

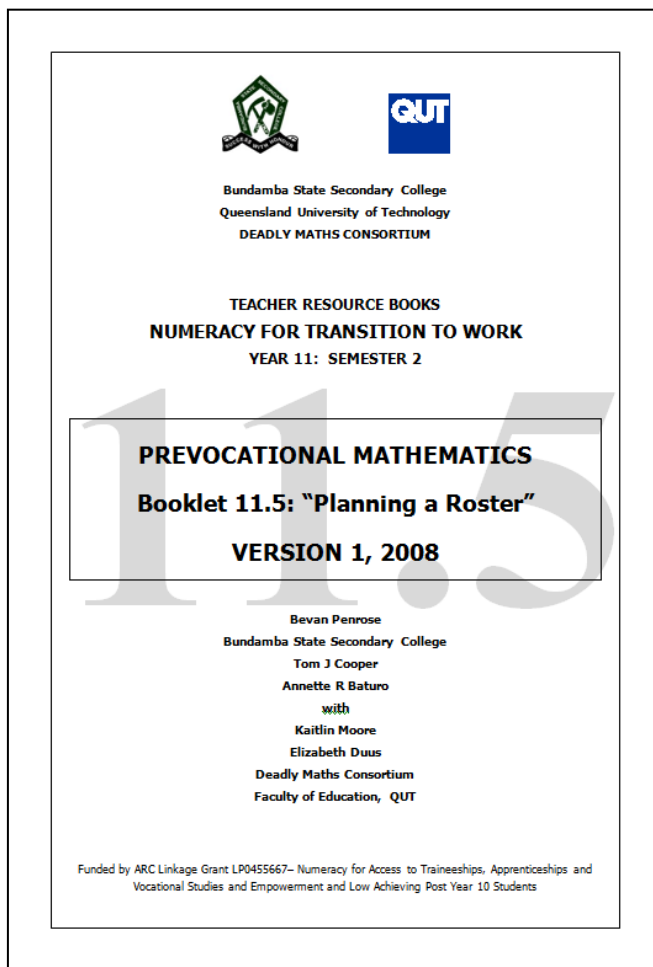


YUMI DEADLY CENTRE
School of Curriculum

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Numeracy for Transition to Work
Year 11 Prevocational Mathematics
Booklet 11.5: "Planning a Roster"
Tables, 24-hour time, percentages and computation strategies



YuMi Deadly Maths
Past Project Resource

Acknowledgement

We acknowledge the traditional owners and custodians of the lands in which the mathematics ideas for this resource were developed, refined and presented in professional development sessions.

YuMi Deadly Centre

The YuMi Deadly Centre is a Research Centre within the Faculty of Education at Queensland University of Technology which aims to improve the mathematics learning, employment and life chances of Aboriginal and Torres Strait Islander and low socio-economic status students at early childhood, primary and secondary levels, in vocational education and training courses, and through a focus on community within schools and neighbourhoods. It grew out of a group that, at the time of this booklet, was called “Deadly Maths”.

“YuMi” is a Torres Strait Islander word meaning “you and me” but is used here with permission from the Torres Strait Islanders’ Regional Education Council to mean working together as a community for the betterment of education for all. “Deadly” is an Aboriginal word used widely across Australia to mean smart in terms of being the best one can be in learning and life.

YuMi Deadly Centre’s motif was developed by Blacklines to depict learning, empowerment, and growth within country/community. The three key elements are the individual (represented by the inner seed), the community (represented by the leaf), and the journey/pathway of learning (represented by the curved line which winds around and up through the leaf). As such, the motif illustrates the YuMi Deadly Centre’s vision: *Growing community through education*.

More information about the YuMi Deadly Centre can be found at <http://ydc.qut.edu.au> and staff can be contacted at ydc@qut.edu.au.

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This booklet was developed as part of a project which ran from 2005–2008 and was funded by an Australian Research Council Linkage grant, LP0455667: *Numeracy for access to traineeships, apprenticeships, and vocational studies and empowerment and post Year 10 students*.

