Numeracy In Practice

Building Workplace Numeracy Proficiency and Training Skills of VET Practitioners

This Snapshot relates to Question 3c from the Numeracy Proficiency Assessment Tool – Process Manufacturing Industry. It is designed to be read in conjunction with explanatory information provided in the Guide.

Using Rates and Performing Time Calculations

Many jobs require workers to use rates and perform time calculations, for example:

- Sales representatives checking monthly sales performance
- Cleaners checking the need to replenish supplies
- Builders checking how long it will take to complete a job
- Butchers talking to customers about meat prices

This example is a rate expressed as items per second, using a 12-hour clock over the duration of a day. Examples of rates in the workplace include:

- Distance per unit of time (e.g. km/hr)
- Cost per unit of weight (e.g. $/kg)
- Data per unit of time (e.g. bit rate)

Examples of time systems include 24-hour and 12-hour clocks and decimal time.

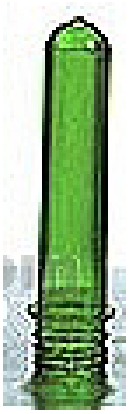
Examples of durations include seconds, minutes, hours, weeks, months and years.

Workers responsible for using rates and calculating time require complementary skills, for example skills to:

- Work safely
- Follow workplace instructions
- Meet quality requirements
- Work cooperatively
- Meet deadlines
- Identify and report problems
- Explain rates and time calculations to other workers, supervisors or customers

THE QUESTION

Blow moulding is a manufacturing process used to make plastic bottles. Preforms are heated and inflated to fit the mould of a plastic bottle.



Preform

Plastic bottle

An operator monitors a blow moulding process that produces 32 preforms every 20 seconds.

A production run started at 11:13 am and finished at 8:43 pm. The machine stopped between 12:17 pm and 12:32 pm for adjustment. How many plastic bottles were produced?

ACSF NUMERACY LEVEL

This question requires skills associated with using rates and calculating time.

Working through this PD resource places you in the role of the learner.

The content area of rates is described as part of indicator .10 at level 3 in the focus area *Mathematic knowledge and skills: number and algebra.*

The content area of time calculations is described as part of indicator .10 at level 3 in the focus area *Mathematics knowledge and skills: measurement and geometry.*

The question requires level 3 indicator .09 skills to read and interpret the question.

The question also requires level 3 indicator .11 skills to communicate the answer.

This question maps to ACSF numeracy level 3.

WHAT THE QUESTION IS ASKING

The mathematical information embedded in the question must be identified and interpreted before the problem can be solved.

The photograph and the first paragraph give context. They do not contain mathematical information. They are not needed to solve the problem.

The second paragraph contains mathematical information about the rate. It describes how many preforms are manufactured every 20 seconds. Knowledge of rates is needed to interpret this information.

The third paragraph contains mathematical information about time. It describes when production started and finished. It also describes an interval of time during which there was no production. The knowledge of time measurement is needed to interpret this information.

The third paragraph also contains mathematical information about the problem to be solved. It asks for the number of plastic bottles produced. Knowledge of rates and time calculations is required to interpret this information.

HOW TO SOLVE THE PROBLEM

There is more than one way to answer this question. Two possible options are shown.

Option 1: Using 12-hour time and rate per second

- Calculate rate per second

  32 preforms in 20 seconds = 32/20

  = 1.6 preforms per second

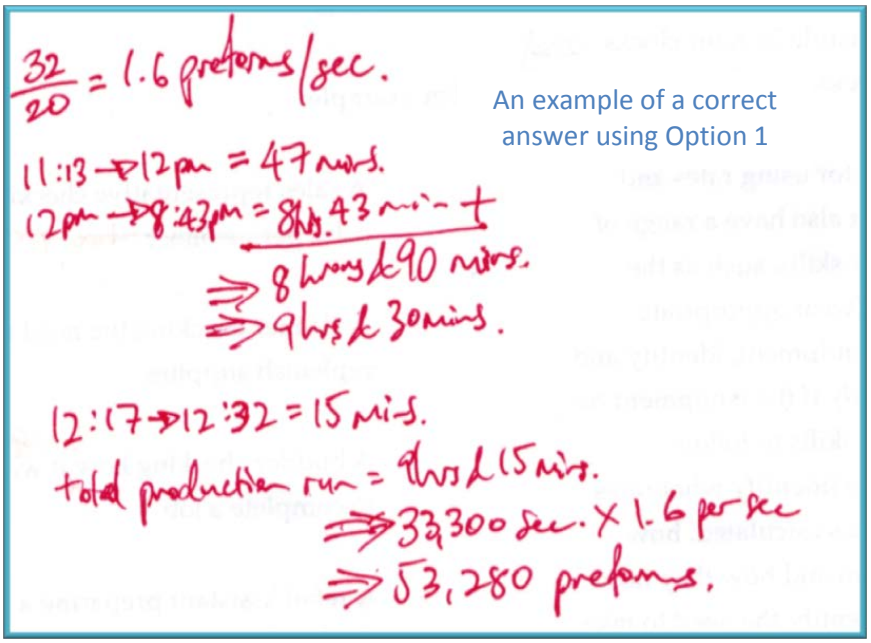
- Find length of production run (11:13 am to 8:43 pm)

