

Foundation Mathematics Units 1 & 2

Chapter 9 Household budgeting and costs

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Chapter 9 Household budgeting and costs — 9C Utility bills

Theory

Every household pays for **utilities** — electricity, gas and water. Knowing how a utility bill is put together lets you check it is correct, compare providers, and plan a budget.

What is on a bill.

Most utility bills have two parts:

- a **usage (consumption) charge** — what you pay for the energy or water you actually used;
- a fixed **supply (service) charge** — a daily amount you pay just to be connected, whether you use anything or not.

The **total** is the usage charge plus the supply charge, with **GST** (the Goods and Services Tax, 10%) added where it applies. Electricity and gas are taxable, so GST is added; **water usage and water/sewerage service charges are GST-free**.

Reading the meter.

The energy you used in a period is found from two meter readings:

$$\text{usage} = \text{current reading} - \text{previous reading}.$$

Electricity is measured in **kilowatt-hours (kWh)**, gas in **megajoules (MJ)**, and water in **kilolitres (kL)**.

The usage charge.

The usage charge is the amount used multiplied by the **unit rate**. Unit rates are often quoted in **cents**, so convert to dollars first (divide by 100): a rate of 30 c/kWh is \$0.30 per kWh.

$$\text{usage charge} = \text{amount used} \times \text{unit rate}.$$

The supply charge.

The supply charge is a fixed **daily** rate times the number of days in the billing period (a quarter is about 90 days):

$$\text{supply charge} = \text{daily rate} \times \text{number of days}.$$

Block (tiered) rates.

Some bills charge a **higher rate once you pass a set amount**. The first block of units is charged at one rate and the rest at another. Work out each block separately and add them.

Adding GST and estimating.

For electricity and gas, add GST last: $\text{GST} = 10\%$ of the subtotal, and $\text{total} = \text{subtotal} + \text{GST}$ (the same as multiplying the subtotal by 1.1). To estimate a **yearly** cost from one quarterly bill, multiply by 4; to estimate a **monthly** cost, divide the yearly figure by 12.

Worked examples

Example 1 — scaffolded

An electricity meter read 15 640 kWh at the start of a 90-day quarter and 16 840 kWh at the end. The usage rate is 30 c/kWh and the supply charge is \$1.10 per day. GST of 10% applies. Find the total bill.

Working

Comment

$$\text{Usage} = 16\,840 - 15\,640 = 1200 \text{ kWh}.$$

Current reading minus previous reading.

Working	Comment
Usage charge = $1200 \times \$0.30 = \360.00 .	30 c/kWh = \$0.30/kWh.
Supply charge = $90 \times \$1.10 = \99.00 .	Daily rate times the number of days.
Subtotal = $360.00 + 99.00 = \$459.00$.	Usage plus supply.
GST = $10\% \times 459.00 = \$45.90$; total = $459.00 + 45.90 = \$504.90$.	Add 10 % GST.

Example 2 — scaffolded

A gas bill for a 90-day quarter uses **block rates**: the first 5000 MJ at 3.2 c/MJ and any extra at 2.8 c/MJ. The household used 8200 MJ. The supply charge is 82 c per day, and GST of 10 % applies. Find the total.

Working	Comment
First block: $5000 \times \$0.032 = \160.00 .	3.2 c = \$0.032.
Extra used = $8200 - 5000 = 3200$ MJ, charged at \$0.028: $3200 \times \$0.028 = \89.60 .	Only the amount above 5000 MJ.
Usage charge = $160.00 + 89.60 = \$249.60$.	Add the two blocks.
Supply = $90 \times \$0.82 = \73.80 ; subtotal = $249.60 + 73.80 = \$323.40$.	Usage plus supply.
GST = $\$32.34$; total = $323.40 + 32.34 = \$355.74$.	Subtotal $\times 1.1$.

Example 3 — unscaffolded

A family's electricity meter read 28 940 kWh on 1 July and 30 320 kWh on 30 September (91 days). The rate is 29.5 c/kWh, the supply charge is \$1.15 per day, and GST of 10 % applies. Find the total bill, and estimate the family's yearly electricity cost.

Usage = $30\,320 - 28\,940 = 1380$ kWh. Usage charge = $1380 \times \$0.295 = \407.10 . Supply charge = $91 \times \$1.15 = \104.65 . Subtotal = $407.10 + 104.65 = \$511.75$. GST = $10\% \times 511.75 = \$51.18$ (to the nearest cent), so the total = $511.75 + 51.18 = \$562.93$. A year is four quarters, so the yearly cost is about $4 \times \$562.93 = \2251.72 .

$\therefore$ the bill is \$562.93, and the estimated yearly cost is about \$2250.

Example 4 — unscaffolded

A household used 78 kL of water in a quarter. Water is charged on **block rates**: the first 50 kL at \$2.74 per kL and any extra at \$3.29 per kL. There is also a fixed water service charge of \$28.60 and a sewerage charge of \$145.40. Water usage and these charges are **GST-free**. Find the total bill.

First block: $50 \times \$2.74 = \137.00 . Extra used = $78 - 50 = 28$ kL: $28 \times \$3.29 = \92.12 . Usage charge = $137.00 + 92.12 = \$229.12$. Fixed charges = $28.60 + 145.40 = \$174.00$. Total = $229.12 + 174.00 = \$403.12$ (no GST, because water is GST-free).

$\therefore$ the water bill is \$403.12.

Practice questions

Scaffolded

Q1. An electricity meter read 61 220 kWh at the start of a quarter and 62 540 kWh at the end. The rate is 27 c/kWh. (a) Find the usage in kWh. (b) Find the usage charge. (c) The supply charge is \$1.05 per day for 90 days. Find the supply charge.

Q2. A gas bill has a usage charge of \$184.00 and a supply charge of \$76.50 (both before GST). (a) Find the subtotal. (b) Find the GST at 10 %. (c) Find the total including GST.

- Q3.** A household used 54 kL of water. The first 45 kL are charged at \$2.60 per kL and any extra at \$3.40 per kL. (a) Find the cost of the first 45 kL. (b) Find the cost of the remaining water. (c) Find the total usage charge.
- Q4.** A quarterly electricity bill totals \$528.40. (a) Estimate the yearly cost (four quarters). (b) Estimate the average cost per month. (c) Estimate the average cost per day (use 365 days), to the nearest cent.
- Q5.** An electricity bill has a usage charge of \$312.00 and a supply charge of \$91.00, with GST of 10 %. (a) Find the subtotal. (b) Find the GST. (c) Find the total.
- Q6.** Two households pay 30 c/kWh for electricity. Household A used 1180 kWh and Household B used 1540 kWh in the quarter. (a) Find Household A's usage charge. (b) Find Household B's usage charge. (c) How much more does Household B pay for usage than Household A?

Un scaffolded

- Q7.** An electricity meter read 8340 kWh and later 9615 kWh, over a 92-day quarter. The rate is 31 c/kWh, the supply charge is \$1.12 per day, and GST of 10 % applies. Find the total bill.
- Q8.** A gas bill uses block rates: the first 6000 MJ at 3.0 c/MJ and any extra at 2.5 c/MJ. The household used 9000 MJ over 90 days, the supply charge is 79 c per day, and GST of 10 % applies. Find the total bill.
- Q9.** A household used 82 kL of water: the first 50 kL at \$2.90 per kL and any extra at \$3.55 per kL, plus a \$32.00 service charge and a \$138.00 sewerage charge. Water is GST-free. Find the total bill.
- Q10.** A quarterly electricity bill covers 91 days. The household used 1456 kWh at 28.5 c/kWh, the supply charge is \$1.08 per day, and GST of 10 % applies. (a) Find the total bill. (b) Estimate the yearly electricity cost.
- Q11.** An electricity usage charge was \$432.00 at a rate of 30 c/kWh. (a) How many kWh were used? (b) If this was over 90 days, find the average daily usage in kWh.
- Q12.** A household expects to use 1300 kWh in a 90-day quarter and compares two plans (prices before GST):

Plan	Usage rate	Supply charge
A	29 c/kWh	\$1.00 per day
B	26 c/kWh	\$1.25 per day

Which plan is cheaper for this household, and by how much?

- Q13.** A water bill (GST-free) has a usage charge of \$196.40, a service charge of \$30.00 and a sewerage charge of \$142.60. (a) Find the total bill. (b) The household reduces its water use so the usage charge falls by 15 %. Find the new usage charge and the new total.
- Q14.** A gas bill totals \$330.00 including GST of 10 %. (a) Find the amount before GST. (b) Find the GST component.
- Q15.** A household's electricity is billed each quarter at 30 c/kWh with a supply charge of \$1.10 per day for 90 days, plus GST of 10 %. In one quarter it used 1120 kWh and in the next 1680 kWh. (a) Find the total for each quarter. (b) Find the combined total for the two quarters.
- Q16.** A family wants to keep its quarterly electricity bill **under \$500 including GST**. The rate is 30 c/kWh, the supply charge is \$99.00 for the quarter, and GST of 10 % applies. What is the greatest whole number of kWh they can use?
- Q17.** A household with solar panels receives an electricity bill showing a usage charge of \$406.00 and a supply charge of \$95.55, with GST of 10 % added to these charges. A solar **feed-in credit** of \$48.00 is then subtracted from the total. Find the amount payable.

Q18. Five housemates share a quarterly electricity bill. They used 1650 kWh at 30 c/kWh, the supply charge is \$1.20 per day for 90 days, and GST of 10 % applies. (a) Find the total bill. (b) Find each housemate's equal share. (c) How much should each housemate set aside per month (over the three months) to cover their share?

Answers

Q1. (a) 1320 kWh. (b) \$ 356.40. (c) \$ 94.50. **Q2.** (a) \$ 260.50. (b) \$ 26.05. (c) \$ 286.55. **Q3.** (a) \$ 117.00. (b) \$ 30.60. (c) \$ 147.60. **Q4.** (a) \$ 2113.60. (b) \$ 176.13. (c) \$ 5.79. **Q5.** (a) \$ 403.00. (b) \$ 40.30. (c) \$ 443.30. **Q6.** (a) \$ 354.00. (b) \$ 462.00. (c) \$ 108.00. **Q7.** \$ 548.12. **Q8.** \$ 358.71. **Q9.** \$ 428.60. **Q10.** (a) \$ 564.56. (b) about \$ 2258.24. **Q11.** (a) 1440 kWh. (b) 16 kWh/day. **Q12.** Plan B is cheaper, by \$ 16.50 (A \$ 467.00, B \$ 450.50). **Q13.** (a) \$ 369.00. (b) new usage charge \$ 166.94, new total \$ 339.54. **Q14.** (a) \$ 300.00. (b) \$ 30.00. **Q15.** (a) \$ 478.50 and \$ 663.30. (b) \$ 1141.80. **Q16.** 1185 kWh. **Q17.** \$ 503.71. **Q18.** (a) \$ 663.30. (b) \$ 132.66. (c) \$ 44.22.

Fully-worked solutions

Q1. (a) Usage = $62\,540 - 61\,220 = 1320$ kWh. (b) Usage charge = $1320 \times \$0.27 = \356.40 . (c) Supply charge = $90 \times \$1.05 = \94.50 .

Q2. (a) Subtotal = $184.00 + 76.50 = \$260.50$. (b) GST = $10\% \times 260.50 = \$26.05$. (c) Total = $260.50 + 26.05 = \$286.55$.

Q3. (a) First 45 kL: $45 \times \$2.60 = \117.00 . (b) Remaining = $54 - 45 = 9$ kL: $9 \times \$3.40 = \30.60 . (c) Total usage charge = $117.00 + 30.60 = \$147.60$.

Q4. (a) Yearly $\approx 4 \times \$528.40 = \2113.60 . (b) Per month $\approx \$2113.60 \div 12 = \176.13 . (c) Per day $\approx \$2113.60 \div 365 = \5.79 .

Q5. (a) Subtotal = $312.00 + 91.00 = \$403.00$. (b) GST = $10\% \times 403.00 = \$40.30$. (c) Total = $403.00 + 40.30 = \$443.30$.

Q6. (a) A: $1180 \times \$0.30 = \354.00 . (b) B: $1540 \times \$0.30 = \462.00 . (c) Difference = $462.00 - 354.00 = \$108.00$.

Q7. Usage = $9615 - 8340 = 1275$ kWh. Usage charge = $1275 \times \$0.31 = \395.25 . Supply = $92 \times \$1.12 = \103.04 . Subtotal = $395.25 + 103.04 = \$498.29$. GST = $10\% \times 498.29 = \$49.83$. Total = $498.29 + 49.83 = \$548.12$.

Q8. First block = $6000 \times \$0.030 = \180.00 . Extra = $9000 - 6000 = 3000$ MJ at \$ 0.025: $3000 \times \$0.025 = \75.00 . Usage charge = $180.00 + 75.00 = \$255.00$. Supply = $90 \times \$0.79 = \71.10 . Subtotal = $255.00 + 71.10 = \$326.10$. GST = \$ 32.61. Total = $326.10 + 32.61 = \$358.71$.

Q9. First 50 kL: $50 \times \$2.90 = \145.00 . Extra = $82 - 50 = 32$ kL: $32 \times \$3.55 = \113.60 . Usage charge = $145.00 + 113.60 = \$258.60$. Fixed charges = $32.00 + 138.00 = \$170.00$. Total = $258.60 + 170.00 = \$428.60$ (GST-free).

Q10. (a) Usage charge = $1456 \times \$0.285 = \414.96 . Supply = $91 \times \$1.08 = \98.28 . Subtotal = $414.96 + 98.28 = \$513.24$. GST = $10\% \times 513.24 = \$51.32$. Total = $513.24 + 51.32 = \$564.56$. (b) Yearly $\approx 4 \times \$564.56 = \2258.24 .

Q11. (a) Usage = $\$432.00 \div \$0.30 = 1440$ kWh. (b) Average daily usage = $1440 \div 90 = 16$ kWh/day.