Bundamba State Secondary College &
Queensland University of Technology

TEACHER RESOURCE BOOKLETS
NUMERACY FOR TRANSITION TO WORK

YEAR 11 PREVOCATIONAL MATHEMATICS
BOOKLET 11.5: "PLANNING A ROSTER"
VERSION 1: 2008

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DEADLY MATHEMATICS VET

Deadly Maths VET was the name given to the materials produced to support the teaching of numeracy to vocational education and training students, particularly those from Indigenous backgrounds. These booklets were produced by the *Deadly Maths Consortium* at Queensland University of Technology (QUT) but also involving a researcher from Nathan Campus of Griffith University.

At the time of the production of this booklet, Deadly Maths VET was producing materials as part of an ARC-funded Linkage grant LP0455667 (12 booklets on Years 11 and 12 Prevocational Mathematics course and 2 booklets on pesticide training) and ASISTM-funded 2008 grant (3 booklets on construction; 3 booklets on engineering; 3 booklets on marine; 1 booklet on retail; and 2 booklets and a series of virtual materials on basic mathematics).

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THE PREVOCATIONAL MATHEMATICS BOOKLETS

In 2005 to 2008 researchers Annette Baturo and Tom Cooper from the Deadly Maths Consortium received an ARC Linkage grant (LP0455667) to study mathematics learning of Year 11 and 12 and adult students undertaking vocational education and training (VET) courses who had low achievement in mathematics. The title of this ARC Linkage project was *Numeracy for access to traineeships and apprenticeships, vocational studies, empowerment and low-achieving post Year 10 students*. The project studied better ways to teach mathematics to VET students at Bundamba State Secondary College, Metropolitan Institute of TAFE (Moreton Campus), Gold Coast Institute of TAFE (Ridgeway Campus), Tagai College (Thursday Island Campus), and the Open Learning Institute of TAFE.

As part of the study, the Deadly Maths research team developed booklets and other resources to be trialled by VET students and teachers. The project's activity with Bundamba State Secondary College focused on the Year 11 and 12 Prevocational Mathematics subjects taught at that college to less able mathematics students. The project used a series of intervention case studies to research learning. As part of this, the following 12 Prevocational Mathematics resource booklets were produced (6 for Year 11 and 6 for Year 12). The booklets are numbered 11.1 to 11.6 and 12.1 to 12.6.

- 11.1 – “Using Numbers of Numbers” – Yr 11 prevocational maths booklet: Number, decimals, fractions and problem solving.
- 11.2 – “The Big Day Out” – Yr 11 prevocational maths booklet: Number, tables, budgeting, algebra and problem solving.
- 11.3 – “Rating our World” – Yr 11 prevocational maths booklet: Rate, area and volume activities and problems.
- 11.4 – “Exchange Student” – Yr 11 prevocational maths booklet: Operations, discounts, tables, metric conversion and best buys.
- 11.5 – “Planning a Roster” – Yr 11 prevocational maths booklet: Tables, 24-hour time, percentages and computation strategies.
- 11.6 – “The Man from Hungary” – Yr 11 prevocational maths booklet: Time relationships, time calculations, timetables and efficient scheduling.
- 12.1 – “Beating the Drought” – Yr 12 prevocational maths booklet: Fractions, probability, graphing and data.
- 12.2 – “Monopoly” – Yr 12 prevocational maths booklet: Fractions, probability, game strategies, property finance, graphs and tables.
- 12.3 – “How tall is the Criminal?” – Yr 12 prevocational maths booklet: Multiplicative structure, ratio and proportion, problem solving.
- 12.4 – “Design a Kitchen” – Yr 12 prevocational maths booklet: Visual imagery, percent, rate, ratio, perimeter, area and volume.
- 12.5 – “Healthy Eating” – Yr 12 prevocational maths booklet: Data collection and analysis, tables and graphing (line and histograms).
- 12.6 – “Rocking around the World” – Yr 12 prevocational maths booklet: Time and angle, time operations and problem-solving strategies.

OVERVIEW

1. Theoretical position

The Bundamba Prevocational Mathematics booklets are based on the notion of Renzulli (1977) that mathematics ideas should be developed through three stages.

Stage 1: Motivate the students – pick an idea that will interest the students and will assist them to engage with mathematics.

Stage 2: Provide prerequisite skills – list and then teach all necessary mathematics ideas that need to be used to undertake the motivating idea.

Stage 3: Culminating task – end the teaching sequence by setting students an open-ended investigation to explore.

