3.5 Mains Electricity and Circuit Wiring Safety: 30-minute Pack

Total Marks

EDEXCEL 4PH1 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State the standard frequency of the UK mains electricity supply and include the unit.

(Total for Question 1 is 1 mark)

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2 State the purpose of the neutral wire in a domestic mains circuit and what potential it is close to during normal operation.

(Total for Question 2 is 1 mark)

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3 State the role of the live wire in a mains appliance and the danger it poses if touched while the appliance is switched on.

(Total for Question 3 is 1 mark)

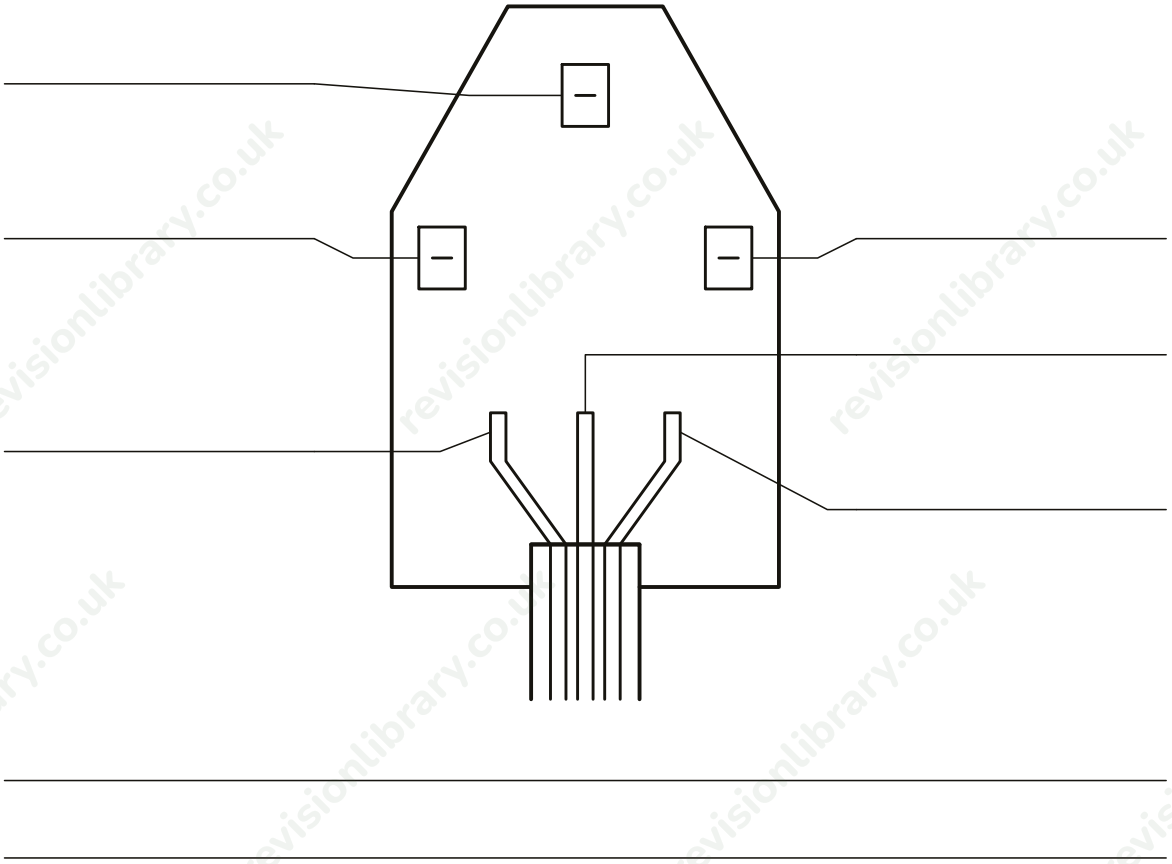
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4 State the colour coding of the three wires found in a standard three-core mains cable used in the UK, giving the colour and the name of each wire: live, neutral, earth. Include the earth colour exactly as used in UK wiring.

(Total for Question 4 is 3 marks)

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5 The diagram shows a simple three-pin plug and a length of three-core cable for a domestic appliance. Label the plug pins and the cable cores with the correct names and colours. In your answer label: Live pin and wire, Neutral pin and wire, Earth pin and wire. Also indicate where the fuse is placed in a correctly wired plug and how the outer sheath of the cable is held in place.



(Total for Question 5 is 6 marks)

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6 Describe briefly how a circuit breaker provides protection compared with a fuse, and give one advantage of a circuit breaker over a fuse in domestic use.

(Total for Question 6 is 2 marks)

7 Explain how double insulation protects a user from electric shock and state an example of an item that might use double insulation instead of an earth wire.

(Total for Question 7 is 3 marks)

8 A kettle marked 2300 W is used on 230 V mains. Calculate the current it draws and determine the smallest standard fuse rating from the common UK plug ratings 3 A, 5 A and 13 A that should be used. Show the equation, substitution and evaluation. State the unit for the current.