Q12. Plan A: $1300 \times \$0.29 + 90 \times \$1.00 = 377.00 + 90.00 = \467.00 . Plan B: $1300 \times \$0.26 + 90 \times \$1.25 = 338.00 + 112.50 = \450.50 . Plan B is cheaper by $467.00 - 450.50 = \$16.50$.

Q13. (a) Total = $196.40 + 30.00 + 142.60 = \369.00 . (b) New usage charge = $196.40 \times 0.85 = \$166.94$. New total = $166.94 + 30.00 + 142.60 = \339.54 .

Q14. (a) Before GST = $\$330.00 \div 1.1 = \300.00 . (b) GST component = $330.00 - 300.00 = \$30.00$.

Q15. Supply each quarter = $90 \times \$1.10 = \99.00 . (a) First quarter: $1120 \times \$0.30 = \336.00 ; subtotal = $336.00 + 99.00 = \$435.00$; total = $435.00 \times 1.1 = \$478.50$. Second quarter: $1680 \times \$0.30 = \504.00 ; subtotal = $504.00 + 99.00 = \$603.00$; total = $603.00 \times 1.1 = \$663.30$. (b) Combined = $478.50 + 663.30 = \$1141.80$.

Q16. Let u be the kWh used. Subtotal $= 0.30u + 99.00$, and total $= 1.1(0.30u + 99.00)$. Require $1.1(0.30u + 99.00) \leq 500$, so $0.30u + 99.00 \leq 500 \div 1.1 = 454.545\dots$, giving $0.30u \leq 355.545\dots$ and $u \leq 1185.15$. The greatest whole number is 1185 kWh (check: $1185 \times 0.30 = 355.50$; $(355.50 + 99.00) \times 1.1 = \$499.95 < \$500$).

Q17. Subtotal $= 406.00 + 95.55 = \$501.55$. GST $= 10\% \times 501.55 = \$50.16$ (to the nearest cent). Total before the credit $= 501.55 + 50.16 = \$551.71$. Subtract the feed-in credit: $551.71 - 48.00 = \$503.71$.

Q18. (a) Usage charge $= 1650 \times \$0.30 = \495.00 . Supply $= 90 \times \$1.20 = \108.00 . Subtotal $= 495.00 + 108.00 = \$603.00$. GST $= \$60.30$. Total $= 603.00 + 60.30 = \$663.30$. (b) Each share $= 663.30 \div 5 = \$132.66$. (c) Over three months, each sets aside $132.66 \div 3 = \$44.22$ per month.

Chapter 9 Household budgeting and costs — 9D Other household expenses

Theory

Running a household means paying for far more than the electricity and water bills. This section looks at the **other major household expenses** and how to bring them together into a **budget**.

Types of household expense.

The largest household cost is usually **housing** — either **rent** (paid to a landlord) or **mortgage repayments** (paid to a bank for a home loan). On top of housing come:

- **council rates** — an annual charge from the local council, often paid in quarterly instalments;
- **insurance** — regular **premiums** for home, contents and car cover;
- **groceries** and household supplies;
- **transport** — fuel, public transport, car registration and servicing.

Fixed and variable expenses.

A **fixed expense** is the same amount each period — for example rent, a mortgage repayment or an insurance premium. A **variable expense** changes from period to period — for example groceries, fuel or the electricity bill. Knowing which costs are fixed and which are variable helps a household plan ahead and find savings.

Insurance: premium and excess.

For insurance you pay a regular **premium** to stay covered. If you make a claim, you also pay a one-off **excess** — an agreed amount you contribute towards the cost. A policy with a **lower premium** often has a **higher excess**, so the cheapest choice depends on whether you expect to make a claim.

Converting between time periods.

Expenses are quoted over different periods, so to compare or add them we convert to a **common period**. Using 52 weeks, 26 fortnights, 12 months and 4 quarters in a year:

$$\text{annual} = \text{weekly} \times 52 = \text{fortnightly} \times 26 = \text{monthly} \times 12 = \text{quarterly} \times 4.$$

To go the other way, divide: a yearly cost divided by 12 is the monthly cost, and divided by 52 is the weekly cost.

Building a budget.

A **budget** lists income and expenses over the same period and compares them:

$$\text{surplus (or deficit)} = \text{total income} - \text{total expenses}.$$

A positive result is a **surplus** (money left over to save); a negative result is a **deficit** (spending more than you earn). Setting the figures out in a table makes the total easy to check.

Worked examples

Example 1 — scaffolded

The Nguyen household records these **weekly** expenses: rent \$ 520, groceries \$ 240, fuel \$ 85 and phone/internet \$ 35. Find the total weekly cost and the total cost for a full year (52 weeks).

Working

$$\text{Weekly total} = 520 + 240 + 85 + 35 = \$ 880.$$

$$\text{Annual cost} = 880 \times 52 = \$ 45\,760.$$

Comment

Add the four weekly amounts.

Multiply the weekly total by 52.

Example 2 — scaffolded

A household's **monthly** income is \$5200. Its expenses are rent \$1800 per month, council rates \$1560 per year, car insurance \$1020 per year, groceries \$900 per month and electricity \$480 per quarter. Convert every expense to a **monthly** amount and find the monthly surplus or deficit.

Working	Comment
Rent = \$1800 and groceries = \$900 are already monthly.	Leave monthly amounts unchanged.
Council rates = $1560 \div 12 = \$130$; car insurance = $1020 \div 12 = \$85$.	Yearly $\div 12$ gives monthly.
Electricity = $480 \div 3 = \$160$ per month.	A quarter is 3 months.
Total expenses = $1800 + 900 + 130 + 85 + 160 = \3075 .	Add the monthly amounts.
Surplus = $5200 - 3075 = \$2125$.	Income – expenses; positive, so a surplus.

Example 3 — unscaffolded

The Patel family has an annual income of \$86 000. Their yearly expenses are mortgage repayments \$24 600, council rates \$2140, insurance \$1860, groceries \$12 480, transport \$6200 and other costs \$9400. Find the total annual expenses, state whether the family has a surplus or deficit, and express that amount as a weekly figure.

Total expenses:

$$24\,600 + 2140 + 1860 + 12\,480 + 6200 + 9400 = \$56\,680.$$

Surplus = $86\,000 - 56\,680 = \$29\,320$, and since income exceeds expenses this is a surplus. Weekly surplus = $29\,320 \div 52 = \$563.85$ (to the nearest cent).

$\therefore$ the Patels spend \$56 680 a year, leaving an annual surplus of \$29 320 — about \$563.85 per week.

Example 4 — unscaffolded

Two car-insurance policies cover the same car. Policy A has a premium of \$960 per year with a \$700 excess; Policy B has a premium of \$1180 per year with a \$300 excess. Compare the total cost of each policy for a year in which the driver makes **one** claim, and for a year with **no** claim.

With one claim you pay the premium plus the excess:

$$A = 960 + 700 = \$1660, B = 1180 + 300 = \$1480.$$

So in a year with a claim, Policy B costs $1660 - 1480 = \$180$ less. With no claim you pay only the premium, so Policy A costs $1180 - 960 = \$220$ less.

$\therefore$ Policy B is cheaper by \$180 if a claim is made, but Policy A is cheaper by \$220 if no claim is made — the better choice depends on whether the driver expects to claim.

Practice questions

Scaffolded

Q1. A household has these weekly costs: rent \$460, groceries \$210 and transport \$95. (a) Find the total weekly cost. (b) Find the total fortnightly cost. (c) Find the total annual cost.

Q2. Classify each expense as **fixed** or **variable**: (a) a monthly mortgage repayment (b) the weekly grocery shopping (c) a yearly car-insurance premium

Q3. Council rates are \$2280 per year, paid in 4 equal quarterly instalments. (a) Find the amount of each quarterly instalment. (b) Find the equivalent monthly cost. (c) Find the equivalent weekly cost (to the nearest cent).

- Q4.** A family's monthly income is \$ 6400 and their total monthly expenses are \$ 5850. (a) Find the monthly surplus. (b) Find the annual surplus. (c) Express the monthly surplus as a percentage of income (to 1 d.p.).
- Q5.** Home insurance has a premium of \$ 1440 per year and a \$ 650 excess per claim. (a) Find the total paid in a year with no claim. (b) Find the total paid in a year with one claim. (c) Find the total paid in a year with two claims.
- Q6.** Convert each amount to an annual figure: (a) rent of \$ 1650 per month (b) fuel of \$ 70 per week (c) contents insurance of \$ 95 per quarter

Unscaffolded

- Q7.** The Rossi household has monthly expenses of rent \$ 2100, groceries \$ 860, transport \$ 430 and other \$ 540, and a monthly income of \$ 4200. Find their monthly surplus or deficit, and state which it is.
- Q8.** Council rates of \$ 1980 per year are paid in 4 quarterly instalments. A household sets aside \$ 180 per month towards the rates. After a full year, will they have set aside enough, and by how much are they over or under?
- Q9.** A weekly grocery bill averages \$ 235. How much is spent on groceries in a year (52 weeks)? If the household reduces the bill by \$ 25 per week, how much would they save in a year?
- Q10.** Two home-insurance policies cover the same house: Policy X has a premium of \$ 880 per year and an \$ 800 excess; Policy Y has a premium of \$ 1120 per year and a \$ 350 excess. For a year with one claim, which policy is cheaper, and by how much?
- Q11.** A family's annual expenses are mortgage \$ 28 800, rates \$ 2400, insurance \$ 2160, groceries \$ 13 000, transport \$ 7800 and other \$ 8640. Find the total annual expenses and the equivalent monthly cost.
- Q12.** A household earns \$ 1500 per week and has fixed weekly expenses of \$ 1180. In one week they have an extra car-repair cost of \$ 540. Find their surplus or deficit for that week.
- Q13.** A car costs the following each year to run: registration \$ 860, insurance \$ 1080, servicing \$ 640, and fuel of \$ 65 per week. Find the total annual cost of running the car.
- Q14.** A household budget allows \$ 1400 per month for groceries. In one month they spend \$ 312, \$ 298, \$ 355 and \$ 289 across four weekly shops. Are they within budget, and by how much?
- Q15.** A family pays rent of \$ 540 per week. Their landlord increases the rent by 6 %. Find the new weekly rent and the extra amount they will pay over a year.
- Q16.** The Kelly household has a monthly income of \$ 7200 and monthly expenses of mortgage \$ 2650, rates \$ 210, insurance \$ 180, groceries \$ 1080, transport \$ 620 and other \$ 1450. Find the total monthly expenses, the monthly surplus, and the surplus as a percentage of income (to 1 d.p.).
- Q17.** A household spends \$ 18 200 on groceries and \$ 9100 on transport in a year. Express the transport cost as a fraction of the grocery cost in simplest form, and as a percentage of the grocery cost.
- Q18.** A family wants to save \$ 6000 in a year for a holiday, and they already have a monthly surplus of \$ 380. (a) How much will they save in a year at the current surplus? (b) Are they on track to reach \$ 6000? By how much are they short or ahead? (c) By how much must they increase their monthly surplus to reach exactly \$ 6000 in the year?
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Answers

Q1. (a) \$ 765. (b) \$ 1530. (c) \$ 39 780. **Q2.** (a) fixed. (b) variable. (c) fixed. **Q3.** (a) \$ 570. (b) \$ 190. (c) \$ 43.85. **Q4.** (a) \$ 550. (b) \$ 6600. (c) 8.6%. **Q5.** (a) \$ 1440. (b) \$ 2090. (c) \$ 2740. **Q6.** (a) \$ 19 800. (b) \$ 3640. (c) \$ 380. **Q7.** \$ 270 surplus. **Q8.** Yes; \$ 180 more than needed. **Q9.** \$ 12 220; saves \$ 1300. **Q10.** Policy Y, by \$ 210. **Q11.** \$ 62 800; \$ 5233.33 per month. **Q12.** \$ 220 deficit. **Q13.** \$ 5960. **Q14.** Within budget, by \$ 146. **Q15.** \$ 572.40; extra \$ 1684.80 over a year. **Q16.** \$ 6190; surplus \$ 1010; 14.0%. **Q17.** $\frac{1}{2}$; 50%. **Q18.** (a) \$ 4560. (b) short by \$ 1440. (c) increase by \$ 120.

Fully-worked solutions

Q1. (a) Weekly total = $460 + 210 + 95 = \$ 765$. (b) Fortnightly = $765 \times 2 = \$ 1530$. (c) Annual = $765 \times 52 = \$ 39\,780$.

Q2. (a) A mortgage repayment is the same each month, so it is **fixed**. (b) Grocery spending changes week to week, so it is **variable**. (c) An insurance premium is set for the year, so it is **fixed**.

Q3. (a) Each instalment = $2280 \div 4 = \$ 570$. (b) Monthly = $2280 \div 12 = \$ 190$. (c) Weekly = $2280 \div 52 = \$ 43.846\dots = \$ 43.85$ (nearest cent).

Q4. (a) Surplus = $6400 - 5850 = \$ 550$. (b) Annual surplus = $550 \times 12 = \$ 6600$. (c) $\frac{550}{6400} \times 100\% = 8.59\dots\% = 8.6\%$ (1 d.p.).

Q5. (a) No claim: only the premium, \$ 1440. (b) One claim: $1440 + 650 = \$ 2090$. (c) Two claims: $1440 + 2 \times 650 = 1440 + 1300 = \$ 2740$.

Q6. (a) $1650 \times 12 = \$ 19\,800$. (b) $70 \times 52 = \$ 3640$. (c) $95 \times 4 = \$ 380$.

Q7. Total expenses = $2100 + 860 + 430 + 540 = \$ 3930$. Surplus = $4200 - 3930 = \$ 270$; since income is greater, it is a surplus.

Q8. Set aside over the year = $180 \times 12 = \$ 2160$. The rates are \$ 1980, so they have $2160 - 1980 = \$ 180$ more than needed — yes, enough, with \$ 180 to spare.