These booklets use Stage 3 as an assessment item and so we have added an assessment rubric whereby the culminating task can be used to check the knowledge held by the student.

The booklets combine two approaches to teaching:

- (1) structural activities that lead to the discovery and abstraction of mathematical concepts, processes, strategies and procedures; and
- (2) rich-style tasks which allow students an opportunity to solve problems and build their own personal solution.

2. Mathematics for this booklet

In preparing to complete a roster, the following prerequisites appear necessary:

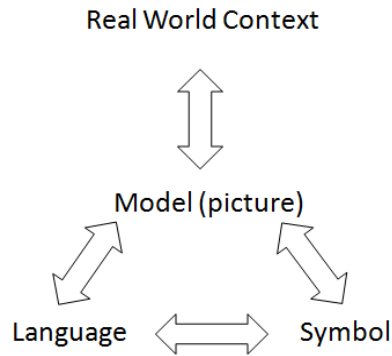
- (1) reading/constructing tables – to build ability to work with tables in rosters;
- (2) 24-hour time – knowledge to use 24-hour time on the roster;
- (3) percentage – knowledge of percentages to take account of percentage calculations;
- (4) percentage calculations – ability to calculate effects of percentages; and
- (5) addition/subtraction computation strategies – ways to do the calculations in the rostering.

These prerequisites make up the preliminary activities.

3. Pedagogy

The pedagogy for the culminating task is to (a) interest the students in the situations so they are engaged in the task, (b) provide them with all they need mathematically to gather information and compute totals, and (c) let them develop their solution as they see fit.

The pedagogy for the prerequisite skills is to develop mental models (pictures in the mind) and connect all representations for the mathematics concepts, processes, strategies and procedures that are needed to tackle the culminating task. Thus instruction is based on the so-called Rathmell Triangle (Payne & Rathmell, 1978):



The prerequisite pedagogy also involves three major generic strategies:

- (1) Flexibility – trying to ensure students understand things in a variety of ways (e.g. discount, reduction, etc.; %, part per 100, decimal hundredths, fraction out of 100, and so on).
- (2) Reversing – trying to teach in all directions (e.g. real-world situation to best buy; best buy to real-world situation).
- (3) Generalising – trying to teach things in the most general way (going beyond the needs of a task).

Particular strategies for tackling some of the preliminary activities will be provided at the start of the activities.

4. How to use this booklet

The major focus of the unit is the culminating task. The preliminary activities are only suggestions for prior work if you think your students require this work before they begin the culminating task. Therefore:

- (1) use the culminating task as the focus of the unit – to motivate engagement;
- (2) look through the preliminary activities and pick and choose things that you believe will be useful for your students – it is not necessary to do everything and to do it in the order that it appears in this booklet (although there is a logic to the order);
- (3) do these activities as a lead in to the culminating activity; and
- (4) try to organise things so that the students can do the culminating activity as an assessment of their abilities to do mathematics.

The preliminary activities are in five sections and there are real activities at the end of each section. The earlier parts of each section simply explain the ideas/models/pictures in the mind that are being attempted. Although how they are presented gives some hints on pedagogy, you will have to determine your own way to teach these.

PRELIMINARY ACTIVITIES

1. Reading/Constructing tables

A table is based on an array – columns and rows. You need to become familiar with reading tables across and down.

Constructing a table requires the following:

- (1) working out what will be in the columns – their names/titles;
- (2) working out what will be in the rows – their names/titles; and
- (3) placing or reading the information correctly in the cells.

Teaching activities:

- (1) Obtain a table, for example, a train schedule, and see if students can read it.
- (2) Provide students with a variety of information for a variety of situations, e.g. different costs for mobile phones, and work with them to develop a table.
- (3) Discuss how tables can be different and perform different tasks, e.g.:
 - (a) square, rectangular, missing sections
 - (b) to compare different options
 - (c) to describe different options
 - (d) to ensure all options are covered.

1.1. Table activities

Examine the bus timetable below.

