UK?
   a 55 V
   b 110 V
   c 230 V
   d 400 V

47 What is the purpose of a switch for mechanical maintenance?
   a For electrical isolation purposes.
   b For overload and fault protection.
   c To enable normal user operation of the equipment.
   d To stop the unwanted functioning of the equipment.

48 Why is bonding installed?
   a To connect together conduit and trunking.
   b To provide a link between extraneous parts.
   c To provide a path for fault current to flow.
   d To connect together all exposed conductive parts.

49 Why must a cpc be correctly designed?
   a For sufficient earth fault current to flow to allow a short disconnection time.
   b For sufficient overload current to prevent nuisance tripping of an RCD.
   c For sufficient short-circuit current to flow to allow for discrimination.
   d For sufficient nominal current for the loading of the equipment.

50 What is an example of an exposed conductive part?
   a Centrally heated towel rail.
   b Plastic casing of a light switch.
   c Metal casing of a heating pump.
   d Suspended ceiling T-bars.

51 What is used to determine total earth-fault loop impedance?
   a $Z_S = Z_e - (R_1 + R_2)$
   b $Z_S = Z_e + (R_1 + R_2)$
   c $Z_e = Z_S + (R_1 + R_2)$
   d $Z_S = Z_e + (R_1 - R_2)$

52 How is basic protection provided within a dwelling?
   a Insulation of live parts.
   b 100 mA RCD protection.
   c Supplementary bonding.
   d Placing out of reach.

53 What are rating factors applied to during cable selection?
   a $I_n$
   b $I_b$
   c $I_a$
   d $I_z$

54 What would be the actual length of a wall measuring 40 mm on 1:50 scaled drawing?
   a 6 m
   b 4 m
   c 2 m
   d 1 m

55 What information must be included in a manufacturer's handbook for an electric cooker?
   a Rating of grouping factors for the wiring arrangement.
   b Instructions on how the user operates the appliance.
   c Specifications of the supply earthing arrangement.
   d Detail of the wiring route to supply the appliance.
Questions 56 to 60 refer to the following scenario.

A new single-phase electrical installation within a small workshop is to be wired using single-core non-sheathed 70 °C thermoplastic (PVC) cables having stranded copper conductors.

The cables are to be installed in a mixture of surface, metallic conduit and trunking. Part of the schedule for the final-circuits is shown below.

Table 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Designation</th>
<th>Live mm²</th>
<th>CPC mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9 kW steel cutting machine</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>6 kW drill</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>3 kW space heater</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>Ring final circuit</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>5</td>
<td>3 kW water heater</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>6x 100 W fluorescent luminaires</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

56 A short, straight conduit run of 0.5 m is required to carry all the final circuit cables between the CCU and the trunking below. What is the minimum conduit size required?

- a 20 mm
- b 32 mm
- c 38 mm
- d 50 mm

57 Who is responsible for maintaining the meter tails which link the meter to the consumers' control unit?

- a DNO.
- b ECA.
- c Installer.
- d Consumer.

58 What type of circuit-breaker would be selected for protecting the lighting circuit?

- a Type A.
- b Type B.
- c Type C.
- d Type D.

59 What is the correct coordination for the water heater final-circuit?

- a \( I_b = 20 \, A, I_n = 25 \, A, I_z = 18 \, A \)
- b \( I_b = 18 \, A, I_n = 15 \, A, I_z = 13 \, A \)
- c \( I_b = 13 \, A, I_n = 16 \, A, I_z = 20 \, A \)
- d \( I_b = 25 \, A, I_n = 16 \, A, I_z = 13 \, A \)

60 The space heater circuit has a length of 14 m installed as method B. What is the voltage drop for this circuit at full load current?

- a 3.26 V
- b 4.32 V
- c 5.94 V
- d 6.89 V

NOW GO BACK AND CHECK YOUR WORK

- IMPORTANT - Are the details at the top of the answer sheet correct?
  Have you filled in your answers in INK in the appropriate boxes on the answer sheet?