Q9. Annual groceries = $235 \times 52 = \$ 12\,220$. Reducing by \$ 25 each week saves $25 \times 52 = \$ 1300$ over the year.

Q10. With one claim: Policy X = $880 + 800 = \$ 1680$; Policy Y = $1120 + 350 = \$ 1470$. Policy Y is cheaper by $1680 - 1470 = \$ 210$.

Q11. Total = $28\,800 + 2400 + 2160 + 13\,000 + 7800 + 8640 = \$ 62\,800$. Monthly = $62\,800 \div 12 = \$ 5233.33$ (nearest cent).

Q12. Ordinary surplus = $1500 - 1180 = \$ 320$. The extra \$ 540 repair makes the week's balance $320 - 540 = -\$ 220$, that is a \$ 220 **deficit** (equivalently $1500 - (1180 + 540) = -220$).

Q13. Annual fuel = $65 \times 52 = \$ 3380$. Total = $860 + 1080 + 640 + 3380 = \$ 5960$.

Q14. Spent = $312 + 298 + 355 + 289 = \$ 1254$. This is within the \$ 1400 budget, by $1400 - 1254 = \$ 146$.

Q15. New rent = $540 \times 1.06 = \$ 572.40$. The rise is $572.40 - 540 = \$ 32.40$ per week, so over a year $32.40 \times 52 = \$ 1684.80$ extra.

Q16. Total expenses = $2650 + 210 + 180 + 1080 + 620 + 1450 = \$ 6190$. Surplus = $7200 - 6190 = \$ 1010$. As a percentage of income, $\frac{1010}{7200} \times 100\% = 14.02\dots\% = 14.0\%$ (1 d.p.).

Q17. $\frac{9100}{18200} = \frac{1}{2}$ in simplest form, which is 50 % of the grocery cost.

Q18. (a) At \$ 380 per month, in a year they save $380 \times 12 = \$ 4560$. (b) The target is \$ 6000, so they are short by $6000 - 4560 = \$ 1440$. (c) To reach \$ 6000 they need $6000 \div 12 = \$ 500$ per month, an increase of $500 - 380 = \$ 120$ per month.

Chapter 9 Household budgeting and costs — 9E Optimising expenses

Theory

Two households with the same income can end up very differently off, because one **optimises** its spending — it keeps looking for the same goods and services at a lower cost, and trims spending that is not needed. This section is about the arithmetic behind those decisions: comparing options, working out the saving, and deciding when an up-front cost is worth paying.

Comparing two options.

To compare two plans or suppliers fairly, work out the **total cost of each over the same period** (a week, a month or a year) and then compare. Include every part of the cost — a plan with a lower usage rate but a higher fixed charge is not always cheaper.

The saving from switching.

The **dollar saving** is the difference between the two totals:

$$\text{saving} = \text{dearer total} - \text{cheaper total}.$$

The **percentage saving** expresses that as a fraction of the original (dearer) cost:

$$\text{percentage saving} = \frac{\text{saving}}{\text{original cost}} \times 100\%.$$

A percentage makes it easy to see how big a saving really is.

Paying more now to save later.

Sometimes a one-off cost — an energy-efficient appliance, solar panels, an annual pass instead of monthly payments — reduces an ongoing cost. The **payback period** is how long the savings take to cover the up-front cost:

$$\text{payback period} = \frac{\text{extra up-front cost}}{\text{saving per period}}.$$

If you will keep the item for longer than the payback period, the change saves money overall.

Unit pricing: bulk versus single.

Buying in bulk is often, but not always, cheaper. Compare the **unit price** (cost per kilogram, per litre, per item):

$$\text{unit price} = \frac{\text{total cost}}{\text{number of units}}.$$

The lower unit price is the better buy — provided you will actually use it before it is wasted.

Needs, wants and a target.

To reach a savings **target**, first find the current saving (income – spending). The extra you must cut is the target minus the current saving. Trim **wants** (things you could do without) before **needs**, until the cuts add up to what is required.

Worked examples

Example 1 — scaffolded

A household uses about 4500 kWh of electricity a year. Plan A charges a supply fee of 95 cents per day plus 28 cents per kWh; Plan B charges 110 cents per day plus 24 cents per kWh. Using a 365-day year, find the cheaper plan and the yearly saving.

Working	Comment
Plan A supply = $\$0.95 \times 365 = \346.75 ; usage = $\$0.28 \times 4500 = \1260 .	Supply fee per day $\times$ days; rate per kWh $\times$ kWh.
Plan A total = $346.75 + 1260 = \$1606.75$.	Add the two parts.
Plan B supply = $\$1.10 \times 365 = \401.50 ; usage = $\$0.24 \times 4500 = \1080 .	Plan B has a higher supply fee but a lower usage rate.
Plan B total = $401.50 + 1080 = \$1481.50$.	Add the two parts.
Cheaper is Plan B; saving = $1606.75 - 1481.50 = \$125.25$.	Compare the totals over the same year.

Example 2 — scaffolded

A family's old fridge costs about \$310 a year in electricity. An energy-efficient model costs \$455 to buy and costs about \$180 a year to run. Find the yearly saving in running cost and the payback period for the new fridge.

Working	Comment
Yearly saving = $310 - 180 = \$130$.	The new fridge is cheaper to run each year.
Payback period = $\frac{\text{cost}}{\text{yearly saving}} = \frac{455}{130}$.	Time for the savings to cover the \$455.
= 3.5 years.	$130 \times 3.5 = 455$, so after 3.5 years the fridge has paid for itself.

Example 3 — unscaffolded

Coffee pods are sold as a box of 10 for \$6.50 or a bulk box of 60 for \$33.00. Compare the price per pod, and find how much is saved by buying 60 pods as one bulk box instead of as six small boxes.

Unit price of the small box: $\frac{\$6.50}{10} = \0.65 per pod. Unit price of the bulk box: $\frac{\$33.00}{60} = \0.55 per pod. So the bulk box saves $0.65 - 0.55 = \$0.10$ per pod. Sixty pods bought as six small boxes cost $6 \times \$6.50 = \39.00 , compared with \$33.00 for the bulk box.

$\therefore$ the bulk box is \$0.10 cheaper per pod, saving $39.00 - 33.00 = \$6.00$ over 60 pods.

Example 4 — unscaffolded

Each month a household takes home \$3200 and spends: rent \$1400, groceries \$520, transport \$260, subscriptions \$95, eating out \$340 and other \$500. They want to save \$400 a month. Show that they are short of the target, and give a set of cuts that reaches it.

Total spending = $1400 + 520 + 260 + 95 + 340 + 500 = \3115 . Current saving = $3200 - 3115 = \$85$, which is below the \$400 target. Extra to cut = $400 - 85 = \$315$. Cutting eating out by \$190 (to \$150), subscriptions by \$65 (to \$30) and other by \$60 (to \$440) saves $190 + 65 + 60 = \$315$.

$\therefore$ the household currently saves only \$85; trimming those three "wants" by \$315 in total lifts the saving to $85 + 315 = \$400$, meeting the target.

Practice questions

Scaffolded

Q1. Two phone plans are compared over one year. Plan X costs \$45 a month. Plan Y costs \$39 a month plus a one-off \$60 handset fee. (a) Find the yearly cost of Plan X. (b) Find the yearly cost of Plan Y. (c) State the cheaper plan and the yearly saving.

- Q2.** A household switches its internet from an old plan of \$85 a month to a new plan of \$70 a month. (a) Find the monthly saving. (b) Find the yearly saving. (c) Find the percentage saving on the old cost, to the nearest whole per cent.
- Q3.** Rice is sold as a 1 kg pack for \$3.20 or a 5 kg bag for \$13.50. (a) Find the price per kilogram of the 1 kg pack. (b) Find the price per kilogram of the 5 kg bag. (c) Find the saving per kilogram by buying the bag, in cents.
- Q4.** A set of LED bulbs costs \$48 to install and saves about \$32 a year on power. (a) Find the payback period, in years. (b) Find the total power saving over 5 years, and the net saving after the \$48 cost. (c) Would the bulbs be worth installing if you were going to move house in one year? Explain.
- Q5.** A household earns \$2800 a month and spends \$2650. They want to save \$300 a month. (a) Find the current monthly saving. (b) Find how much more they must cut to reach the target. (c) If they cut a \$60 streaming service and \$120 of takeaway, do they reach the target? Explain.
- Q6.** Two gyms are compared over one year (52 weeks). Gym A costs \$22 a week. Gym B costs \$15 a week plus a one-off \$99 joining fee. (a) Find the yearly cost of Gym A. (b) Find the yearly cost of Gym B. (c) State the cheaper gym and the yearly saving.

Unscaffolded

- Q7.** A worker buys a \$4.50 coffee 5 days a week. A coffee machine costs \$120 and makes each cup for about \$0.80. Over 48 weeks, compare the cost of buying coffee with the cost of the machine plus home-made cups, and state the saving.
- Q8.** A household using 3600 kWh a year compares two electricity plans over a 365-day year. Plan P: 30 cents per kWh plus 90 cents per day. Plan Q: 26 cents per kWh plus 115 cents per day. Find the cheaper plan and the yearly saving.
- Q9.** A water-saving showerhead costs \$45 and saves about \$78 a year on the water bill. Find the payback period in months, to the nearest tenth of a month.
- Q10.** Nappies are sold as a 30-pack for \$12.00 or a 120-box for \$36.00. (a) Find the price per nappy for each. (b) Find the saving per nappy by buying the box. (c) Find the saving on 120 nappies by buying the box instead of four 30-packs.
- Q11.** A car insurance policy costs \$85 a month if paid monthly, or \$960 if paid once a year. Find the saving from paying annually, and express it as a percentage of the monthly-payment total (to 1 decimal place).
- Q12.** A household pays for three streaming services at \$16, \$14 and \$11 a month. To save money they cancel the \$11 service. (a) Find the new monthly cost. (b) Find the yearly saving from cancelling.
- Q13.** Switching to a cheaper grocery brand saves a family \$6.50 a week. Find the saving over one year (52 weeks) and over three years.
- Q14.** A solar system costs \$4500 to install and saves about \$95 a month on electricity. (a) Find the payback period, in years, to 1 decimal place. (b) Find the net saving over 10 years, after the installation cost.
- Q15.** Driving to work costs a commuter about \$85 a week; public transport would cost \$45 a week. (a) Find the yearly saving (52 weeks) from switching to public transport. (b) A yearly public-transport pass costs \$1800 instead of the weekly fares. Find the yearly saving of the pass compared with driving.
- Q16.** A household earns \$3600 a month, with fixed costs of \$2400 and discretionary spending of \$900. They want to save \$500 a month. (a) Find the current monthly saving. (b) Find how much must be cut from discretionary spending to reach the target, and the new discretionary amount.
- Q17.** Coffee beans are sold as a 250 g pack for \$9.00 or a 1 kg bag for \$28.00. (a) Find the price per 100 g for each. (b) Find how much is saved by buying 1 kg as the bag instead of as four 250 g packs.

Q18. A family switches electricity (saving \$ 18 a month), cancels one subscription (saving \$ 15 a month), and buys an efficient fridge for \$ 520 that saves \$ 11 a month. (a) Find the combined monthly saving from the switch and the cancellation. (b) Find how many whole months the fridge takes to pay for itself from its own saving. (c) Find the total monthly saving once the fridge has paid for itself.

Answers

Q1. (a) \$540. (b) \$528. (c) Plan Y, saving \$12. **Q2.** (a) \$15. (b) \$180. (c) 18%. **Q3.** (a) \$3.20. (b) \$2.70. (c) 50 cents. **Q4.** (a) 1.5 years. (b) \$160 saved; net \$112. (c) No — the payback period (1.5 years) is longer than the one year you would stay. **Q5.** (a) \$150. (b) \$150. (c) Yes — the cuts total $\$180 \geq \150 , lifting the saving to \$330. **Q6.** (a) \$1144. (b) \$879. (c) Gym B, saving \$265. **Q7.** Bought \$1080; machine \$312; saving \$768. **Q8.** Plan Q (\$1355.75 vs \$1408.50); saving \$52.75. **Q9.** 6.9 months. **Q10.** (a) \$0.40 and \$0.30. (b) \$0.10. (c) \$12. **Q11.** Saving \$60; 5.9%. **Q12.** (a) \$30. (b) \$132. **Q13.** \$338 a year; \$1014 over three years. **Q14.** (a) 3.9 years. (b) \$6900. **Q15.** (a) \$2080. (b) \$2620. **Q16.** (a) \$300. (b) cut \$200; new discretionary \$700. **Q17.** (a) \$3.60 and \$2.80 per 100 g. (b) \$8. **Q18.** (a) \$33. (b) 48 months. (c) \$44.

Fully-worked solutions

Q1. (a) Plan X: $\$45 \times 12 = \540 . (b) Plan Y: $\$39 \times 12 + \$60 = 468 + 60 = \$528$. (c) Plan Y is cheaper by $540 - 528 = \$12$ over the year.

Q2. (a) Monthly saving $= 85 - 70 = \$15$. (b) Yearly saving $= 15 \times 12 = \$180$. (c) Percentage saving $= \frac{15}{85} \times 100\% = 17.6\ldots\% \approx 18\%$.

Q3. (a) $\frac{\$3.20}{1} = \3.20 per kg. (b) $\frac{\$13.50}{5} = \2.70 per kg. (c) Saving $= 3.20 - 2.70 = \$0.50 = 50$ cents per kg.

Q4. (a) Payback $= \frac{48}{32} = 1.5$ years. (b) Over 5 years the saving is $32 \times 5 = \$160$; after the \$48 cost the net saving is $160 - 48 = \$112$. (c) No. The bulbs take 1.5 years to pay for themselves, but you would only benefit for 1 year before moving, so you would not recover the \$48.