Major Stops	AM			PM		
Goodna Station	–	9.40	11.40	1.45	3.39	5.39
Redbank Station	–	9.46	11.46	1.51	3.45	5.45
Redbank Plaza	7.50	9.51	11.51	1.56	3.50	5.50
Riverview Primary School	7.55	9.56	11.56	2.01	3.55	5.55
Riverview Gardens	8.00	10.01	12.01	2.06	4.00	6.00
Dinmore Station	8.05	10.06	12.06	2.11	4.05	6.05
Bundamba Primary School	8.09	10.10	12.10	2.15	4.09	6.09
Booval Fair	8.12	10.13	12.13	2.18	4.12	6.12
Ipswich (Bell Street)	8.19	10.20	12.20	2.25	4.19	6.19

- (1) What time would you need to catch the bus from Redbank Plaza in order to get to Bundamba Primary before school starts?
- (2) If the bus leaves Dinmore Station at 2.11 pm what time would it arrive in Ipswich?

- (3) Go on the internet and find different options for mobile phone deals. Construct a table that would enable you to compare options.
- (4) Find times that buses and trains run into the city and construct a table showing when they both run across one 24-hour day.

2. 24-hour time

The day is divided into AM and PM with 12 hours in each.

AM												PM											
1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12

Add another row and start counting from 1 until you reach the end of PM.

AM												PM											
1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

State that 24-hour time is the bottom row with “.00” added. Discuss what the numbers above 12 mean in terms of PM, e.g. 14.00 = 2 pm, 16.00 = 4 pm, 18.00 = 6 pm, 20.00 = 8 pm. Get students to state in their own words a pattern that relates 24-hour clock and pm for numbers above 12.

2.1. 24-hour time activities

- (1) Complete the following table (the first column is done for you):

12hr time	3 pm		11 am			10 pm	5 pm
24hr time	15.00	18.00		21.00	7.00		

- (2) Complete the following table:

12hr time	4.45			3.37	11.42	
24hr time		12.18	19.51			16.23

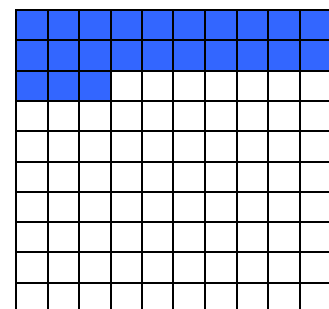
3. Percentage

When a whole is divided into equal parts, each part is a fraction and is named by the number of parts.

For example, a whole divided into 5 equal parts means that each part is one-fifth.

If a whole is divided into 100 equal parts each part is one-hundredth. A special name for hundredth is percent (from “per centum” which means “per hundred”). Thus 23 percent is 23 hundredths as shown on right. It has a special notation, i.e. 23%.

In terms of fractions, twenty-three hundredths is 23/100 and in terms of decimals twenty-three hundredths is 0.23. This means that 23% is the same as 23/100 and 0.23. It also means that 100% is the same as 100/100 or 1.



3.1. Percentage activities

(1) Shade the following on 10×10 grids (page 14):

- (a) 36% (b) 217% (c) 0.78 (d) $182/100$

(2) Complete the following table (the first column has been done for you).

%	37%	48%					7%
Fraction	$37/100$		$64/100$			$86/100$	
Decimal	0.37			0.28	0.91		

(3) Percent (%) can be more than 1; complete the following:

%	343%			436%			382%
Fraction	$343/100$		$561/100$		$111/100$		
Decimal	3.43	1.28				2.06	

4. Percentage calculations

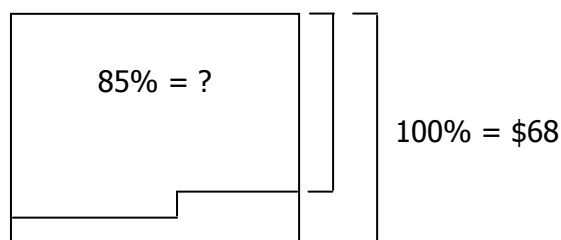
There are three types of percent calculations:

- Type 1 – Percentage unknown: Find 85% of \$68. This is straightforward multiplication (i.e. $0.85 \times 68 = \$57.80$).
- Type 2 – Total unknown: 85% is \$68, what is total? This is division (i.e. $68 \div 0.85 = \$80$).
- Type 3 – Percent unknown: What % of \$68 is \$51? This is also division (i.e. % is $51/68 \times 100/1 = 75\%$).