(Total for Question 8 is 3 marks)

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9 A toaster has power rating 1500 W and is used on 230 V mains. Calculate the current drawn by the toaster. Then explain why a 3 A fuse would be unsuitable in the plug for this toaster, giving the numerical reason. Show the equation, substitution and evaluate the current; state the unit.

(Total for Question 9 is 3 marks)

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10 A small charger has a label showing 12 V output and 2 A maximum on the low-voltage side. The charger is powered from 230 V mains via an internal transformer and internal fuse in the live input. Explain why the charger still needs an internal fuse on the mains side even though the low-voltage side limit is 2 A, and state what the fuse on the mains side protects against. Give two distinct reasons.

(Total for Question 10 is 4 marks)

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Mark scheme · 3.5 Mains Electricity and Circuit Wiring Safety: 30-minute Pack

Question 1

50 Hz (50 hertz) cao **B1**

Answer: 50 Hz

Question 2

completes the circuit back to the supply and is close to earth potential (near 0 V) during normal operation **B1**

Answer: Neutral completes the circuit back to the supply and is close to earth potential (near 0 V) in normal use.

Question 3

carries the alternating voltage from the supply to the appliance and can give a dangerous electric shock if touched while live **B1**

Answer: Live carries the supply voltage to the appliance and can give a dangerous shock if touched when the appliance is switched on.

Question 4

live is brown **B1**

neutral is blue **B1**

earth is green-and-yellow (green with yellow stripe) cao **B1**

Answer: Live = brown; Neutral = blue; Earth = green-and-yellow

Question 5

live pin labelled and live wire colour given as brown **B1**

neutral pin labelled and neutral wire colour given as blue **B1**

earth pin labelled and earth wire colour given as green-and-yellow **B1**

correct position of the fuse inside the live conductor in the plug is shown or stated **B1**

correct identification of the live, neutral and earth pin positions (live on the right, neutral on the left, earth at the top, when looking into the back of the open plug with the cable at the bottom; accept the mirror-image left and right if the view is from the pin face) **B1**

shows that the cable outer sheath is clamped and that individual cores are connected to the correct pins **B1**

Answer: Live = brown to live pin (right pin, looking into the open plug with the cable at the bottom), Neutral = blue to neutral pin (left pin), Earth = green-and-yellow to top pin; fuse is in the live conductor inside the plug; outer sheath clamped.

Question 6

circuit breaker trips to open the circuit when current is too high, often using an electromagnet or bimetallic strip **B1**

advantage: it can be reset rather than replaced, so quicker and more convenient after a fault **B1**

Answer: A circuit breaker trips to open the circuit when excess current flows, often using electromagnetism or a bimetal strip; it can be reset after a fault instead of replacing it like a fuse.

Question 7

double insulation has two layers of insulation or reinforced insulation so live parts cannot touch external metal parts **B1**

prevents any fault current reaching the outside casing, so user cannot receive a shock even if internal wiring fails **B1**

gives a correct example, e.g. a hairdryer with a plastic casing or many handheld power tools and battery chargers **B1**

Answer: Double insulation uses two layers or reinforced insulation so live parts cannot reach an external metal case; this prevents fault current reaching a user. Example: a hairdryer with a plastic outer case or many handheld power tools.

Question 8

quotes the equation I = P / V and substitutes values I = 2300 / 230 **M1**

evaluates current = 10 A (2300 / 230 = 10.0 A) cao **A1**

states smallest suitable fuse is 13 A, since 3 A and 5 A are too small and 13 A is the next standard rating above 10 A **B1**

Answer: I = P / V = 2300 / 230 = 10.0 A, so use a 13 A fuse (3 A and 5 A would blow).

Question 9

quotes I = P / V and substitutes I = 1500 / 230 **M1**

evaluates current = 6.5217... A, cao, states unit A **A1**

explains 3 A fuse is unsuitable because 3 A < 6.52 A so it would blow under normal operation; suggests a 13 A fuse is appropriate **B1**

Answer: I = P / V = 1500 / 230 = 6.52 A (about 6.5 A). A 3 A fuse is unsuitable because 3 A is less than the operating current (6.52 A) so it would blow; use 13 A.

Question 10

internal fuse on mains side protects the charger and wiring from excessive current drawn from the mains due to a fault in the charger, preventing overheating and fire **B1**

it protects the mains supply and user by disconnecting the high-voltage side if a fault causes a short or overload, limiting damage and reducing shock/fire risk **B1**

the low-voltage 2 A rating does not limit mains-side current directly because transformation changes voltage and current; a mains fuse ensures faults on either side cannot cause unsafe mains currents **B1**

explicit statement that the fuse protects against internal short circuits, earth faults or component failures that would otherwise cause excessive heating or fire risk **B1**

Answer: The mains-side internal fuse stops excessive current from the 230 V supply if the charger develops a fault, protecting the charger and cable from overheating and preventing fire, and it disconnects the mains to reduce shock risk. The 2 A low-voltage limit does not prevent mains-side faults, so a mains fuse is needed to protect against internal shorts, earth faults and overloads.

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