Q5. (a) Current saving $= 2800 - 2650 = \$150$. (b) Extra to cut $= 300 - 150 = \$150$. (c) The cuts total $60 + 120 = \$180$, which is at least the \$150 needed, so the saving rises to $150 + 180 = \$330$ — the target is reached.

Q6. (a) Gym A: $\$22 \times 52 = \1144 . (b) Gym B: $\$15 \times 52 + \$99 = 780 + 99 = \$879$. (c) Gym B is cheaper by $1144 - 879 = \$265$ over the year.

Q7. Buying coffee: $\$4.50 \times 5 \times 48 = \1080 . Machine and home-made cups: $\$120 + \$0.80 \times 5 \times 48 = 120 + 192 = \312 . Saving $= 1080 - 312 = \$768$.

Q8. Plan P $= \$0.30 \times 3600 + \$0.90 \times 365 = 1080 + 328.50 = \1408.50 . Plan Q $= \$0.26 \times 3600 + \$1.15 \times 365 = 936 + 419.75 = \1355.75 . Plan Q is cheaper by $1408.50 - 1355.75 = \$52.75$.

Q9. Payback $= \frac{45}{78}$ years $= 0.5769\ldots$ years. In months, $0.5769\ldots \times 12 = 6.9$ months (to 1 d.p.).

Q10. (a) 30-pack: $\frac{\$12.00}{30} = \0.40 each. 120-box: $\frac{\$36.00}{120} = \0.30 each. (b) Saving per nappy $= 0.40 - 0.30 = \$0.10$. (c) Four 30-packs cost $4 \times \$12 = \48 , against \$36 for the box, a saving of $48 - 36 = \$12$.

Q11. Paying monthly costs $\$85 \times 12 = \1020 a year. Paying annually costs \$960, a saving of $1020 - 960 = \$60$. As a percentage of the monthly-payment total, $\frac{60}{1020} \times 100\% = 5.9\%$ (to 1 d.p.).

Q12. (a) Keeping the \$16 and \$14 services: $16 + 14 = \$30$ a month. (b) The cancelled service was \$11 a month, so the yearly saving is $11 \times 12 = \$132$.

Q13. One year: $\$6.50 \times 52 = \338 . Three years: $338 \times 3 = \$1014$.

Q14. (a) Yearly saving = $\$95 \times 12 = \1140 . Payback = $\frac{4500}{1140} = 3.9$ years (to 1 d.p.). (b) Over 10 years the saving is $1140 \times 10 = \$11\,400$; after the $\$4500$ cost the net saving is $11\,400 - 4500 = \$6900$.

Q15. (a) Weekly saving = $85 - 45 = \$40$, so yearly = $40 \times 52 = \$2080$. (b) Driving costs $\$85 \times 52 = \4420 a year; the pass costs $\$1800$, a saving of $4420 - 1800 = \$2620$.

Q16. (a) Current saving = $3600 - 2400 - 900 = \$300$. (b) To save $\$500$ they must cut $500 - 300 = \$200$ more from discretionary spending, leaving $900 - 200 = \$700$.

Q17. (a) 250 g pack: $\frac{\$9.00}{2.5} = \3.60 per 100 g. 1 kg bag: $\frac{\$28.00}{10} = \2.80 per 100 g. (b) Four 250 g packs cost $4 \times \$9 = \36 , against $\$28$ for the 1 kg bag, a saving of $36 - 28 = \$8$.

Q18. (a) Combined monthly saving from the switch and cancellation = $18 + 15 = \$33$. (b) The fridge saves $\$11$ a month, so it pays for itself in $\frac{520}{11} = 47.3\dots$ months, that is 48 whole months. (c) Once the fridge is paid off, the total monthly saving is $33 + 11 = \$44$.

Chapter 9 Household budgeting and costs — 9F Communications plans

Theory

Almost every household pays for **communications** — a mobile phone, home internet, or both. Choosing well means comparing plans on the same footing and matching a plan to how much you actually use.

What a plan includes.

A typical plan has:

- a fixed **monthly fee** (sometimes called the plan cost or access fee);
- an **inclusion** — an amount of **data** (measured in gigabytes, GB), and usually calls and texts (often “unlimited”);
- **excess-usage charges** for going over the inclusion — extra data charged per GB, or per fixed **block** of data, and calls charged per minute.

Total monthly cost.

If your usage is within the inclusion, you pay just the monthly fee. If you go over, you add the excess charge:

$$\text{total} = \text{monthly fee} + \text{excess charge}.$$

Excess data is often billed in whole **blocks** (for example, per 1 GB or per 5 GB), and a part-block is **rounded up** to the next whole block — you pay for a block as soon as you start using it.

Prepaid and postpaid.

On a **postpaid** plan you use the service and are billed at the end of the month (so an excess charge is possible). On a **prepaid** plan you pay first for a set amount that lasts a set number of days; when it runs out you **recharge**. Prepaid avoids surprise excess charges but you may need several recharges to cover a long period.

Comparing value.

Two useful comparisons are:

- **cost per GB** of the included data, $\frac{\text{monthly fee}}{\text{data included}}$ — lower is better value per gigabyte;
- the **total cost for your own usage** — work out what each plan would cost for the *same* amount of use, then choose the cheapest.

The cheapest monthly fee is not always the cheapest plan: a low fee with a small inclusion can cost far more once excess charges are added.

Worked examples

Example 1 — scaffolded

A mobile plan costs \$45 per month and includes 40 GB of data. Extra data is charged at \$10 per GB. In one month Dana uses 46 GB. Find the total cost for the month.

Working

Included data is 40 GB; Dana used 46 GB.

Excess = $46 - 40 = 6$ GB.

Excess charge = $6 \times \$10 = \60 .

Total = $\$45 + \$60 = \$105$.

Comment

Compare usage with the inclusion.

Only the amount *over* 40 GB is charged.

Extra data at \$10 per GB.

Monthly fee plus excess.

Example 2 — scaffolded

Two plans are advertised: **Plan A** is \$30 per month with 15 GB included, and **Plan B** is \$36 per month with 40 GB included. Compare their value using the cost per GB of included data.

Working

Comment

$$\text{Plan A: cost per GB} = \frac{\$30}{15} = \$2.00 \text{ per GB.}$$

Monthly fee $\div$ data included.

$$\text{Plan B: cost per GB} = \frac{\$36}{40} = \$0.90 \text{ per GB.}$$

Same calculation for Plan B.

$\$0.90 < \2.00 , so Plan B gives more data for each dollar.

Lower cost per GB is better value.

Example 3 — unscaffolded

A phone plan costs \$35 per month, includes unlimited calls and texts and 30 GB of data, and charges extra data at \$15 per 5 GB block (any part-block is rounded up to a whole block). In one month the user uses 41 GB. Find the total cost.

The excess data is $41 - 30 = 11$ GB. The number of 5 GB blocks needed is $11 \div 5 = 2.2$, rounded up to 3 blocks. The excess charge is $3 \times \$15 = \45 . The total is $\$35 + \$45 = \$80$.

$\therefore$ the month costs \$80.

Example 4 — unscaffolded

A household that uses about 60 GB of data each month is choosing between three internet plans:

Plan	Monthly fee	Included data	Excess
X	\$50	100 GB	—
Y	\$40	50 GB	\$10 per GB
Z	\$55	unlimited	—

Work out each plan's cost for 60 GB and state which is cheapest.

Plan X: 60 GB is within 100 GB, so the cost is the fee, \$50. Plan Y: excess = $60 - 50 = 10$ GB, charged at \$10 per GB = \$100, so the cost is $\$40 + \$100 = \$140$. Plan Z: data is unlimited, so the cost is the fee, \$55. Comparing \$50, \$140 and \$55, Plan X is cheapest.

$\therefore$ for 60 GB a month, Plan X at \$50 is the best value — even though Plan Y has the lowest monthly fee, its excess charge makes it by far the dearest.

Practice questions

Scaffolded

Q1. A mobile plan costs \$40 per month and includes 30 GB of data. Extra data is charged at \$10 per GB. (a) How much data is included for the \$40? (b) In a month Priya uses 34 GB. How many GB over the included amount is this? (c) Find her total cost for the month.

Q2. Plan C is \$28 per month with 8 GB included; Plan D is \$50 per month with 40 GB included. (a) Find the cost per GB of included data for Plan C. (b) Find the cost per GB of included data for Plan D. (c) Which plan gives better value per GB of included data?

Q3. A prepaid plan is \$20 for 10 GB. Extra data is \$5 per 2 GB block, and part-blocks are rounded up. Sam uses 13 GB. (a) How many GB over 10 GB is this? (b) How many 2 GB blocks must Sam pay for? (c) Find the total cost.

Q4. A plan has a \$15 monthly fee with unlimited standard calls, but charges \$0.30 per text and \$0.50 per minute for international calls. In one month Lee sends 20 texts and makes 12 minutes of international calls. (a) Find the charge for the texts. (b) Find the charge for the international calls. (c) Find the total monthly cost.

Q5. A home internet plan is \$70 per month. A rival plan is \$65 per month but has a one-off \$90 set-up fee. (a) Find the cost of the first plan over 12 months. (b) Find the cost of the rival plan over 12 months. (c) Which is cheaper over 12 months, and by how much?

Q6. A plan includes 50 GB for \$45 per month, with excess data at \$10 per GB. (a) Find the total cost in a month when 48 GB is used. (b) Find the total cost in a month when 53 GB is used. (c) One month the bill was \$85. How many GB were used?

Un scaffolded

Q7. A \$55 per month plan includes 60 GB of data, with extra data at \$8 per GB. Find the total cost in a month when 67 GB is used.

Q8. Plan A is \$45 per month with 80 GB; Plan B is \$60 per month with unlimited data. For a user who uses 75 GB each month, which plan is cheaper, and by how much?

Q9. A prepaid recharge is \$30 for 25 GB and lasts 30 days. Find (a) the cost per GB, and (b) the cost per day.

Q10. A plan is \$25 per month with 5 GB included; extra data is \$6 per 3 GB block, rounded up. Find the total cost in a month when 12 GB is used.

Q11. For a user who uses 20 GB each month, compare Plan M (\$30 per month, 15 GB included, \$10 per GB excess) with Plan N (\$45 per month, 25 GB included). Which is cheaper, and by how much?

Q12. A plan charges a \$10 monthly fee plus \$0.25 per text and \$0.90 per minute for calls. In a month a user sends 40 texts and talks for 60 minutes. Find the total cost.

Q13. Home internet Plan R is \$79 per month. Plan S is \$69 per month plus a one-off \$120 modem fee. After how many months is the total cost of the two plans equal?

Q14. A \$50 per month plan includes 100 GB, with excess at \$9 per GB. A household uses 100 GB in January, 112 GB in February and 95 GB in March. Find the total cost over the three months.

Q15. A user currently pays \$36 per month for 30 GB. They are considering a \$48 per month plan with 60 GB. Find (a) the extra cost per month of upgrading, and (b) the extra GB gained for each extra dollar spent.

Q16. A prepaid plan gives 8 GB for \$15 and lasts 28 days. A user needs this amount of data continuously for a full year of 365 days. Find how many recharges are needed and the total cost for the year.

Q17. A user needing 40 GB each month compares two plans over a 24-month period: Plan X (\$40 per month, 50 GB included) and Plan Y (\$30 per month, 30 GB included, \$5 per GB excess). Find the total cost of each plan over 24 months and state which is cheaper.

Q18. A family plan is \$90 per month and includes four SIM cards sharing 120 GB, with excess data at \$10 per GB. In one month the four members use 35, 28, 40 and 25 GB. (a) Find the total data used. (b) Determine the total monthly cost. (c) Find the average cost per SIM card for the month.

Answers

Q1. (a) 30 GB. (b) 4 GB. (c) \$80. **Q2.** (a) \$3.50 per GB. (b) \$1.25 per GB. (c) Plan D. **Q3.** (a) 3 GB. (b) 2 blocks. (c) \$30. **Q4.** (a) \$6.00. (b) \$6.00. (c) \$27.00. **Q5.** (a) \$840. (b) \$870. (c) The first plan, by \$30. **Q6.** (a) \$45. (b) \$75. (c) 54 GB. **Q7.** \$111. **Q8.** Plan A, by \$15. **Q9.** (a) \$1.20 per GB. (b) \$1.00 per day. **Q10.** \$43. **Q11.** Plan N, by \$35. **Q12.** \$74. **Q13.** 12 months. **Q14.** \$258. **Q15.** (a) \$12 per month. (b) 2.5 GB per extra dollar. **Q16.** 14 recharges; \$210. **Q17.** Plan X \$960; Plan Y \$1920; Plan X is cheaper. **Q18.** (a) 128 GB. (b) \$170. (c) \$42.50.

Fully-worked solutions

Q1. (a) The plan includes 30 GB. (b) Excess = $34 - 30 = 4$ GB. (c) Excess charge = $4 \times \$10 = \40 , so total = $\$40 + \$40 = \$80$.

Q2. (a) Plan C: $\frac{\$28}{8} = \3.50 per GB. (b) Plan D: $\frac{\$50}{40} = \1.25 per GB. (c) Plan D costs less per GB ($\$1.25 < \3.50), so Plan D is better value per GB of included data.

Q3. (a) Excess = $13 - 10 = 3$ GB. (b) Blocks = $3 \div 2 = 1.5$, rounded up to 2 blocks. (c) Excess charge = $2 \times \$5 = \10 , so total = $\$20 + \$10 = \$30$.

Q4. (a) Texts: $20 \times \$0.30 = \6.00 . (b) International calls: $12 \times \$0.50 = \6.00 . (c) Total = $\$15 + \$6.00 + \$6.00 = \27.00 .

Q5. (a) First plan: $12 \times \$70 = \840 . (b) Rival: $12 \times \$65 + \$90 = \$780 + \$90 = \$870$. (c) $\$840 < \870 , so the first plan is cheaper by $\$870 - \$840 = \$30$.