There are three ways to solve the problems, as follows.

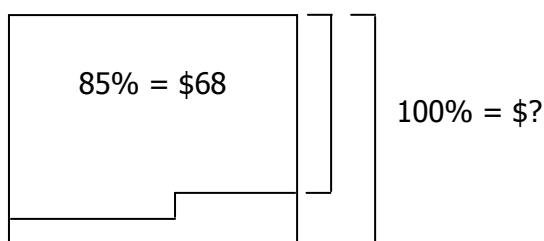
(1) Use a diagram

Type 1: Find 85% of \$68



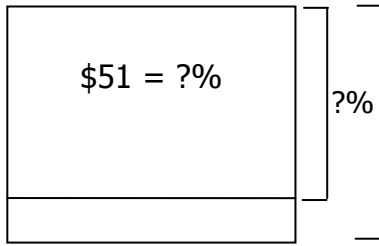
$100\% = \$68$ $1\% = 68/100$ $85\% = 68/100 \times 85 = \57.80 or $85\% = 68 \times 85/100 = 68 \times 0.85 = \57.80	100×8
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Type 2: 85% is \$68, what is the total?



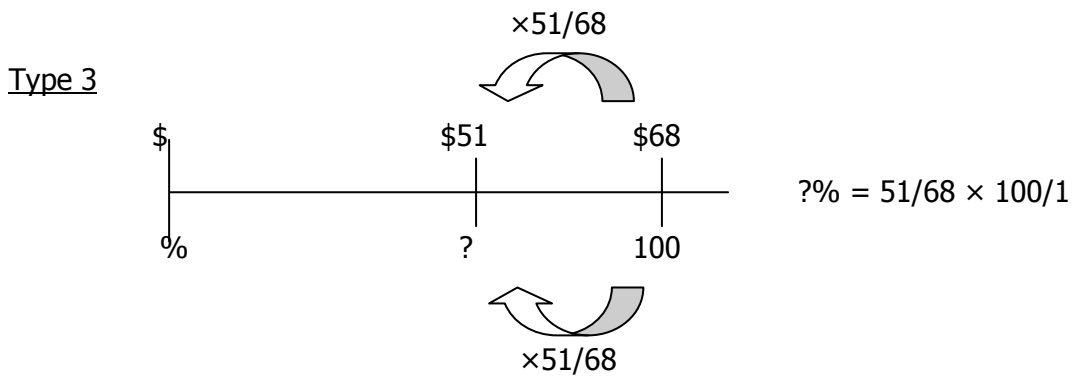
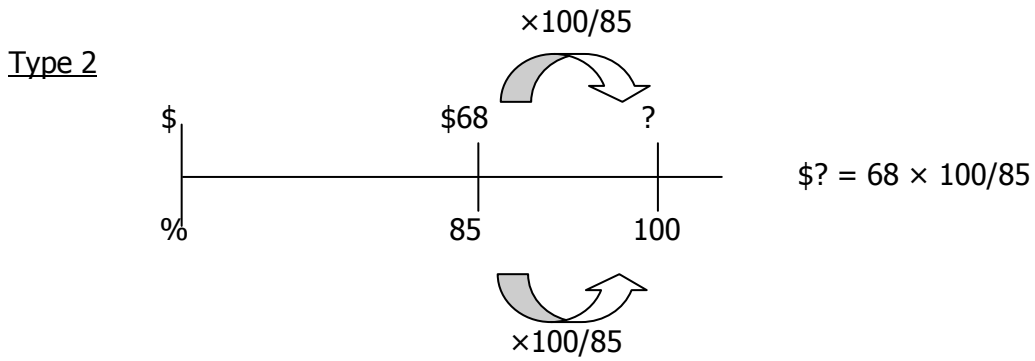
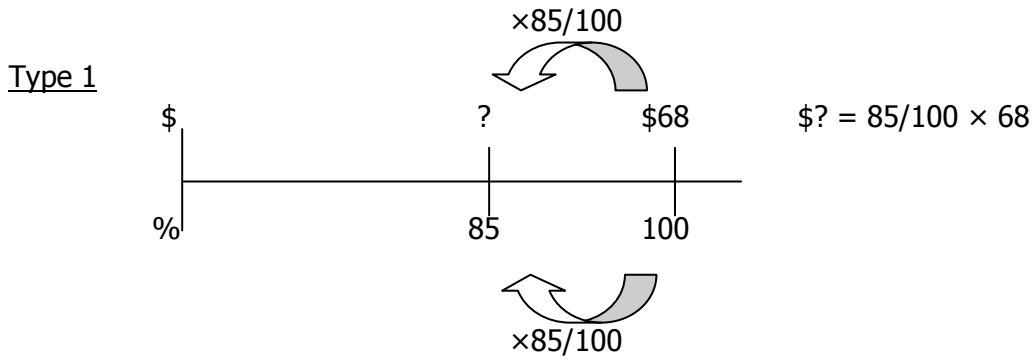
$85\% = \$68$ $1\% = 68/85$ $100\% = 68/85 \times 100 = \80 or $100\% = 68 \times 100/85 = 68/0.85 = \80
--

