

Power, energy and electricity bills

Grade 8 science (Year 9 · Class 8) · Worksheet answers

Each answer shows the formula, the substitution and the result with its unit. Check that you changed minutes to hours or seconds, and watts to kilowatts, before multiplying, because that step causes most lost marks.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS3

Problem 1 Watts and kilowatts

1. The unit of power is the **watt (W)**.
2. $3.5 \times 1000 = \mathbf{3500\ W}$.
3. $450 \div 1000 = \mathbf{0.45\ kW}$.

Problem 2 Two power formulas

1. $P = V \times I$, with P in watts, V in volts and I in amperes.
2. $E = P \times t$, with E in joules, P in watts and t in seconds.
3. The bill uses the **kilowatt-hour (kWh)**.

Problem 3 Torch bulb

1. $P = V \times I$.
2. $P = 6.0\ V \times 0.50\ A = \mathbf{3.0\ W}$.

Problem 4 Hair dryer energy

1. $2 \times 60 = 120\ s$.
2. $E = P \times t = 1500\ W \times 120\ s = \mathbf{180\ 000\ J}$.

Problem 5 Oven in kilowatt-hours

1. $E = P \times t$, with P in kW and t in hours.
2. $E = 3\ kW \times 2\ h = \mathbf{6\ kWh}$.

Problem 6 Read the rating plate

1. The power is 1200 W.
2. $1200 \div 1000 = 1.2\ kW$.
3. $E = 1.2\ kW \times 0.5\ h = \mathbf{0.6\ kWh}$.

Problem 7 Rice cooker current

1. $I = P \div V$.
2. $I = 700 \text{ W} \div 230 \text{ V} = 3.04\dots \text{ A}$, so **3.0 A**.

Problem 8 Heater element voltage

1. $V = P \div I$.
2. $V = 1840 \text{ W} \div 8.0 \text{ A} = \mathbf{230 \text{ V}}$.

Problem 9 A fan overnight

1. $40 \text{ W} = 0.040 \text{ kW}$, so $E = 0.040 \text{ kW} \times 5 \text{ h} = \mathbf{0.20 \text{ kWh}}$.
2. $5 \text{ h} = 18\,000 \text{ s}$, so $E = 40 \text{ W} \times 18\,000 \text{ s} = \mathbf{720\,000 \text{ J}}$.
3. $0.20 \text{ kWh} \times 3\,600\,000 \text{ J/kWh} = 720\,000 \text{ J}$, so the answers agree.

Problem 10 Cost of ironing

1. $E = 1.5 \text{ kW} \times 2 \text{ h} = 3.0 \text{ kWh}$.
2. $\text{Cost} = 3.0 \times 1.20 = \mathbf{3.60 \text{ cedis}}$.

Problem 11 Reading the meter

1. $7470 - 7408 = \mathbf{62 \text{ kWh}}$.
2. $\text{Cost} = 62 \times 18 = \mathbf{1116 \text{ rupees}}$.

Problem 12 LED against filament lamp

1. $\text{Time} = 5 \times 30 = 150 \text{ h}$. LED: $0.009 \text{ kW} \times 150 \text{ h} = \mathbf{1.35 \text{ kWh}}$. Filament lamp: $0.060 \text{ kW} \times 150 \text{ h} = \mathbf{9.0 \text{ kWh}}$.
2. $9.0 - 1.35 = \mathbf{7.65 \text{ kWh}}$.
3. $\text{Saving} = 7.65 \times 20 \text{ p} = \mathbf{153 \text{ p}} \text{ (£1.53)}$.

Problem 13 How long will it run?

1. $t = E \div P$.
2. $t = 10 \text{ kWh} \div 2.0 \text{ kW} = \mathbf{5.0 \text{ h}}$.

Problem 14 Weekly energy chart

1. The **fridge** (10 kWh).
2. $4 + 7 + 10 + 3 = \mathbf{24 \text{ kWh}}$.
3. $\text{Cost} = 24 \times \$0.14 = \mathbf{\$3.36}$.
4. $7 \div 24 \times 100 = 29.2\dots$, so **29 %**.

Problem 15 Fast kettle, slow kettle

1. Power is energy per second. The 2300 W kettle transfers more joules every second, so it reaches the same total energy sooner.
2. $\text{Time} = E \div P$, so the ratio is $2300 \div 800 = \mathbf{2.9 \text{ times longer}}$.
3. A joule is tiny, so household use would be huge numbers (millions of joules). The kWh is a convenient size for a bill.

Problem 16 Air conditioner season

1. $\text{Time} = 8 \times 30 = 240 \text{ h}$. $E = 1.2 \times 240 = \mathbf{288 \text{ kWh}}$.
2. $\text{Cost} = 288 \times 0.30 = \mathbf{\$86.40}$.
3. New unit: $0.9 \times 240 = 216 \text{ kWh}$. Saved energy = $288 - 216 = 72 \text{ kWh}$, so saving = $72 \times 0.30 = \mathbf{\$21.60}$.

Problem 17 Choosing a fuse

1. Lamp: $60 \div 230 = \mathbf{0.26 \text{ A}}$. Toaster: $920 \div 230 = \mathbf{4.0 \text{ A}}$. Heater: $2400 \div 230 = \mathbf{10.4 \text{ A}}$.
2. Lamp: **3 A**. Toaster: **5 A**. Heater: **13 A**.
3. If a fault makes the current rise, a fuse that is too large would not melt in time, so the wires could overheat and start a fire.

Problem 18 Solar panel savings

1. $P = 18 \text{ V} \times 5.0 \text{ A} = \mathbf{90 \text{ W}}$.
2. $E = 0.090 \text{ kW} \times 6 \text{ h} = \mathbf{0.54 \text{ kWh}}$.
3. Per day: $0.54 \times 60 = 32.4 \text{ naira}$. In 30 days: $32.4 \times 30 = \mathbf{972 \text{ naira}}$.

Problem 19 Spot the errors

1. The time must be in hours, not minutes. $90 \text{ min} = 1.5 \text{ h}$, so $E = 2 \times 1.5 = \mathbf{3.0 \text{ kWh}}$.
2. 30×2 is an energy (60 Wh), not a power; the power stays 30 W. $E = 0.030 \text{ kW} \times 2 \text{ h} = \mathbf{0.060 \text{ kWh}}$.
3. $\text{Cost} = 3.0 \times 22 = \mathbf{66 \text{ p}}$.

Problem 20 Motor at three settings

1. $3.0 \times 0.20 = \mathbf{0.60 \text{ W}}$; $6.0 \times 0.45 = \mathbf{2.7 \text{ W}}$; $9.0 \times 0.80 = \mathbf{7.2 \text{ W}}$.
2. $2.7 \div 0.60 = \mathbf{4.5 \text{ times}}$ (the voltage only doubled).
3. $E = 7.2 \text{ W} \times 20 \text{ s} = \mathbf{144 \text{ J}}$.
4. Power is $V \times I$. When the voltage rises, the current also rises, so both factors grow and the product grows faster than either.