Q6. (a) 48 GB is within the 50 GB inclusion, so the cost is just \$45. (b) Excess = $53 - 50 = 3$ GB, charged $3 \times \$10 = \30 , so total = $\$45 + \$30 = \$75$. (c) The excess part of the bill is $\$85 - \$45 = \$40$, which is $40 \div 10 = 4$ GB of excess, so usage = $50 + 4 = 54$ GB.

Q7. Excess = $67 - 60 = 7$ GB, charged $7 \times \$8 = \56 . Total = $\$55 + \$56 = \$111$.

Q8. Plan A: 75 GB is within 80 GB, so it costs \$45. Plan B: unlimited, so it costs \$60. Plan A is cheaper by $\$60 - \$45 = \$15$.

Q9. (a) Cost per GB = $\frac{\$30}{25} = \1.20 per GB. (b) Cost per day = $\frac{\$30}{30} = \1.00 per day.

Q10. Excess = $12 - 5 = 7$ GB. Blocks = $7 \div 3 = 2.33\dots$, rounded up to 3 blocks. Excess charge = $3 \times \$6 = \18 , so total = $\$25 + \$18 = \$43$.

Q11. Plan M: excess = $20 - 15 = 5$ GB, charged $5 \times \$10 = \50 , total = $\$30 + \$50 = \$80$. Plan N: 20 GB is within 25 GB, so it costs \$45. Plan N is cheaper by $\$80 - \$45 = \$35$.

Q12. Texts: $40 \times \$0.25 = \10 . Calls: $60 \times \$0.90 = \54 . Total = $\$10 + \$10 + \$54 = \74 .

Q13. Set the totals equal after m months: $79m = 69m + 120$. Then $10m = 120$, so $m = 12$ months.

Q14. January: 100 GB, no excess, \$50. February: excess = $112 - 100 = 12$ GB, charged $12 \times \$9 = \108 , total $\$50 + \$108 = \$158$. March: 95 GB, no excess, \$50. Total = $\$50 + \$158 + \$50 = \258 .

Q15. (a) Extra cost = $\$48 - \$36 = \$12$ per month. (b) Extra data = $60 - 30 = 30$ GB, so extra GB per extra dollar = $30 \div 12 = 2.5$ GB per dollar.

Q16. Number of recharges = $365 \div 28 = 13.03\dots$, rounded up to 14 recharges (thirteen recharges last only $13 \times 28 = 364$ days). Total cost = $14 \times \$15 = \210 .

Q17. Plan X: 40 GB is within 50 GB, so it costs \$40 per month; over 24 months, $24 \times \$40 = \960 . Plan Y: excess $= 40 - 30 = 10$ GB, charged $10 \times \$5 = \50 , so the monthly cost is $\$30 + \$50 = \$80$; over 24 months, $24 \times \$80 = \1920 . Plan X (\$960) is far cheaper than Plan Y (\$1920), because Plan Y's small inclusion means an excess charge every month.

Q18. (a) Total data $= 35 + 28 + 40 + 25 = 128$ GB. (b) Excess $= 128 - 120 = 8$ GB, charged $8 \times \$10 = \80 , so total $= \$90 + \$80 = \$170$. (c) Average per SIM $= \$170 \div 4 = \42.50 .

Chapter 9 Household budgeting and costs — 9G Inflation and CPI

Theory

Over time, most prices slowly **rise**. The coffee, rent or bus fare that costs one amount this year usually costs a little more next year. This general, ongoing rise in prices is called **inflation**, and it is one of the most important ideas in managing a household budget.

Measuring inflation.

Inflation is measured as an annual **percentage increase** in prices. If prices rise by 3 % in a year, then something that cost \$ 100 at the start of the year costs about \$ 103 at the end. To apply an inflation rate to a price for **one year**:

$$\text{new price} = \text{old price} \times \left(1 + \frac{\text{rate}}{100}\right).$$

For example, with 4 % inflation a \$ 50 item becomes $50 \times 1.04 = \$ 52$.

The Consumer Price Index (CPI).

To track the prices of *many* goods and services at once, the government measures the cost of a fixed “basket” of typical household items and reports it as the **Consumer Price Index (CPI)**. The CPI is an **index number**: one period is chosen as the base and set to 100, and every other period is measured against it. A CPI of 128.4 means prices are 28.4 % higher than in the base period (when the index was 100).

Finding the inflation rate between two years.

The inflation rate from one year to the next is the **percentage change** in the CPI:

$$\text{inflation rate} = \frac{\text{CPI}_{\text{later}} - \text{CPI}_{\text{earlier}}}{\text{CPI}_{\text{earlier}}} \times 100 \%.$$

(This is just the percentage-change formula applied to index numbers. Because each year’s CPI is given to us directly, we never need to “compound” a rate over several years — we simply compare the two index numbers.)

Purchasing power.

When prices rise, a fixed amount of money buys **less** than it used to — its **purchasing power** falls. If prices rise 4 %, then goods costing \$ 50 now will cost \$ 52 next year, so \$ 50 next year will *not* stretch as far. Money held as cash quietly loses value to inflation.

Beating inflation.

A pay rise only leaves you better off in **real terms** if it is **bigger than inflation**. If your pay rises 2.5 % but prices rise 3.2 %, you can actually afford slightly *less* than before, even though the dollar figure went up. Comparing a pay rise (or a pension or interest rate) against the inflation rate tells you whether you are really getting ahead.

Worked examples

Example 1 — scaffolded

A family’s weekly grocery bill is currently \$ 240. Over the next year, grocery prices are expected to rise with inflation of 3.5 %. Find the new weekly grocery bill.

Working

Comment

The bill rises by 3.5 %, so multiply by $1 + \frac{3.5}{100} = 1.035$.

Adding 3.5 % means multiplying by 1.035.

New bill = $240 \times 1.035 = \$ 248.40$.

Type 240×1.035 on the calculator.

Check: the increase is $240 \times 0.035 = \$8.40$, and
 $240 + 8.40 = \$248.40$.

The rise of \$8.40 is a reasonable weekly increase.

Example 2 — scaffolded

The Consumer Price Index for a country was 132.5 one year and 137.1 the next. Find the annual inflation rate, correct to 1 decimal place.

$$\text{Inflation rate} = \frac{\text{CPI}_{\text{later}} - \text{CPI}_{\text{earlier}}}{\text{CPI}_{\text{earlier}}} \times 100\%.$$

Percentage change in the CPI.

$$= \frac{137.1 - 132.5}{132.5} \times 100\% = \frac{4.6}{132.5} \times 100\%.$$

Find the rise in the index first.

$$= 3.4717\ldots\% \approx 3.5\%.$$

Round to 1 decimal place.

Example 3 — unscaffolded

A retiree spends \$850 each month on essential items. If inflation over the next year is 4%, find what those same essentials will cost each month next year, and how much extra the retiree must budget each month.

Applying 4% inflation to the monthly cost:

$$850 \times 1.04 = \$884.00.$$

The extra amount needed each month is

$$884 - 850 = \$34.00.$$

$\therefore$ the same essentials will cost \$884 per month, so the retiree must budget an extra \$34 per month.

Example 4 — unscaffolded

A worker earning \$58 000 per year is given a pay rise of 2.5%, in a year when inflation is 3.2%. Find the new salary, and decide whether the worker is better or worse off in real terms.

The new salary is

$$58\,000 \times 1.025 = \$59\,450.$$

To just keep pace with 3.2% inflation, the salary would need to be

$$58\,000 \times 1.032 = \$59\,856.$$

Because the new salary \$59 450 is **less** than \$59 856, the pay rise has not kept up with prices. The shortfall is

$$59\,856 - 59\,450 = \$406.$$

$\therefore$ the worker is **worse off** in real terms: the 2.5% rise is smaller than 3.2% inflation, leaving them about \$406 short of keeping their buying power.

Practice questions

Scaffolded

Q1. A loaf of bread costs \$4.20. Inflation is 5%. (a) Find the increase in price (5% of \$4.20). (b) Find the new price of the loaf. (c) If inflation had instead been 8%, what would the new price be (to the nearest cent)?

Q2. The CPI for three consecutive years was: Year 1 = 100.0, Year 2 = 103.6, Year 3 = 106.8. (a) Find the inflation rate from Year 1 to Year 2. (b) Find the inflation rate from Year 2 to Year 3 (to 1 decimal place). (c) In which of the two years was inflation higher?

Q3. Prices rise by 4 % over one year. (a) Goods that cost \$ 50 now — how much will they cost next year? (b) How much extra is that? (c) If you have only \$ 50 next year, can you still afford those goods? Explain.

Q4. A worker earning \$ 45 000 receives a 3 % pay rise, in a year when inflation is 2 %. (a) Find the new salary. (b) Find the salary that would just keep pace with inflation. (c) State whether the worker is better or worse off in real terms, and by how much.

Q5. A weekly rent of \$ 380 rises with inflation of 6 %. (a) Find the new weekly rent. (b) Find the extra rent per week. (c) Find the extra rent over a full year (52 weeks).

Q6. In a base year (index 100) a basket of goods is measured. Eight years later the CPI is 128.4. (a) By what percentage have prices risen since the base year? (b) An item that cost \$ 200 in the base year would cost about how much now, using the index?

Un scaffolded

Q7. A café currently charges \$ 4.50 for a coffee. It raises the price by 4 % to cover inflation. Find the new price, and state the price if the café rounds it up to the nearest 10 cents.

Q8. The CPI rose from 145.2 to 149.8 over one year. Find the annual inflation rate, correct to 1 decimal place.

Q9. Sara keeps \$ 1000 as cash in a drawer for a year. If inflation is 3 %, find what that \$ 1000 is worth in today's buying power at the end of the year (that is, $\$ 1000 \div 1.03$), to the nearest cent, and explain what this shows about holding cash.

Q10. A pension of \$ 28 000 per year is increased by 2.8 %, in a year when inflation is 3.5 %. Find the new pension, the amount needed to keep pace with inflation, and state whether the pensioner is better or worse off, and by how much.

Q11. A household's electricity bill is \$ 520 per quarter. With inflation of 7 %, find the new quarterly bill, the extra per quarter, and the extra over a full year (four quarters).

Q12. The CPI over four years was: 2020 = 112.0, 2021 = 115.9, 2022 = 124.3, 2023 = 131.0. Find the inflation rate for each year (to 1 decimal place) and state which year had the highest inflation.

Q13. An appliance cost \$ 80 some years ago, when the CPI was 105.0. The CPI is now 126.0. Using the index, estimate what the appliance would cost now.

Q14. A worker earning \$ 62 000 wants a pay rise that at least keeps pace with inflation of 3.4 %. Find the minimum new salary (to the nearest dollar) that would keep pace, and state what salary would be needed to *beat* inflation.

Q15. A student's weekly grocery spend is \$ 180. With inflation of 4.5 %, find the new weekly spend, the extra per week, and the extra over a full year (52 weeks).

Q16. After a year in which prices rose 5 %, a basket of goods now costs \$ 315. Find what the same basket cost a year ago.

Q17. Between 2019 (CPI 100) and 2024 the CPI rose to 119.2. (a) By what percentage did prices rise over this period? (b) A weekly rent of \$ 400 in 2019 would be about how much in 2024, using the index? (c) If wages over the same period rose by 15 %, did they keep up with prices? Explain.

Q18. A retiree's essential monthly costs are currently \$ 1450. Inflation next year is forecast at 3.6 %. (a) Find the new monthly cost. (b) Find the extra amount needed over a full year. (c) The retiree's income (currently $\$ 1450 \times 12 = \$ 17\,400$ per year) will rise by only 2 %. Determine whether this rise covers the increase in costs, and by how much it falls short if it does not.

Answers

Q1. (a) \$0.21. (b) \$4.41. (c) \$4.54. **Q2.** (a) 3.6%. (b) 3.1%. (c) Year 1 to Year 2 (3.6% > 3.1%). **Q3.** (a) \$52. (b) \$2. (c) No — the goods now cost \$52, so \$50 falls \$2 short. **Q4.** (a) \$46 350. (b) \$45 900. (c) Better off by \$450 (3% > 2%). **Q5.** (a) \$402.80. (b) \$22.80. (c) \$1185.60. **Q6.** (a) 28.4%. (b) \$256.80. **Q7.** \$4.68; rounded up to \$4.70. **Q8.** 3.2%. **Q9.** \$970.87; cash loses buying power to inflation. **Q10.** New \$28 784; keep-pace \$28 980; worse off by \$196. **Q11.** \$556.40 per quarter; extra \$36.40 per quarter; \$145.60 per year. **Q12.** 2020–21: 3.5%; 2021–22: 7.2%; 2022–23: 5.4%; highest 2021–22. **Q13.** \$96. **Q14.** Keep pace: \$64 108; to beat inflation, more than \$64 108. **Q15.** New \$188.10; extra \$8.10 per week; \$421.20 per year. **Q16.** \$300. **Q17.** (a) 19.2%. (b) \$476.80. (c) No — wages rose 15% but prices rose 19.2%, so real wages fell. **Q18.** (a) \$1502.20. (b) \$626.40. (c) No — a 2% rise is \$348, which falls \$278.40 short of the \$626.40 increase.

Fully-worked solutions

Q1. (a) Increase = $4.20 \times 0.05 = \$0.21$. (b) New price = $4.20 \times 1.05 = \$4.41$ (equivalently $4.20 + 0.21$). (c) At 8%: $4.20 \times 1.08 = 4.536$, which rounds to \$4.54.

Q2. (a) Year 1 to Year 2: $\frac{103.6 - 100.0}{100.0} \times 100\% = 3.6\%$. (b) Year 2 to Year 3:

$\frac{106.8 - 103.6}{103.6} \times 100\% = \frac{3.2}{103.6} \times 100\% = 3.0888\ldots\% \approx 3.1\%$. (c) 3.6% > 3.1%, so inflation was higher from

Year 1 to Year 2.