Type 3: What % of \$68 is \$51?



$$\begin{aligned}
 \$68 &= 100\% \\
 \$1 &= 100/68 \\
 \$51 &= 100/68 \times 51 = 75\% \\
 \text{or} \\
 \$51 &= 51/68 \times 100/1 = 75\%
 \end{aligned}$$

(2) Double number line



(3) Multiplication change diagram

	Total	× percent →	Percentage	
Type 1:	\$68	× 0.85 →	?	? = \$68 × 0.85
Type 2:	?	× 0.85 →	\$68	? = 68/0.85
Type 3:	\$68	× ? →	\$51	? = 51 ÷ 68 × 100

4.1. Percentage calculation activities

Solve the following (use a calculator):

- (1) John paid 65% of the cost of a TV. The TV cost \$185. How much did John pay?
- (2) June paid \$125. This was 45% of the cost of the TV. How much did the TV cost?
- (3) Fred paid \$250 towards a \$375 TV. What % did Fred pay?

5. Addition/Subtraction computation strategies

Without a calculator there are three methods of adding and subtracting numbers. These methods are also the basis of estimation.

5.1. Separation

Separate both numbers into parts, add or subtract the parts separately and then combine the answers:

Addition

	\$56		\$56		\$84.47	
	+ \$28		+ \$28		+ \$47.55	
add tens	70	add ones	\$84	add \$s	120.00	\$130.00
first	14	first		first	11.00	will do as
	\$84				1.02	estimate
					\$132.02	

Subtraction

	\$82		\$8 ¹ 2		\$7 ¹ 4.08	
	- \$27		- \$27		- \$45.69	
subtract	60	subtract	\$55	subtract	\$29.00	\$29.00 will
tens first	down 5	ones first		\$s first	down 61	do as
	\$55				\$28.39	estimate

5.2. Sequencing

Keep the first number whole and add parts of the second number:

$\begin{array}{r} \$56 \\ + \$28 \\ \hline 76 \\ + 8 \\ \hline \$84 \end{array}$	$\begin{array}{r} \$84.47 \\ + \$47.55 \\ \hline 124.47 \\ + 7.55 \\ \hline 131.47 \\ + .55 \\ \hline 131.97 \\ + .05 \\ \hline 132.02 \end{array}$	$\begin{array}{r} \$82 \\ - \$27 \\ \hline 62 \\ - 7 \\ \hline \$55 \end{array}$	$\begin{array}{r} \$74.08 \\ - \$45.69 \\ \hline \$34.08 \\ - 5.69 \\ \hline 29.08 \\ - .69 \\ \hline 28.48 \\ - .09 \\ \hline \$28.39 \end{array}$
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Subtraction can be done additively (building from smaller to larger instead of taking smaller from larger):

$\begin{array}{r} \$82 \\ - 27 \\ \hline \end{array} \rightarrow \begin{array}{r} 27 \rangle 3 \\ 30 \rangle 50 \\ 80 \rangle 2 \\ 82 \\ \hline \$55 \end{array}$	$\begin{array}{r} \$74.08 \\ - \$45.69 \\ \hline \end{array} \rightarrow \begin{array}{r} 45.69 \rangle .31 \\ 46.00 \rangle 4.00 \\ 50.00 \rangle 24.00 \\ 74.00 \rangle .08 \\ 74.08 \\ \hline \$28.39 \end{array}$
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5.3. Compensation

