Cambridge Assessment International Education

Using multiple choice questions to identify student misconceptions

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Using multiple choice questions

Purpose:

- *To gain an insight into the writing of multiple choice questions*
- *Learn how to use statistical evidence to reveal areas of misconception and error*
- *Explore how to use multiple choice questions in the classroom to identify and address specific areas for development*
- *Share ideas for activities involving multiple choice questions to suit different learning styles*

Writing multiple choice questions

Why multiple choice questions?

- In summative assessment:
  - For wide syllabus coverage
  - Contribute to reliability
  - Quick and easy to mark electronically
  - Easy to create similar but different questions (sibling items)
- In formative assessment
  - To reinforce learning
  - To identify misconceptions
  - Easy to create sibling items to re-test misconceptions
  - Quick and easy to mark

Jargon

Term	Meaning
Item	everything: stem, question and options
Stem	the material preceding the question
Question	the question itself (the sentence ending with '?')
Options	the choices **A**, **B**, **C**, **D**
Key	the correct option
Distractor	an incorrect option

The circuit of a motor racing track is 3.0 km in length. In a race, a car goes 25 times round the circuit in 30 minutes.

What is the average speed of the car?

A 75 km / hour **B** 90 km / hour **C** 150 km / hour **D** 750 km / hour

Jargon

- Sibling – a closely related item

The circuit of a motor racing track is 3.0 km in length. In a race, a car goes 25 times round the circuit in 30 minutes.

What is the average speed of the car?

A 75 km / hour **B** 90 km / hour **C** 150 km / hour **D** 750 km / hour

The circuit of a motor racing track is 7.0 km in length. In a race, a car goes 12 times round the circuit in 36 minutes.

What is the average speed of the car?

A 84 km / hour **B** 252 km / hour **C** 140 km / hour **D** 432 km / hour

What makes a good multiple choice item?

- There is a unique correct answer that is on syllabus
- The key is correct no matter how much science is known beyond the syllabus
- All options are plausible
- All distractors are on syllabus
- It is neither too easy nor too difficult
- The language is clear and technical terms are on the syllabus
- There is no trickery, or gender, racial or cultural bias of any kind

Distractors – non-calculation questions

- Distractors for non-calculation items are all reasonable choices given incomplete knowledge

When dilute sulfuric acid is electrolysed using inert electrodes, two gases are produced.

What are these two gases?

A hydrogen and oxygen

B hydrogen and sulfate

C hydrogen and sulfur dioxide

D oxygen and sulfur dioxide

Distractors – calculation questions

- Distractors for calculations can all be reached using the data given, ideally with just one mistake in the process

A 2.0 g sample of sodium chloride is dissolved in water to give a solution of volume 80 cm^3.

What is the concentration of this solution in g/dm^3?

A **B** 25 **C** **D**

- Key: 80 ÷ 1000 = 0.08 dm^3 2.0 ÷ 0.08 = 25 g/dm^3
- What could be good distractors?
  - not converting to dm^3 = 0.025 (g/cm^3)
  - fraction wrong way up = 0.04 (dm^3/g)
  - multiplying instead of dividing = 0.16 ($g\,dm^3$)

Distractors – calculation questions

A 2.0 g sample of sodium chloride is dissolved in water to give a solution of volume 80 cm^3.

What is the concentration of this solution in g/dm^3?

A **B** 25 **C** **D**

- Other possible distractors
  - not converting to dm^3 and wrong way up = 40 (cm^3/g)
  - multiplying 80 x 2 = 160
  - adding 80 + 2 = 82
  - random answer e.g. 33

Distractors – calculation questions

- Distractors for calculations can all be reached using the data given, ideally with just one mistake in the process

The potential difference across a resistor is 6.0 V, and the current in it is 3.0 A.

What is the resistance of the resistor?

A 0.50 Ω **B** 2.0 Ω **C** 9.0 Ω **D** 18 Ω

- Ohm's Law: $V = I \times R$
- where V is voltage, I is current in amperes (A) and R is the resistance in ohms (Ω)
- Rearrange: $R = V \div I = 6.0 \div 3.0 =$ 2.0 Ω