Q3. (a) $50 \times 1.04 = \$52$. (b) Extra = $52 - 50 = \$2$. (c) No: next year the goods cost \$52, so \$50 is \$2 short — the money buys less than it did, which is exactly what inflation does to purchasing power.

Q4. (a) New salary = $45\,000 \times 1.03 = \$46\,350$. (b) Keeping pace with 2%: $45\,000 \times 1.02 = \$45\,900$. (c) $\$46\,350 > \$45\,900$, so the worker is **better off** in real terms, by $46\,350 - 45\,900 = \$450$ (because the 3% rise beat 2% inflation).

Q5. (a) New rent = $380 \times 1.06 = \$402.80$. (b) Extra per week = $402.80 - 380 = \$22.80$. (c) Over 52 weeks: $22.80 \times 52 = \$1185.60$.

Q6. (a) The index has risen from 100 to 128.4, a rise of 28.4, so prices are 28.4% higher. (b) An item scales with the index: $200 \times \frac{128.4}{100} = 200 \times 1.284 = \256.80 .

Q7. New price = $4.50 \times 1.04 = \$4.68$. Rounded up to the nearest 10 cents, the café would charge \$4.70.

Q8. $\frac{149.8 - 145.2}{145.2} \times 100\% = \frac{4.6}{145.2} \times 100\% = 3.168\ldots\% \approx 3.2\%$.

Q9. In today's buying power, \$1000 after a year of 3% inflation is worth $\frac{1000}{1.03} = \$970.87$ (to the nearest cent). The cash still says \$1000, but it now buys only about \$970.87 worth of goods at last year's prices — holding cash loses value to inflation.

Q10. New pension = $28\,000 \times 1.028 = \$28\,784$. To keep pace with 3.5% inflation it would need to be $28\,000 \times 1.035 = \$28\,980$. Since $\$28\,784 < \$28\,980$, the pensioner is **worse off**, by $28\,980 - 28\,784 = \$196$.

Q11. New bill = $520 \times 1.07 = \$556.40$. Extra per quarter = $556.40 - 520 = \$36.40$. Over four quarters: $36.40 \times 4 = \$145.60$ extra per year.

Q12. 2020 – 21: $\frac{115.9 - 112.0}{112.0} \times 100\% = 3.5\%$. 2021 – 22: $\frac{124.3 - 115.9}{115.9} \times 100\% = 7.2\%$. 2022 – 23: $\frac{131.0 - 124.3}{124.3} \times 100\% = 5.4\%$. The highest inflation was in 2021 – 22 at 7.2%.

Q13. Scaling by the index: $80 \times \frac{126.0}{105.0} = 80 \times 1.2 = \96 .

Q14. To keep pace with 3.4%: $62\,000 \times 1.034 = \$64\,108$. Any salary **above** \$64 108 would beat inflation.

Q15. New weekly spend = $180 \times 1.045 = \$188.10$. Extra per week = $188.10 - 180 = \$8.10$. Over 52 weeks: $8.10 \times 52 = \$421.20$.

Q16. Let the old cost be the amount that becomes \$315 after a 5% rise: old cost = $\frac{315}{1.05} = \$300$.

Q17. (a) The index rose from 100 to 119.2, so prices rose 19.2%. (b) Rent scales with the index:

$400 \times \frac{119.2}{100} = 400 \times 1.192 = \476.80 . (c) Wages rose 15% but prices rose 19.2%; since 15% < 19.2%, wages did **not** keep up, so real wages fell.

Q18. (a) New monthly cost = $1450 \times 1.036 = \$1502.20$. (b) Extra per month = $1502.20 - 1450 = \$52.20$; over 12 months, $52.20 \times 12 = \$626.40$. (c) A 2% rise on \$17 400 is $17\,400 \times 0.02 = \$348$. Since $\$348 < \626.40 , it does **not** cover the increase — it falls short by $626.40 - 348 = \$278.40$.

Chapter 9 Household budgeting and costs — 9H Informed spending

Theory

Spending well is not just about finding a low price — it is about working out **which option gives you the most for your money**. A larger pack, a “special”, a discount and a rewards card can all look like good value, but only a calculation tells you for sure. This section builds the tools of an **informed shopper**: unit pricing, comparing specials, valuing rewards, and seeing through a misleading “bargain”.

Unit pricing.

The **unit price** is the cost of a single standard amount of a product — per 100 g, per litre, per item. It lets you compare packs of different sizes fairly:

$$\text{unit price} = \frac{\text{total price}}{\text{number of units}}.$$

For example, a 3-pack of soap for \$5 costs $\$5 \div 3 = \1.67 per bar. The option with the **lower unit price** is better value (as long as you will actually use it).

Comparing specials.

Shops advertise specials in several ways. To compare them, turn each into a **price per item** or a **total cost** for the amount you need:

- **Multibuy** — “4 for \$6” means $\$6 \div 4 = \1.50 each.
- **Percentage off** — “25 % off \$48” saves $\$48 \times 0.25 = \12 , so you pay \$36.
- **Spend-and-save** — “\$15 off when you spend \$90” only helps once your total reaches the threshold.

Rewards and loyalty points.

Loyalty programs give **points** that convert to a dollar value. Treat the value of the points as a discount, and find the **effective percentage** it represents:

$$\text{effective discount} = \frac{\text{value of reward}}{\text{amount spent}} \times 100\%.$$

Seeing through a “bargain”.

A bigger pack is **not always** cheaper per unit, and a “was/now” price is only a saving if it beats what you can pay elsewhere. Always compare the **unit price** or the **actual amount you will pay** — not the size of the claimed discount. Also remember that two percentage discounts do not simply add: “25 % off, then 20 % off” is **not** 45 % off.

Worked examples

Example 1 — scaffolded

A pasta sauce comes in a 400 g jar for \$6.40 or a 750 g jar for \$10.50. Use unit pricing (cost per 100 g) to decide which jar is better value.

Working	Comment
400 g jar: $\$6.40 \div 4 = \1.60 per 100 g.	400 g is 4 lots of 100 g.
750 g jar: $\$10.50 \div 7.5 = \1.40 per 100 g.	750 g is 7.5 lots of 100 g.
$\$1.40 < \1.60 , so the 750 g jar is better value.	Lower unit price wins.
It saves $\$1.60 - \$1.40 = \$0.20$ on every 100 g.	The size of the advantage.

Example 2 — scaffolded

Single tubs of yoghurt cost \$1.80 each. A supermarket runs a special of “4 for \$6”. Find the price per tub on the special, and the saving if a family buys 8 tubs on the special instead of at the single price.

Working	Comment
Special price per tub: $\$6 \div 4 = \1.50 .	Divide the deal price by the number of tubs.
Saving per tub: $\$1.80 - \$1.50 = \$0.30$.	Compared with the single price.
8 tubs on special: $2 \times \$6 = \12 .	8 tubs is two lots of “4 for \$6”.
8 tubs at single price: $8 \times \$1.80 = \14.40 .	The full-price cost.
Saving: $\$14.40 - \$12 = \$2.40$.	Total saved on 8 tubs.

Example 3 — unscaffolded

Ravi needs 3 pairs of work trousers. Store A sells them at \$54 a pair with 30% off. Store B sells them at \$45 a pair on a “buy 2, get 1 free” deal. Which store is cheaper for 3 pairs, and by how much?

Store A — each pair is discounted: $\$54 \times (1 - 0.30) = \$54 \times 0.70 = \$37.80$. Three pairs at Store A: $3 \times \$37.80 = \113.40 .

Store B — “buy 2, get 1 free” means 3 pairs cost the price of 2: $2 \times \$45 = \90 . Three pairs at Store B: \$90 (that is \$30 a pair).

Difference: $\$113.40 - \$90 = \$23.40$.

$\therefore$ Store B is cheaper for 3 pairs, by \$23.40.

Example 4 — unscaffolded

A supermarket rewards card earns 2 points for every \$1 spent, and 100 points can be redeemed for a \$3 store credit. Priya spends \$250 on groceries. Find the value of the points she earns and the effective percentage discount.

Points earned: $\$250 \times 2 = 500$ points. Value of the points: $500 \div 100 = 5$ lots of \$3, so $5 \times \$3 = \15 . Effective discount: $\frac{\$15}{\$250} \times 100\% = 6\%$.

$\therefore$ Priya’s points are worth \$15, an effective discount of 6%.

Practice questions

Scaffolded

Q1. A breakfast cereal is sold as a 500 g box for \$4.50 or a 750 g box for \$6.30. (a) Find the unit price (per 100 g) of the 500 g box. (b) Find the unit price (per 100 g) of the 750 g box. (c) Which box is better value?

Q2. Cans of soft drink cost \$1.20 each, or “6 for \$6”. (a) Find the price per can on the “6 for \$6” special. (b) How much is saved per can compared with the single price? (c) Find the cost of 12 cans bought on the special.

Q3. A jacket is priced at \$80 with 25% off. (a) Find the discount in dollars. (b) Find the sale price. (c) At the register a further 10% is taken off the sale price. Find the final price.

Q4. A store offers “\$15 off when you spend \$90 or more”. Maria’s basket comes to \$86. (a) How much more must she spend to reach the \$90 threshold? (b) She adds a \$6 item. Find the amount she now pays after the \$15 discount. (c) Explain whether adding the \$6 item was worthwhile.

Q5. A rewards card earns 1 point for every \$2 spent, and 150 points convert to a \$5 voucher. Sam spends \$300. (a) How many points does Sam earn? (b) What is the voucher worth? (c) Find the effective percentage discount (to 2 decimal places).

Q6. Laundry powder is sold as a 1 kg box for \$8.00 or a 2 kg box for \$16.80. (a) Find the unit price (per 100 g) of the 1 kg box. (b) Find the unit price (per 100 g) of the 2 kg box. (c) Which is better value, and is the bigger box always the cheaper choice per 100 g?

Unscaffolded

Q7. Olive oil is sold as a 500 mL bottle for \$7.50 or a 1 L bottle for \$13.20. Compare the price per litre and state which is better value.

Q8. Coffee pods come in a box of 10 for \$6.50 or a box of 30 for \$17.40. Find the price per pod for each and state which is better value.

Q9. A snack bar costs \$3.90 each, or “3 for \$10”. A shopper needs 6 bars. Find the total cost of 6 bars on the special, and the saving compared with buying 6 at the single price.

Q10. A pair of headphones is \$65 with 40% off. The same store offers “spend \$50 or more, save \$8”. Find the price paid, and explain whether the “save \$8” offer also applies.

Q11. Dishwashing liquid is sold as a 3 L bottle for \$22.50 or a 5 L bottle for \$35.00. Compare the price per litre and state which is better value.

Q12. To buy a \$120 appliance, Shop A gives 10% off, while Shop B charges full price but gives 5% of the price back as points. Find the effective cost at each shop and state which is cheaper.

Q13. A television is advertised as “was \$99, now \$79”. A competitor sells the same model for \$72. Which is cheaper, and by how much is the competitor cheaper than the “now” price?

Q14. Rice is sold as a 2 kg bag for \$5.60, a 5 kg bag for \$13.50, or a 10 kg bag for \$28.00. Find the price per kilogram of each and state which bag is the best value.

Q15. Muffins cost \$2.60 each, or “4 for \$9”. A café owner needs 10 muffins. Find the cheapest total cost (specials and singles may be combined) and the saving compared with buying 10 singles.

Q16. A coat priced at \$200 is reduced by “25% off, then a further 20% off the reduced price”. Find the final price, and state what single percentage discount off the original this represents.

Q17. A card earns 3 points per \$1 spent; 200 points convert to a \$6 voucher (only whole lots of 200 points can be redeemed). A shopper spends \$180. (a) How many points are earned? (b) What is the total voucher value that can be redeemed? (c) Find the effective percentage discount (to 2 decimal places).

Q18. A pasta sauce is available as a 500 g jar for \$3.20, a 700 g jar for \$4.20, or “2 × 500 g for \$5.60”. Find the price per 100 g of each option and state which is the best value.

Answers

Q1. (a) \$0.90. (b) \$0.84. (c) the 750 g box. **Q2.** (a) \$1.00. (b) \$0.20. (c) \$12.00. **Q3.** (a) \$20. (b) \$60. (c) \$54. **Q4.** (a) \$4. (b) \$77. (c) worthwhile — see solution. **Q5.** (a) 150 points. (b) \$5. (c) 1.67%. **Q6.** (a) \$0.80. (b) \$0.84. (c) the 1 kg box; no. **Q7.** \$15.00/L vs \$13.20/L; the 1 L bottle. **Q8.** \$0.65 vs \$0.58 per pod; the box of 30. **Q9.** \$20.00 for 6; saving \$3.40. **Q10.** \$39; the “save \$8” offer does not apply. **Q11.** \$7.50/L vs \$7.00/L; the 5 L bottle. **Q12.** Shop A \$108, Shop B \$114; Shop A is cheaper. **Q13.** the competitor at \$72; cheaper by \$7. **Q14.** \$2.80, \$2.70, \$2.80 per kg; the 5 kg bag. **Q15.** \$23.20; saving \$2.80. **Q16.** \$120; a 40% discount (not 45%). **Q17.** (a) 540 points. (b) \$12. (c) 6.67%. **Q18.** \$0.64, \$0.60, \$0.56 per 100 g; the “2 × 500 g for \$5.60” deal.

Fully-worked solutions

Q1. (a) 500 g is 5 lots of 100 g: $\$4.50 \div 5 = \0.90 per 100 g. (b) 750 g is 7.5 lots of 100 g: $\$6.30 \div 7.5 = \0.84 per 100 g. (c) $\$0.84 < \0.90 , so the 750 g box is better value.

Q2. (a) $\$6 \div 6 = \1.00 per can. (b) $\$1.20 - \$1.00 = \$0.20$ saved per can. (c) 12 cans is two lots of “6 for \$6”: $2 \times \$6 = \12.00 .