Both numbers are kept whole, numbers are changed to make operations easy, then the change is compensated for:

$\begin{array}{r} \$56 \\ + 28 \\ \hline \end{array} \rightarrow \begin{array}{r} \$56 \\ + 30 \text{ change} \\ \hline 86 \\ - 2 \text{ compensation} \\ \hline \$84 \end{array}$	$\begin{array}{r} \$82 \\ - 27 \\ \hline \end{array} \rightarrow \begin{array}{r} \$82 \\ - \$30 \text{ change} \\ \hline 52 \\ + 3 \text{ compensation} \\ \hline \$55 \end{array}$
--	--

$\begin{array}{r} \$84.47 \\ + 47.55 \\ \hline \end{array} \rightarrow \begin{array}{r} \$84.47 \\ + 50.00 \text{ change} \\ \hline 134.47 \\ - 2.45 \text{ compensation} \\ \hline \$132.02 \end{array}$	$\begin{array}{r} \$74.08 \\ - 45.69 \\ \hline \end{array} \rightarrow \begin{array}{r} \$74.08 \\ - 44.00 \text{ change} \\ \hline \$30.08 \\ - 1.69 \text{ compensation} \\ \hline 30.08 \\ - 2.00 \text{ change} \\ \hline \$28.08 \\ + 0.31 \text{ compensation} \\ \hline \$28.39 \end{array}$
---	---

5.4. Estimation/Approximation

To estimate ignore the cents and just try to get to the nearest \$10 or \$5. Later you can try to get closer if needed:

$$\begin{array}{r} \$368.57 \\ + 459.68 \\ \hline \end{array} \quad \longrightarrow \quad \begin{array}{r} \$370.00 \\ + 460.00 \\ \hline \$830.00 \end{array}$$

$$\begin{array}{r} \$917.47 \\ - 348.69 \\ \hline \end{array} \quad \longrightarrow \quad \begin{array}{r} \$920.00 \\ - \$350.00 \\ \hline \$570.00 \end{array}$$

5.5. Addition/subtraction activities

Calculate the following using some pen and paper or a mental method:

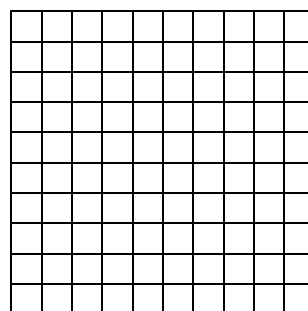
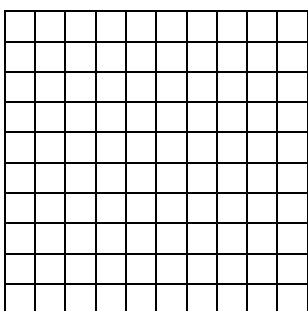
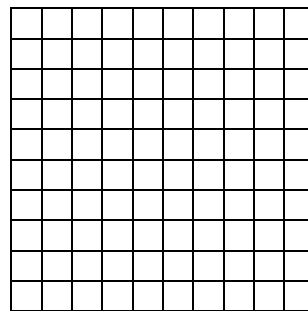
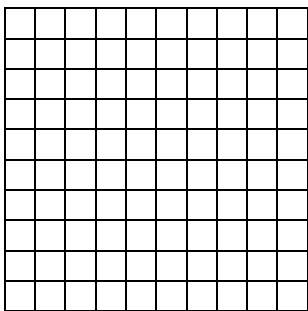
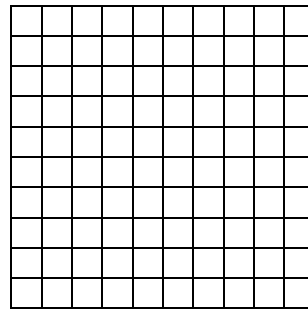
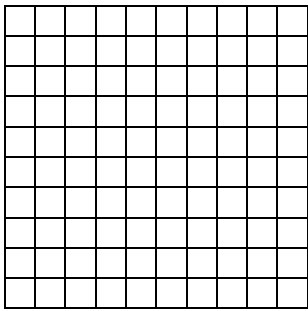
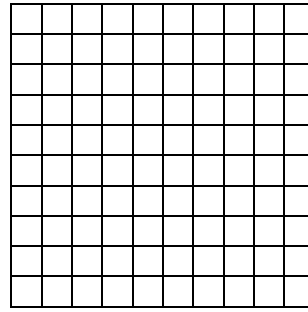
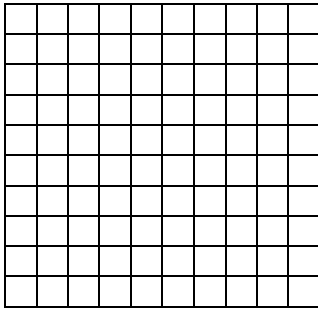
$$(a) \quad \begin{array}{r} \$68.27 \\ + 49.56 \\ \hline \end{array} \quad (b) \quad \begin{array}{r} \$147.21 \\ - 86.48 \\ \hline \end{array}$$