  The numbering on a 12-hour clock restarts every 12 hours. One way to calculate the length of the production run is to find out the length of the production run before 12:00 pm and add it to the length of the production run after 12:00 pm.

  Before 12:00 pm (11:13 pm to 12:00 pm)

  There are 60 minutes in every hour

  Therefore 60 – 13 = 47 minutes



An example of a correct answer using Option 1

After 12:00 pm (12:00 pm to 8:43 pm) = 8 hours and 43 minutes

Length of the production run

= 47 minutes + 8 hours and 43 minutes

= 9 hours and 30 minutes

- Find length of disruption (12:17 pm to 12:32 pm)

  Subtract end time from start time hours

  12 – 12 = 0 hours

  Subtract end time from start time minutes

  32 – 17 = 15 minutes

  Length of disruption
  = 0 hours and 15 minutes

- Find length of running time

  Subtract the length of disruption from the length of production run

  = 9 hours and 30 minutes – 15 minutes

  = 9 hours and 15 minutes

- Convert to seconds

  Convert hours
  9 x 60 x 60 = 32 400 seconds

  Convert minutes
  15 x 60 = 900 seconds

  Length of running time
  = 32 400 + 900 = 33 300 seconds

Working through this PD resource will support you to confirm and strengthen your numeracy teaching skills.

- Find how many plastic bottles were produced

  Multiply length of running time by rate

  = 33 300 x 1.6
  = 53 280 bottles

Option 2: Using decimal time and rate per hour

- Calculate rate per hour

  32 preforms in 20 seconds
  = 32/20 x 60 x 60 = 5760 preforms per hour

- Find length of production run (11:13 am to 8:43 pm) in decimal time

Convert start time to decimal time
11 + 13/60 = 11.22 hours

Convert end time to decimal time
8 + 43/60 = 8.72 hours

Subtract end time from start time
8.72 – 11.22 = –2.50 hours

The hours are less than 0 so add 12
–2.50 + 12 = 9.50 hours

- Find the length of the disruption (12:17 pm to 12:32 pm) in decimal time

Subtract end time from start time hours

12 – 12 = 0 hours

Subtract end time from start time minutes

32 – 17 = 15 minutes

Length of disruption
= 0 hours and 15 minutes

Convert to decimal time

15/60 = 0.25 hours

- Find the length of running time in decimal hours

Subtract length of the disruption from length of the production run

Length of running time

= 9.5 hours – 0.25 hours

= 9.25 hours

- Find how many plastic bottles were produced

Multiply length of running time by rate

= 9.25 x 5760 = 53 280 bottles

HOW TO CHECK THE ANSWER

Check that the length of the running time is correct using estimation skills. For example, the start time is 11:13 am which is almost 11:00 am. The end time is 8:43 pm which is almost 9:00 pm. Therefore the running time will be less than 10 hours once the disruption is taken into account.

Check that the rate calculation is correct by testing with a different rate, such as preforms per hour instead of preforms per second.

HOW TO COMMUNICATE THE ANSWER

Record the answer providing the result and the unit of measure. The most technically correct answer is 53 280 bottles.

ACSF ASSESSMENT DECISIONS

A Credit is applied to the following answers:

1. 53 280 bottles
2. 53 280 (the question provided the unit of measurement and therefore the answer can stand alone without a unit of measurement)

MEETING WORKPLACE EXPECTATIONS

In most workplaces the worker is expected to record the correct answer in accordance with workplace instructions. This is consistent with responses 1 and 2 above.

Incorrect answers may cause problems that impact productivity, quality and safety. This is unacceptable in the workplace.