Statistics

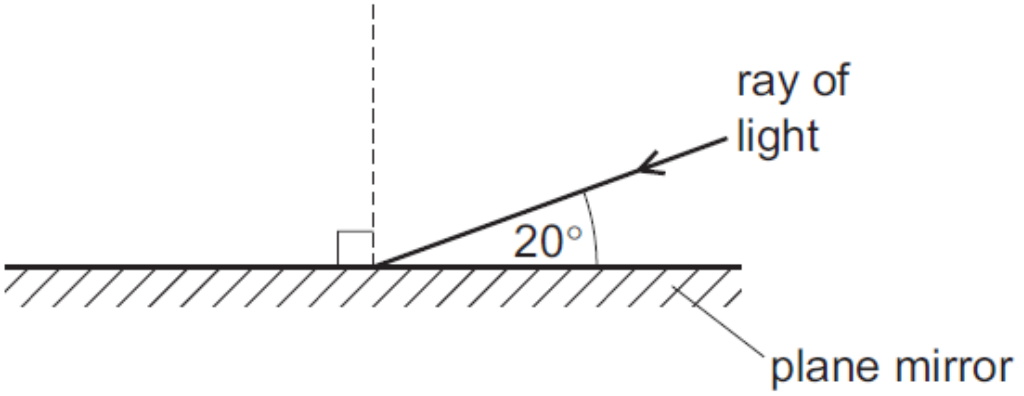
Statistics – item facility

- Facility = the proportion of students that answered correctly
- Target range is 0.25 – 0.80
- An extremely high value indicates the question is too easy
- An extremely low value indicates the question is too hard
- 0.25 is the “guessing rate” in a four-option question

Statistics

- Proportion endorsing = the proportion choosing each option

The diagram shows a ray of light striking a plane mirror.



What is the angle of reflection?

A 20° **B** 40° **C** 70° **D** 140°

Statistics

- Look at the proportion of candidates in the upper 27% of the test score distribution who gave the correct answer to the item, and the same proportion in the lowest 27% group.
- Should find that the proportion endorsing the key is greater for the stronger group than for the weaker group
- AND the proportion endorsing for the distractors is greater for the weaker group than for the stronger group

Statistics

- Statistics for the question:

Proportion correct	Option	Proportion endorsing			Key
		All	Low	High	
0.36	**A**	0.56	0.63	0.40	
	B	0.03	0.06	0.01	
	C	0.36	0.25	0.57	*
	D	0.04	0.06	0.02	

- PE report: This question on reflection of light proved challenging. The majority of candidates chose option **A**; it should be noted that the angle of reflection is always measured between the ray and the normal.

Using the statistics

- Use the facility to identify which topics are generally well understood and which are less well understood
- Use the proportion endorsing to identify specific misconceptions and identify which topics weaker candidates struggle with

Using multiple choice questions in the classroom

Use in the classroom

- At the beginning of the topic to assess prior knowledge
- During a topic to assess progress
- During a lesson to check understanding
- As homework
- At the end of a topic to plan targeted revision

Sources of questions

- Past papers
- Test-maker
- Text books
- Online
- Write your own

Writing multiple choice questions - tips

- Keep notes of ideas as teaching
- Identify topic/learning outcome to test
- Start by writing a question with correct answer
- Consider distractors to test common misconceptions/mistakes
- Ask someone else to review

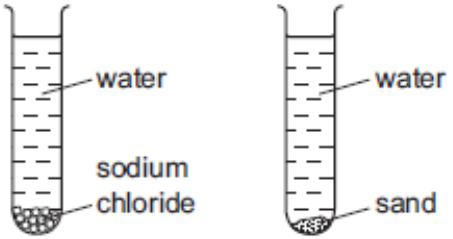
Learning styles

Learning styles

Small amounts of sodium chloride and sand are shaken with separate samples of water in two test-tubes. The test-tubes are left to stand for 24 hours.

Which diagram shows how the test-tubes appear after leaving them to stand for 24 hours?

A



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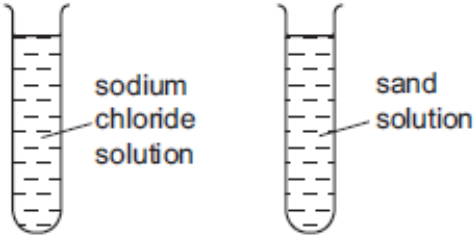
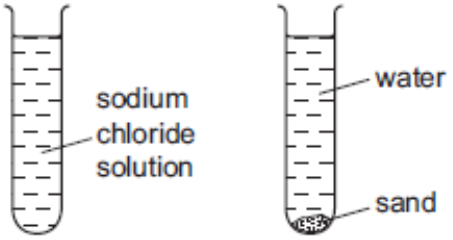
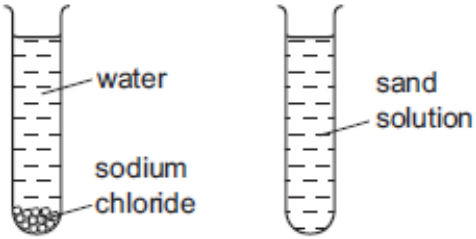