Q3. (a) Discount = $\$80 \times 0.25 = \20 . (b) Sale price = $\$80 - \$20 = \$60$. (c) A further 10% off: $\$60 \times (1 - 0.10) = \$60 \times 0.90 = \$54$.

Q4. (a) $\$90 - \$86 = \$4$ more to reach the threshold. (b) Adding the \$6 item makes the total $\$86 + \$6 = \$92$, which is over \$90, so the \$15 comes off: $\$92 - \$15 = \$77$. (c) Without the item she would pay \$86; by adding a \$6 item she pays only \$77 **and** takes home the extra item — so it is worthwhile, provided she wants the item.

Q5. (a) 1 point per \$2: $\$300 \div 2 = 150$ points. (b) 150 points convert to a \$5 voucher. (c) Effective discount $= \frac{\$5}{\$300} \times 100\% = 1.67\%$ (to 2 d.p.).

Q6. (a) 1 kg = 1000 g = 10 lots of 100 g: $\$8.00 \div 10 = \0.80 per 100 g. (b) 2 kg = 20 lots of 100 g: $\$16.80 \div 20 = \0.84 per 100 g. (c) $\$0.80 < \0.84 , so the 1 kg box is better value per 100 g. No — the bigger box is not always cheaper per unit, so it always pays to check.

Q7. 500 mL bottle: \$7.50 for 0.5 L is $\$7.50 \div 0.5 = \15.00 per litre. The 1 L bottle is \$13.20 per litre. Since $\$13.20 < \15.00 , the 1 L bottle is better value.

Q8. Box of 10: $\$6.50 \div 10 = \0.65 per pod. Box of 30: $\$17.40 \div 30 = \0.58 per pod. Since $\$0.58 < \0.65 , the box of 30 is better value.

Q9. 6 bars is two lots of “3 for \$10”: $2 \times \$10 = \20.00 . At the single price, $6 \times \$3.90 = \23.40 . Saving $= \$23.40 - \$20.00 = \$3.40$.

Q10. 40% off: $\$65 \times (1 - 0.40) = \$65 \times 0.60 = \$39$. The “spend \$50 or more, save \$8” offer needs a spend of at least \$50, but the price is only \$39, so it does not apply. The price paid is \$39.

Q11. 3 L bottle: $\$22.50 \div 3 = \7.50 per litre. 5 L bottle: $\$35.00 \div 5 = \7.00 per litre. Since $\$7.00 < \7.50 , the 5 L bottle is better value.

Q12. Shop A: $\$120 \times (1 - 0.10) = \108 . Shop B: 5% of \$120 is $\$120 \times 0.05 = \6 back in points, so the effective cost is $\$120 - \$6 = \$114$. Since $\$108 < \114 , Shop A is cheaper (by \$6).

Q13. The competitor’s \$72 is lower than the “now” price of \$79, so the competitor is cheaper. It is cheaper than the “now” price by $\$79 - \$72 = \$7$.

Q14. 2 kg: $\$5.60 \div 2 = \2.80 per kg. 5 kg: $\$13.50 \div 5 = \2.70 per kg. 10 kg: $\$28.00 \div 10 = \2.80 per kg. The lowest is \$2.70 per kg, so the 5 kg bag is the best value — the largest bag is **not** the cheapest here.

Q15. Buying two lots of “4 for \$9” gives 8 muffins for $2 \times \$9 = \18 ; the remaining 2 muffins at the single price cost $2 \times \$2.60 = \5.20 , for a total of $\$18 + \$5.20 = \$23.20$. (Three lots of “4 for \$9” would give 12 muffins for \$27, which is more.) Buying 10 singles costs $10 \times \$2.60 = \26.00 , so the saving is $\$26.00 - \$23.20 = \$2.80$.

Q16. First reduction: $\$200 \times 0.75 = \150 . Second reduction: $\$150 \times 0.80 = \120 . The final price is \$120. Since $\$200 - \$120 = \$80$ has been taken off, that is $\frac{\$80}{\$200} \times 100\% = 40\%$ off the original — not 45%, because the two percentages do not simply add.

Q17. (a) 3 points per \$1: $\$180 \times 3 = 540$ points. (b) Only whole lots of 200 points redeem, and $540 \div 200 = 2$ whole lots (with 140 points left over), so $2 \times \$6 = \12 can be redeemed. (c) Effective discount $= \frac{\$12}{\$180} \times 100\% = 6.67\%$ (to 2 d.p.).

Q18. 500 g jar: $\$3.20 \div 5 = \0.64 per 100 g. 700 g jar: $\$4.20 \div 7 = \0.60 per 100 g. “2 × 500 g for \$5.60” is 1000 g for \$5.60: $\$5.60 \div 10 = \0.56 per 100 g. The lowest is \$0.56, so the “2 × 500 g for \$5.60” deal is the best value.

Chapter 9 Household budgeting and costs — 9I Recreational spending

Theory

Household spending divides into **essential** costs you must pay — rent, groceries, utilities, transport to work — and **discretionary** spending, the “wants” you choose to spend on. **Recreational spending** — concerts, streaming, sport, eating out, holidays — is discretionary, so it is where a budget has the most flexibility. Planning it carefully means you can enjoy it without going short on the essentials.

Costing an outing or event.

The cost of a day out is the **sum of all its parts**: tickets, transport, food and drink, and any extras such as parking or merchandise. List every item, then add. Making a quick estimate first (round each item to a leading digit) tells you roughly what to expect and flags a total that looks wrong.

Splitting shared costs.

When a group shares a cost equally, each person pays

$$\text{each person pays} = \frac{\text{total cost}}{\text{number of people}}.$$

If some items are shared and others are personal, add each person’s own items to their share of the shared cost.

Saving toward a goal.

To reach a savings target by a certain date, divide what you still need by the number of weeks you have:

$$\text{save per week} = \frac{\text{amount still needed}}{\text{number of weeks}}.$$

If you have already saved some of the target, subtract that first.

Recreation as a share of income.

It is sensible to keep discretionary spending to a planned share of your income. As a percentage,

$$\text{percentage of income} = \frac{\text{amount spent}}{\text{income}} \times 100\%.$$

Comparing options within a budget.

Given a fixed budget, compare options by their total cost or by the **cost per person** (or per visit), and check which ones fit. The best value is not always the cheapest single option — a season pass or membership can beat single tickets once you go often enough.

Worked examples

Example 1 — scaffolded

Four friends go to a concert. Tickets are \$79 each, return train travel is \$8.40 each, and they share one \$36 food platter. Find the total cost for the group and the amount each friend pays if they split it equally.

Working	Comment
Tickets for the group: $4 \times \$79 = \316 .	Each friend needs a ticket.
Train for the group: $4 \times \$8.40 = \33.60 .	A return fare each.
Food platter: \$36, shared.	One platter for everyone.
Total: $\$316 + \$33.60 + \$36 = \385.60 .	Add all the parts.

Working	Comment
Each pays: $\$385.60 \div 4 = \96.40 .	Split the total evenly among 4.

Example 2 — scaffolded

Mia wants to buy a \$620 music-festival ticket in 15 weeks. She has already saved \$155. How much must she save each week to reach her goal?

Working	Comment
Amount still needed: $\$620 - \$155 = \$465$.	Subtract what she already has.
Weeks available: 15.	The time she has to save.
Save per week: $\$465 \div 15 = \31 .	Divide the amount needed by the weeks.

Example 3 — unscaffolded

Five friends rent a beach house for a weekend. The costs are accommodation \$540, fuel \$95 and groceries \$115, all split equally. Find each person's share. If one friend then drops out and the remaining four share the same total, find the new share and how much more each now pays.

Total cost = $\$540 + \$95 + \$115 = \750 . With five sharing: $\$750 \div 5 = \150 each. With four sharing: $\$750 \div 4 = \187.50 each. Extra per person = $\$187.50 - \$150 = \$37.50$.

$\therefore$ each of the five pays \$150; with only four, each pays \$187.50, which is \$37.50 more per person.

Example 4 — unscaffolded

Jordan earns \$960 per fortnight. In one fortnight Jordan spends \$72 on streaming and cinema, \$45 on a sports club and \$63 eating out for fun. (a) What percentage of the fortnight's income is this recreational spending? (b) Jordan is choosing between a gym pay-as-you-go rate of \$18 per visit and a monthly pass of \$96, expecting about 6 visits a month. Which is cheaper, and by how much?

(a) Recreation total = $\$72 + \$45 + \$63 = \180 . Percentage of income = $\frac{180}{960} \times 100\% = 18.75\%$.

(b) Pay-as-you-go for 6 visits = $6 \times \$18 = \108 . Monthly pass = \$96. Difference = $\$108 - \$96 = \$12$.

$\therefore$ recreation is 18.75% of the fortnightly income; the monthly pass (\$96) is cheaper than pay-as-you-go (\$108) by \$12 for six visits.

Practice questions

Scaffolded

Q1. Three friends go to a football match. Tickets are \$45 each, and they share \$27 on food and \$18 on parking. (a) Find the total spent on tickets. (b) Find the total cost for the group. (c) If they split the whole cost equally, how much does each pay?

Q2. Ava is saving for a \$450 weekend trip. She has \$90 saved and wants the money ready in 12 weeks. (a) How much more does she still need? (b) How much must she save each week? (c) If she can only manage \$25 a week, will she reach her goal in time? Justify your answer.

Q3. A cinema charges \$22 per adult ticket. A group of 5 also buys \$40 worth of snacks. (a) Find the cost of 5 tickets. (b) Find the total cost including snacks. (c) Find the cost per person if the total is shared equally.

Q4. Noah earns \$800 per fortnight and spends \$120 of it on recreation. (a) Write the recreation spending as a fraction of his income in simplest form. (b) Write it as a percentage. (c) He wants to keep recreation under 10% of his income. By how many dollars is he over?

Q5. A theme park sells single-day tickets at \$89 and an annual pass at \$249. (a) Find the cost of 2 single-day tickets. (b) Find the cost of 3 single-day tickets. (c) How many single-day visits make the annual pass worth buying (that is, the visits cost at least as much as the pass)?

Q6. Four housemates plan a party. They spend \$64 on drinks, \$85 on food and \$36 on decorations, split equally. (a) Find the total cost. (b) Find each person's equal share. (c) One housemate also pays an extra \$20 to hire a speaker (not shared). What is that housemate's total cost?

Un scaffolded

Q7. Five friends go to a music festival. Tickets are \$115 each and they share a \$75 campsite. Find the total cost and the amount each pays.

Q8. Liam wants to save \$540 for a gaming console in 18 weeks, starting from nothing. How much must he save each week? If instead he saves \$35 a week, how many whole weeks will it take to reach his goal?

Q9. A weekend camping trip for a group costs \$180 for the site, \$120 for fuel and \$150 for food. If 6 people share the total equally, how much does each pay?

Q10. Zoe earns \$1150 per fortnight and budgets 16% of it for recreation. How much is that in dollars? If she actually spends \$210, is she over or under budget, and by how much?

Q11. A concert ticket is \$94. A group of 8 buys tickets together and receives a 10% group discount on the total. Find the total after the discount and the cost per person.

Q12. Ethan has a \$150 budget for a day out. He spends \$58 on a ticket, \$24 on transport and \$39 on food. How much of his budget is left, and what percentage of the budget did he spend (to 1 decimal place)?

Q13. A streaming service costs \$14.99 per month, or \$149 for a year paid upfront. How much would 12 months cost paid monthly, and how much is saved by paying for the year upfront?

Q14. Six friends share a holiday apartment costing \$1140 for the week. Four of them pay a full share s , and two who stay only half the week each pay a half share $\frac{1}{2}s$. The shares add to \$1140. Find the value of a full share.

Q15. A family of 2 adults and 2 children visits a water park. Adult tickets are \$52, child tickets are \$38, and parking is \$15. Find the total cost and the average cost per person.

Q16. Chloe saves for a \$680 interstate trip. She saves \$40 a week for the first 8 weeks, then \$60 a week after that. How much has she saved after the first 8 weeks, and how many more weeks at \$60 will she need to reach her goal?

Q17. A gym offers three ways to pay for a year: pay-per-visit at \$16, a monthly pass at \$55, or an annual membership at \$540. Ravi expects about 150 visits in the year (about 12 a month). (a) Find the yearly cost of 150 pay-per-visits. (b) Find the yearly cost of 12 monthly passes. (c) Which of the three is cheapest for Ravi?

Q18. Eight friends plan a group weekend costing accommodation \$900, transport \$240 and activities \$300. (a) Find the total cost and each person's equal share. (b) Two friends drop out and the remaining six split the same total. Find the new share per person and how much more each now pays than in part (a).

Answers

Q1. (a) \$135. (b) \$180. (c) \$60. **Q2.** (a) \$360. (b) \$30. (c) No — $\$25 \times 12 = \300 , giving \$390 in total, which is \$60 short of \$450. **Q3.** (a) \$110. (b) \$150. (c) \$30. **Q4.** (a) $\frac{3}{20}$. (b) 15%. (c) \$40. **Q5.** (a) \$178. (b) \$267. (c) 3 visits. **Q6.** (a) \$185. (b) \$46.25. (c) \$66.25. **Q7.** Total \$650; each \$130. **Q8.** \$30 a week; at \$35 a week, 16 weeks. **Q9.** \$75. **Q10.** \$184 budgeted; over by \$26. **Q11.** Total \$676.80; per person \$84.60. **Q12.** \$29 left; 80.7% spent. **Q13.** \$179.88 monthly; saves \$30.88. **Q14.** $s = \$228$. **Q15.** Total \$195; average \$48.75 per person. **Q16.** \$320 saved; 6 more weeks. **Q17.** (a) \$2400. (b) \$660. (c) the annual membership (\$540). **Q18.** (a) total \$1440, each \$180. (b) \$240 each, which is \$60 more.