ANALYSING INCORRECT RESPONSES TO IDENTIFY SKILL GAPS

Common incorrect responses include incorrect time calculation, incorrect rate usage or both.

Common incorrect time calculation problems include:

- Incorrectly calculating the length of the production run. Calculating 8 hours and 30 minutes instead of 9 hours and 30 minutes is a common mistake
- Not subtracting the time lost during the disruption
- Using 12-hour time to perform calculations that can only be performed with decimal time

Common incorrect rate usage problems include:

- Calculating the time in minutes and then using a rate specified in seconds
- Calculating the time in seconds and dividing by 20

These responses suggest that support is most likely needed at this level for indicator .10 because the correct procedure for using rates and/or performing time calculations has not been demonstrated.

IMPLICATIONS FOR TRAINING DELIVERY

Encourage the learner to talk about using rates and performing time calculations at home and at work.

Talk about:

- Rates they must use
- The time calculations they must do
- What they are used for
- Why they are important
- How they are used
- What calculations are needed
- How and where the outcome is reported
- How and where it is recorded

Working through this PD resource will support you to confirm and strengthen your own numeracy skills.

Check learner performance against workplace requirements to identify learner needs. The learner may:

- Need support in one or more of the numeracy indicators
- Be suffering from maths anxiety
- Lack the complementary skills needed to perform the task, such as a correct understanding of the workplace procedures for using rates and performing time calculations

Use a range of teaching strategies, such as:

- Ask the learner to show their work and explain the working out
- Draw on what the learner already knows and challenge them
- Sequence the material according to the learners' individual needs. For example, they may be skilled in using rates but need support with performing time calculations

- Incorporate a range of rates and time calculations and workplace conditions
- Use actual clocks found in the workplace
- Include examples from different areas of the operation that use different rates, perhaps introducing a 24-hour clock
- Ask questions to extend the learner, such as:
  - How would you explain to someone else what a rate is?
  - What if you had to find out how many preforms could be produced over a week?
  - How do you recognise a correct answer?
  - How do you recognise an incorrect answer?
- Mix up questions that do and do not require time calculations for additional challenge
- Provide opportunities for practice without fear of failure and with time for reflection
- During training, use rates and perform time calculations gathered from the workplace and discuss the results
- Separate time calculations and rate usage to build the skills for each before combining
- Outside training, encourage the learner to remove avoidance strategies, such as relying on another team member to undertake the calculations
- Assign a workplace buddy or mentor
- Ask learners to reflect on what they have learnt, the challenges encountered and how they were overcome

PROFESSIONAL DEVELOPMENT LEARNING STRATEGIES

Build your own skills:

- Find examples of typical rates and time calculations found in the workplace
- Take a tour of the workplace and talk to people in the workplace about the rates used and time calculations performed, including:
  - What they are used for
  - Why they are important
  - Who uses them
  - How they are used
  - How and where the results are reported
  - How and where they are recorded

- Find examples of typical rates found in the home, such as the fuel efficiency of a car or the running costs of the household
- Find examples of typical time calculations found in the home, such as work and leisure schedules
- Practise using rates and calculating time found in the workplace, home or on the internet
- Check your answers with a trusted peer or mentor
- Ask a trusted peer or mentor to challenge you to extend your skills

ABOUT THIS RESOURCE

Numeracy in Practice is a professional development resource to support the development of VET practitioner numeracy proficiency skills and numeracy training skills.

It has been developed in response to a National Centre for Vocational Education and Research (NCVER) report titled *Seeking the N in LLN*. This report found that there may be a need to increase the capacity of the VET workforce to meet the numeracy skills needs of existing workers. A copy of the full report is available for download at www.ncver.edu.au.

Numeracy in Practice: Building Workplace Numeracy Proficiency and Training Skills of VET Practitioners includes:

- A Guide with professional development activities
- A Numeracy Professional Assessment Tool – Process Manufacturing Industry
- Six Snapshots exploring different workplace numeracy skills

Topics covered in the Snapshots include:

- Reading instruments
- Using ratios and metric conversions
- Using rates and performing time calculations
- Measuring lengths
- Calculating quantities
- Reading specifications

Working through this PD resource will support you to confirm and strengthen your numeracy teaching skills.

VET practitioners interested in increasing their awareness of numeracy skills in the workplace may also like to access the companion resource *Numeracy in Focus: Building VET Practitioner Awareness of Numeracy in the Workplace*.

Numeracy in Practice and *Numeracy in Focus* are available for download from the WELL practitioners' website at www.wellpractitioners.com.au.

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