C



D



Learning styles

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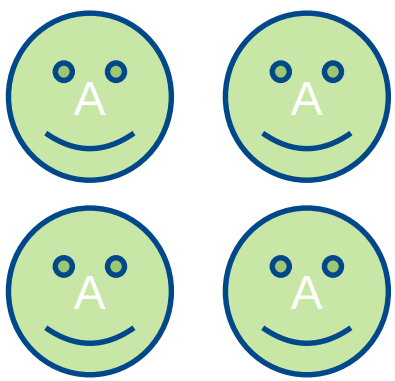
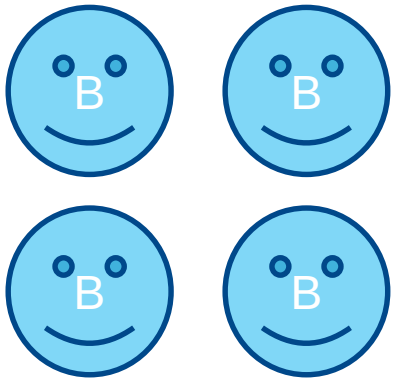
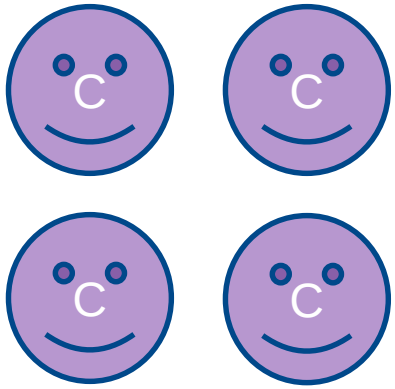
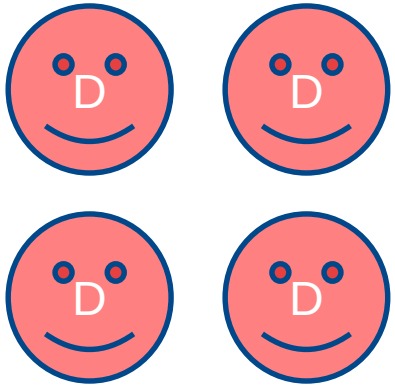
Learning styles

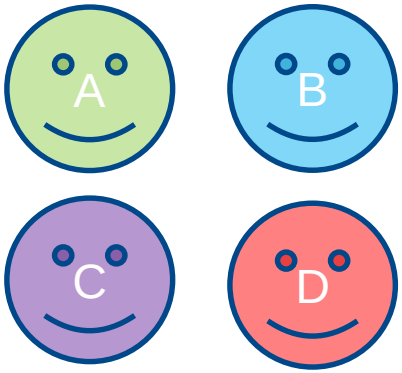


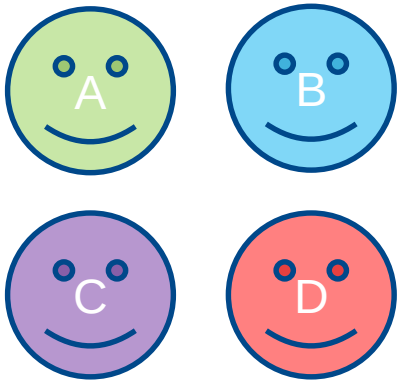


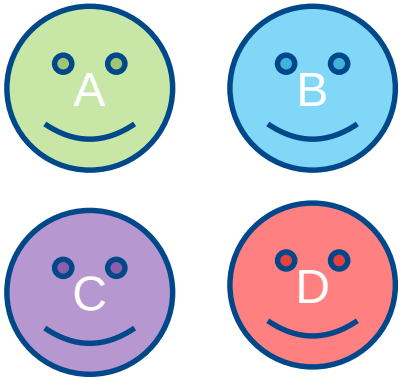


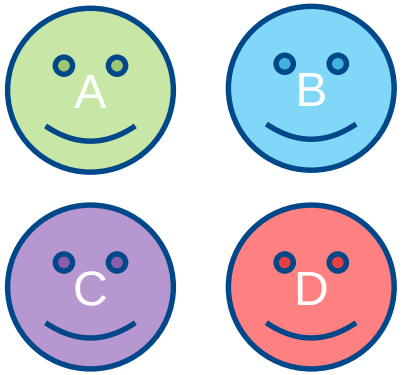


Learning styles



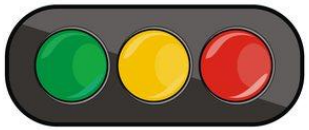






Learning styles

- Further ideas…
- Students to write their own
- Using paper/mini white boards to hold up what they think it is – gives quick idea whether they are getting it
- Yes/no/maybe – traffic lights or smiley faces, to vote on each choice



- A, B, C, D stations around the classroom

Summary

Using multiple choice questions

Outcomes:

- *Gained an insight into the writing of multiple choice questions*
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- *Explored how to use multiple choice questions in the classroom to identify and address specific areas for development*
- *Shared ideas for activities involving multiple choice questions to suit different learning styles*

Assessment

We recognise that assessment has two important roles: to prove and improve – to prove what students are learning, and to suggest how they can improve their understanding and skills.

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Thank you

Any questions?






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Learn more!

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