$$(c) \quad \begin{array}{r} \$487.85 \\ + 234.19 \\ \hline \end{array} \quad (d) \quad \begin{array}{r} \$643.87 \\ - 256.49 \\ \hline \end{array}$$

Estimate the following to nearest \$10:

$$(a) \quad \begin{array}{r} \$356.87 \\ + 298.37 \\ \hline \end{array} \quad (b) \quad \begin{array}{r} \$861.28 \\ - 282.43 \\ \hline \end{array}$$

10 × 10 grids



CULMINATING TASK

PLANNING A ROSTER

Directions: Taco Bell Inc. is a major American fast food franchise that is seeking to open a 24-hour restaurant in the Ipswich District.

Your task is to recruit staff, plan a roster for a period of one (1) week, trading 24 hours a day, and to calculate the cost of wages for the same period.

22% of the total wages bill must be invested every week to allow for superannuation, work cover, insurance and incidentals.

Present your final report as an easy-to-read document.

This should include explanations, calculations and a roster in the form of a table.

Things you need to know:

- (a) Either the store manager or an assistant must be on duty at all times.
- (b) You must have a minimum of five (5) staff during the day and a minimum of four (4) at night.
- (c) You may choose to employ as many casual senior workers as you deem essential.
- (d) You may employ one (1) junior 14–16 years old, per shift.
- (e) Junior Wages (Casual) \$5.93 per hour (14–16 year old) – maximum 20 hours per week – minimum 4 hours per week.
- (f) Senior Wages (Casual) \$12.30 per hour minimum 4-hour shift – no maximum.
- (g) Senior Wage (Permanent) \$503.20 maximum 38 hours per week.
- (h) Assistant Manager – \$32,000.00 p.a.
- (i) Store Manager – \$ 57,000.00 p.a.

Learning outcomes:

- Students to read, record and interpret 24-hour time and develop and use own timetables using 12-hour time to organise time over a week.
- Students select and use efficient methods of calculation to find approximate and exact solutions to problems involving addition and subtraction of any whole numbers and decimal fractions.

ASSESSMENT RUBRIC

Assessment Form:

General Objectives	Specifics	Assignment Grade (A-E)
Knowing	Write numbers in everyday representational form. Round numbers. Use a calculator. Rates as applied to wages. Units of time. Access information about income.	
Applying	Operate on numbers. Calculate percentages. Organise data. Convert time measurements. Calculate total costs. Select effective methods. Solve simple rates problems. Organise data information in a table. Construct timetables. Solve time management problems. Interpret rates of pay. Calculate total earnings.	
Explaining	Use common words, phrases and symbols. Present solutions in writing. Present advice about time management. Present numerical information in tabular form.	

Assessment Criteria

GRADE	KNOWLEDGE	APPLICATION	EXPLAINING
A	Effectively uses given rules to carry out tasks.	Applies rules across all contexts effectively.	Presents detailed solutions logically and clearly.
B	Uses given rules to carry out tasks.	Applies rules across most contexts effectively.	Presents solutions logically and clearly.
C	Uses given rules adequately to carry out tasks.	Applies rules adequately across most contexts.	Presents readable solutions.
D	Uses given rules to carry out parts of tasks.	Applies rules in some contexts adequately.	Presents partial solutions.
E	Did not meet standard D.	Did not meet standard D.	Did not meet standard D.