Direct and alternating potential difference

6.2.3.1 · Physics · revision notes

The difference between direct and alternating potential difference, and the values for the UK mains supply. Expect short recall questions (50 Hz, about 230 V) and 2-mark 'explain the difference' questions, sometimes with a graph of potential difference against time.

Key facts

- dc: pd (and current) in one direction only
- Cells and batteries supply dc
- Frequency = number of complete cycles per second, in hertz (Hz)
- ac: pd (and current) keeps reversing direction
- UK mains: ac, 50 Hz, about 230 V
- Grade 7+ only Time period = 1 ÷ frequency

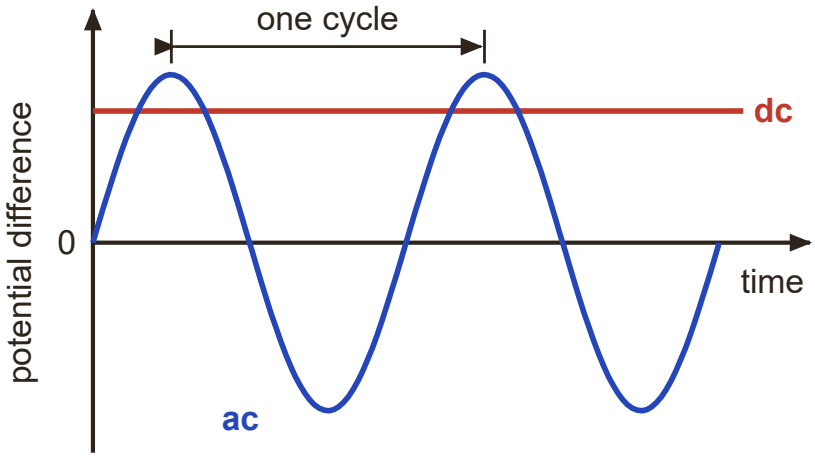
Notes

Direct potential difference (dc)

- A **direct** potential difference always acts in the **same direction**, so the current flows in one direction only.
- Cells and batteries supply a direct pd: the positive terminal stays positive and the negative terminal stays negative.
- On a graph of pd against time, a steady dc supply is a horizontal straight line. A pd that changes size but never goes below zero is still direct.

Alternating potential difference (ac)

- An **alternating** potential difference keeps **reversing direction**, so the current keeps changing direction.
- On a graph of pd against time, ac is a wave: the pd rises to a positive peak, falls through zero to a negative peak, and repeats.



dc: steady, one direction. ac: keeps reversing, repeating every cycle.

- The **frequency** is the number of complete cycles each second, measured in hertz (Hz).

The UK mains supply

- Mains electricity is an **ac** supply.
- In the UK the domestic supply has a frequency of **50 Hz** and a potential difference of about **230 V**.
- 50 Hz means 50 complete cycles every second. Each cycle has two changes of direction, so the mains reverses direction 100 times a second.
- The time for one cycle (the time period) = 1 ÷ frequency. For the mains, 1 ÷ 50 = 0.02 s. Grade 7+ only

How to answer each type of question

Recall the mains values

1 mark each | Grade 3

1. Learn the two numbers: 50 Hz and about 230 V.
2. Give the unit with each number.

Example. (a) State the frequency of the UK mains electricity supply.
(b) State the potential difference of the UK mains electricity supply.

Model answer.

(a) 50 Hz (1)
(b) About 230 V (1)

Explain the difference between direct and alternating pd

2 marks | Grade 5

1. Write one sentence about dc: acts in one direction only.
2. Write one sentence about ac: keeps reversing (changing) direction.
3. Link each to the current if you can: the current is one way, or keeps changing direction.

Example. A torch uses a battery. A kettle uses the mains supply.
Explain the difference between the potential difference supplied by the battery and the potential difference supplied by the mains.

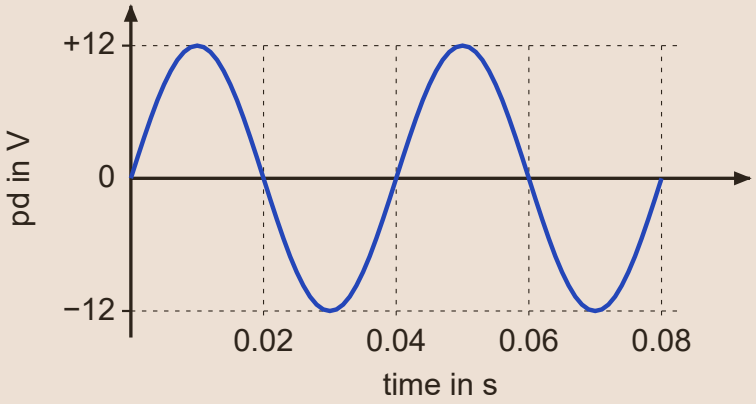
Model answer. The battery supplies a direct pd, which acts in one direction only, so the current is always in the same direction (1). The mains supplies an alternating pd, which keeps reversing direction, so the current keeps changing direction (1).

Interpret a pd–time graph

2 to 3 marks | **Grade 7**

1. Decide ac or dc: does the pd go below zero (change direction)?
2. Find the time for ONE complete cycle (positive peak to the next positive peak).
3. Use frequency = 1 ÷ time period, with the time in seconds.

Example. A graph of the potential difference of a supply against time is a wave. The pd goes from +12 V down to −12 V and back up again. One complete cycle takes 0.040 s.



(a) State whether the supply is ac or dc. Give a reason.
(b) Calculate the frequency of the supply.

Model answer.

(a) ac, because the pd changes between positive and negative / changes direction (1)

(b) frequency = 1 ÷ 0.040 (1)

frequency = 25 Hz (1)

Don’t lose marks

- Saying ac 'changes size' or 'turns on and off'. The key idea is that it changes direction.
- Swapping the values: the mains is 230 V and 50 Hz, not 50 V and 230 Hz.
- Saying batteries supply ac.
- Reading the time for half a cycle from a graph and using it as the time period.

More tips

Memory tricks

- AC = Alternating = keeps changing direction. DC = Direct = one Direction.
- Mains numbers: '230 volts, 50 hertz'. The bigger number is the volts.
- One cycle has two reversals, so 50 Hz means 100 changes of direction per second.

Exam technique

- In 'explain the difference' questions, describe BOTH types, one sentence for each.
- Use the word 'direction': examiners look for 'one direction' and 'changes / reverses direction'.
- Always give units: V for potential difference and Hz for frequency.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 — **State that mains electricity is ac**
The mains supply is an alternating current (ac) supply.

Grade 3 — **Recall the UK mains frequency and pd**
The UK domestic supply has a frequency of 50 Hz and is about 230 V.

Grade 4 — **Name a source of direct pd**
Cells and batteries supply a direct potential difference.

Grade 5 — **Explain the difference between dc and ac**
A direct pd acts in one direction only; an alternating pd keeps reversing direction.

Grade 6 — **Interpret pd–time graphs for ac and dc**
A steady dc supply is a horizontal line; ac is a wave that goes positive and negative.

Grade 7 — **Find frequency from a pd–time graph**
Read the time for one complete cycle and use frequency = 1 ÷ time period.

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