Fully-worked solutions

Q1. (a) Tickets: $3 \times \$45 = \135 . (b) Total = $\$135 + \$27 + \$18 = \180 . (c) Each pays $\$180 \div 3 = \60 .

Q2. (a) Still needed = $\$450 - \$90 = \$360$. (b) Per week = $\$360 \div 12 = \30 . (c) Saving \$25 a week for 12 weeks gives $12 \times \$25 = \300 . Added to the \$90 she has, that is \$390, which is \$60 short of \$450, so she will **not** reach her goal in time.

Q3. (a) Tickets: $5 \times \$22 = \110 . (b) Total = $\$110 + \$40 = \$150$. (c) Per person = $\$150 \div 5 = \30 .

Q4. (a) $\frac{120}{800} = \frac{3}{20}$ (dividing top and bottom by 40). (b) $\frac{3}{20} = \frac{15}{100} = 15\%$. (c) 10% of \$800 is \$80; he spends \$120, so he is over by $\$120 - \$80 = \$40$.

Q5. (a) $2 \times \$89 = \178 . (b) $3 \times \$89 = \267 . (c) Two visits cost \$178 (less than the \$249 pass), but three visits cost \$267 (more than \$249). So from 3 **visits** onward the annual pass is worth buying.

Q6. (a) Total = $\$64 + \$85 + \$36 = \185 . (b) Each share = $\$185 \div 4 = \46.25 . (c) That housemate pays their share plus the speaker: $\$46.25 + \$20 = \$66.25$.

Q7. Tickets = $5 \times \$115 = \575 . Total = $\$575 + \$75 = \$650$. Each pays $\$650 \div 5 = \130 .

Q8. Saving from nothing: $\$540 \div 18 = \30 a week. At \$35 a week, $\$540 \div \$35 = 15.42\dots$ weeks, which rounds up to 16 weeks (since 15 weeks give only $15 \times \$35 = \525).

Q9. Total = $\$180 + \$120 + \$150 = \450 . Each pays $\$450 \div 6 = \75 .

Q10. Budget = 16% of \$1150 = $0.16 \times \$1150 = \184 . She spends \$210, which is more than \$184, so she is **over** by $\$210 - \$184 = \$26$.

Q11. Full price = $8 \times \$94 = \752 . After a 10% discount: $\$752 \times 0.90 = \676.80 . Per person = $\$676.80 \div 8 = \84.60 .

Q12. Spent = $\$58 + \$24 + \$39 = \121 . Left = $\$150 - \$121 = \$29$. Percentage spent = $\frac{121}{150} \times 100\% = 80.7\%$ (to 1 d.p.).

Q13. Paid monthly: $12 \times \$14.99 = \179.88 . Saving by paying yearly = $\$179.88 - \$149 = \$30.88$.

Q14. The four full shares and two half shares add to \$1140: $4s + 2 \times \frac{1}{2}s = 1140$ $4s + s = 1140$ $5s = 1140$ $s = 228$. So a full share is \$228 (and a half share is \$114). Check: $4 \times \$228 + 2 \times \$114 = \$912 + \$228 = \$1140$. ✓

Q15. Adults: $2 \times \$52 = \104 . Children: $2 \times \$38 = \76 . Total = $\$104 + \$76 + \$15 = \195 . Average per person = $\$195 \div 4 = \48.75 .

Q16. First 8 weeks: $8 \times \$40 = \320 . Still needed = $\$680 - \$320 = \$360$. At \$60 a week: $\$360 \div \$60 = 6$ more weeks.

Q17. (a) Pay-per-visit: $150 \times \$16 = \2400 . (b) Monthly passes: $12 \times \$55 = \660 . (c) Comparing \$2400, \$660 and \$540, the **annual membership at \$540** is cheapest.

Q18. (a) Total = $\$900 + \$240 + \$300 = \1440 . With 8 sharing: $\$1440 \div 8 = \180 each. (b) With 6 sharing: $\$1440 \div 6 = \240 each, which is $\$240 - \$180 = \$60$ more per person.

Topic 3 Test A — Multiple-choice

Topic 3 (Financial and consumer mathematics), cumulative over Chapters 7–9. Approved materials: one bound reference that may be annotated; one scientific calculator. Section A: 15 multiple-choice questions (15 marks). Approximate time: 25 minutes. Unless otherwise indicated, values are in Australian dollars.

Section A — Multiple-choice questions

Choose the response that is correct for the question.

Question 1

A casual worker is paid \$24.80 per hour and works 32 hours in a week. Her gross pay for the week is

- A. \$824.80
- B. \$79.36
- C. \$793.60
- D. \$768.00

Question 2

A worker's ordinary rate of pay is \$30 per hour. Overtime is paid at time-and-a-half. Her pay for 4 hours of overtime is

- A. \$135
- B. \$120
- C. \$180
- D. \$240

Question 3

The simple interest earned on \$3000 invested at 4% per annum for 5 years is

- A. \$120
- B. \$600
- C. \$60
- D. \$3600

Question 4

A tradesperson quotes \$240 for a job, before GST. After 10% GST is added, the total charge is

- A. \$264
- B. \$250
- C. \$268
- D. \$216

Question 5

A café bill comes to \$ 132 including GST. The amount of GST included in the bill is

- A. \$ 14.52
- B. \$ 120
- C. \$ 12
- D. \$ 13.20

Question 6

Income tax is nil on the first \$ 18 200 of taxable income and 19 cents per dollar on income above \$ 18 200. The tax on a taxable income of \$ 28 000 is

- A. \$ 1862
- B. \$ 1900
- C. \$ 2280
- D. \$ 5320

Question 7

The Medicare levy is 2 % of taxable income. On a taxable income of \$ 46 500 the levy is

- A. \$ 930
- B. \$ 232.50
- C. \$ 9300
- D. \$ 2325

Question 8

An employer pays superannuation at 11.5 % of ordinary earnings. On earnings of \$ 56 000 the super contribution is

- A. \$ 5600
- B. \$ 7280
- C. \$ 6440
- D. \$ 644

Question 9

A pair of shoes priced at \$ 140 is discounted by 30 %. The sale price is

- A. \$ 170
- B. \$ 98
- C. \$ 42
- D. \$ 110

Question 10

A 400 g jar of coffee costs \$ 12.00 and a 600 g jar costs \$ 16.80. Which is the better value for money?

- A. the 400 g jar
- B. the 600 g jar
- C. they are equal value
- D. it cannot be determined

Question 11

A payslip shows gross pay of \$ 1450 and income tax of \$ 290. Superannuation is paid by the employer and is not deducted from pay. The net (take-home) pay is

- A. \$ 1740
- B. \$ 1450
- C. \$ 993.25
- D. \$ 1160

Question 12

A fridge is bought on a payment plan: a deposit of \$ 100 plus 12 monthly payments of \$ 75. The total cost of the fridge under the plan is

- A. \$ 1000
- B. \$ 900
- C. \$ 975
- D. \$ 875

Question 13

An electricity bill charges 28 cents per kWh plus a daily supply charge of 90 cents over a 90-day quarter. For 500 kWh used, the total charge before GST is

- A. \$ 140
- B. \$ 302
- C. \$ 500
- D. \$ 221

Question 14

A household's monthly budget has income of \$ 3200 and total expenses of \$ 2750. The monthly surplus is

- A. \$ 550
- B. \$ 450
- C. \$ 5950
- D. \$ 2750

Question 15

A worker receives a pay rise of 2 % in a year in which inflation is 3.5 %. The worker's buying power has

- A. stayed the same
- B. risen
- C. risen by 5.5 %
- D. fallen

End of Section A

Topic 3 Test A — Solutions

Question	Answer	Working
1	C	$32 \times 24.80 = \$793.60.$
2	C	$4 \times 30 \times 1.5 = \$180.$
3	B	$I = \frac{Prt}{100} = \frac{3000 \times 4 \times 5}{100} = \$600.$
4	A	$240 \times 1.10 = \$264.$
5	C	GST is one-eleventh of a GST-inclusive total: $\frac{132}{11} = \$12.$
6	A	$0.19 \times (28\,000 - 18\,200) = 0.19 \times 9800 = \$1862.$
7	A	$0.02 \times 46\,500 = \$930.$
8	C	$0.115 \times 56\,000 = \$6440.$
9	B	$140 \times (1 - 0.30) = 140 \times 0.70 = \$98.$
10	B	$\$12.00 \div 400 = 3.0 \text{ c/g};$ $\$16.80 \div 600 = 2.8 \text{ c/g}$ — the 600 g jar is cheaper per gram.
11	D	net pay = gross – deductions $= 1450 - 290 = \$1160$ (super is not deducted).
12	A	$100 + 12 \times 75 = 100 + 900 = \$1000.$
13	D	$500 \times 0.28 + 90 \times 0.90 = 140 + 81 = \$221.$
14	B	surplus = income – expenses $= 3200 - 2750 = \$450.$
15	D	the 2% rise is below 3.5% inflation, so real buying power has fallen.

Topic 3 Test B — Short answer

Section B: 6 questions (30 marks). Approximate time: 40 minutes. Approved materials: one bound reference; one scientific calculator. Answer all questions in the spaces provided. In questions where more than one mark is available, appropriate working must be shown. Only round when instructed.

Section B

Question 1 (5 marks)

Priya invests \$3500 in an account paying 3% per annum simple interest.

- a. Find the simple interest earned after 3 years. 1 mark
- b. Find the interest rate per annum that would instead earn \$420 interest on this \$3500 over 3 years. 2 marks
- c. At the original 3% per annum, find how many years it would take to earn \$630 in interest. 2 marks

Question 2 (5 marks)

Sam's taxable income for the year is \$54 000. Income tax is calculated using the table below (rates for the 2023–24 financial year).

Taxable income	Tax on this income
0 – \$18 200	Nil
\$18 201 – \$45 000	19c for each \$1 over \$18 200
\$45 001 – \$120 000	\$5092 plus 32.5c for each \$1 over \$45 000

- a. Show that Sam's income tax is \$8017. 2 marks
- b. The Medicare levy is 2% of taxable income. Find the levy Sam must pay. 1 mark
- c. Find Sam's net income for the year after income tax and the Medicare levy. 2 marks

Question 3 (5 marks)

In one quarter a small business had sales of \$46 200 (including GST) and purchases of \$17 600 (including GST). GST is 10%.

- a. Find the GST included in the sales. 2 marks
- b. Find the GST included in the purchases. 1 mark
- c. Find the net GST the business must pay on its Business Activity Statement (BAS). 2 marks

Question 4 (5 marks)

Marco works 38 hours in a week at \$30.00 per hour.

- a. Find Marco's gross weekly pay. 1 mark
- b. His employer pays superannuation at 11.5% of gross pay. Find the super contribution. 2 marks
- c. His payslip deducts \$210 in income tax. Superannuation is paid by the employer and is not deducted. Find Marco's net pay. 2 marks

Question 5 (5 marks)

Two internet plans each run for 24 months. Plan A costs \$65 per month. Plan B costs \$59 per month plus a one-off \$150 set-up fee.

- a. Find the total cost of Plan A over 24 months. 1 mark

b. Find the total cost of Plan B over 24 months. 2 marks

c. State which plan is cheaper over the 24 months, and by how much. 2 marks

Question 6 (5 marks)

a. An electricity bill charges 30 cents per kWh plus a daily supply charge of 95 cents over a 90-day quarter. For 700 kWh used, find the total charge before GST. 2 marks

b. Add 10 % GST to the amount in part **a**. 1 mark

c. A basket of groceries cost \$ 75 last year and now costs \$ 81. Find the percentage increase in its cost. 2 marks

End of Section B

Topic 3 Test B — Solutions

Question 1.

a. $I = \frac{Prt}{100} = \frac{3500 \times 3 \times 3}{100} = \frac{31500}{100} = \$315.$

b. Rearranging $I = \frac{Prt}{100}$ for the rate, $r = \frac{100I}{Pt} = \frac{100 \times 420}{3500 \times 3} = \frac{42000}{10500} = 4\%$ per annum.

c. Rearranging for time, $t = \frac{100I}{Pr} = \frac{100 \times 630}{3500 \times 3} = \frac{63000}{10500} = 6$ years.

Question 2.

a. Sam's income of \$54 000 falls in the third bracket. The tax is

$$\$5092 + 0.325 \times (54\,000 - 45\,000) = 5092 + 0.325 \times 9000 = 5092 + 2925 = \$8017.$$

(The \$5092 is the tax on the first \$45 000: $0.19 \times (45\,000 - 18\,200) = 0.19 \times 26\,800 = \$5092.$)

b. Medicare levy $= 0.02 \times 54\,000 = \$1080.$

c. Net income $= 54\,000 - 8017 - 1080 = \$44\,903.$

Question 3.

a. The sales total includes GST, so the GST is one-eleventh of the total: $\frac{46\,200}{11} = \$4200.$

b. GST in the purchases $= \frac{17\,600}{11} = \$1600.$

c. Net GST payable $= \text{GST collected} - \text{GST paid} = 4200 - 1600 = \$2600.$

Question 4.

a. Gross weekly pay $= 38 \times 30.00 = \$1140.$

b. Super $= 0.115 \times 1140 = \$131.10.$

c. Net pay $= \text{gross} - \text{tax} = 1140 - 210 = \930 (the superannuation is paid by the employer and is not deducted from pay).

Question 5.

a. Plan A: $65 \times 24 = \$1560.$

b. Plan B: $59 \times 24 + 150 = 1416 + 150 = \$1566.$

c. Plan A is cheaper, by $1566 - 1560 = \$6$ over the 24 months.

Question 6.

a. Usage charge $= 700 \times 0.30 = \$210$; supply charge $= 90 \times 0.95 = \$85.50$. Total before GST $= 210 + 85.50 = \$295.50.$

b. Adding 10% GST: $295.50 \times 1.10 = \$325.05.$

c. Percentage increase $= \frac{81 - 75}{75} \times 100\% = \frac{6}{75} \times 100\% = 8\%.$