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Question design for effective e-assessment

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Overview

- SCHOLAR
- Designing Questions
 - What is important?
 - Using different question types
 - Constructed answers
- Feedback and Reporting

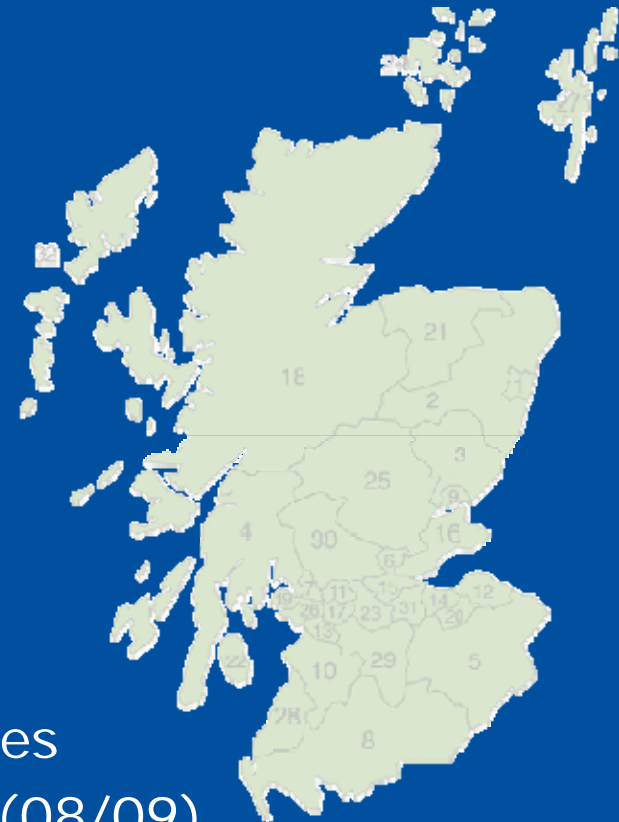
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The SCHOLAR Forum in Scotland



- All Scottish secondary schools and colleges
- > 100,000 enrolled students & teachers (08/09)
- Extensive staff development (~2500 teachers p.a.)

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Advanced Higher	Higher	Intermediate
Mathematics	Mathematics	Mathematics
Biology	Biology Human Biology	
Chemistry	Chemistry	
Physics	Physics	
Computing	Computing	
Information Systems	Information Systems	
Business Management	Business Management	
French	French	
<i>Accounting</i>	Accounting	
<i>German</i>	German	
<i>Spanish</i>	Spanish	
<i>Economics</i>	Economics	
	Psychology	
		<i>Mandarin</i>

New for 2009

Simplify

$$3(7 - x + 6x^2 + 4x^3 - 8x^4) - 4(2 - 2x + 9x^3)$$

- $-1 + 7x + 6x^2 - 32x^3 - 8x^4$
- $29 - 11x + 18x^2 + 48x^3 - 24x^4$
- $23 - 5x + 18x^2 + 21x^3 - 24x^4$
- $13 + 5x + 18x^2 - 24x^3 - 24x^4$

The 4 options:

- Not using multiplier of 1st bracket
- Not using sign for 2nd bracket
- Not using multiplier of 2nd bracket
- Correct

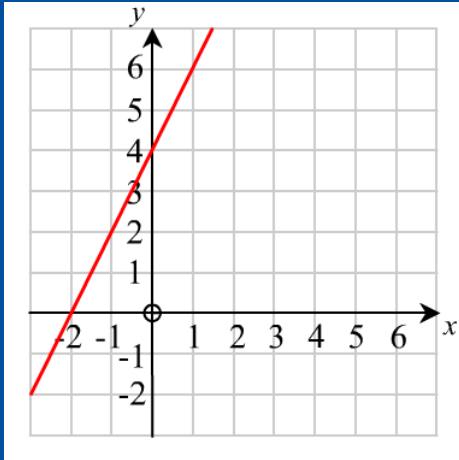
Correct answer can be found by multiply out the numbers only.

Need to be aware the question is different to a constructed version.

Often when MC versions are created, questions are changed dramatically.

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What is the equation of the line?

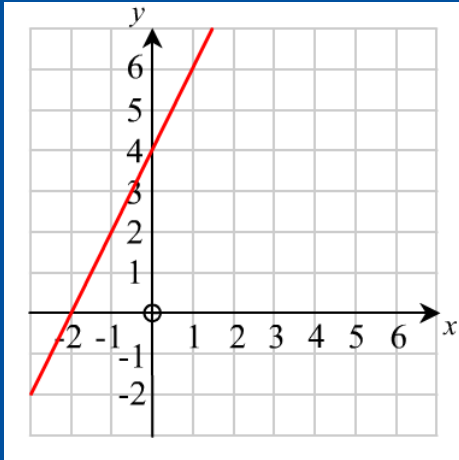
We need to make sure the students answer is in the list of choices for an MC.

Assume student knows:

- the form of a straight line equation,
- that m is the gradient & relates to how much we move up and along,
- that c is the intercept & relates to where the line crosses an axis.

So... possible choice are expression of the form $y = m x + c$

with possible values of
 $m: 2, \frac{1}{2}, -2, -\frac{1}{2}$
 $c: 4, -2$



What is the equation of the line?

- $y = 2x + 4$
- $y = 2x - 2$
- $y = \frac{1}{2}x + 4$
- $y = \frac{1}{2}x - 2$
- $y = -2x + 4$
- $y = -2x - 2$
- $y = -\frac{1}{2}x + 4$
- $y = -\frac{1}{2}x - 2$

Even with all these assumptions, we still have 8 reasonable choices for the answer.

How many choices are needed if we don't make all of these assumptions?

How easy is it to find your answer in amongst all of these choices?

Question Design

Often we are trying to create a question online which used to exist on paper.

We need to assess the same objectives.

What are our options?

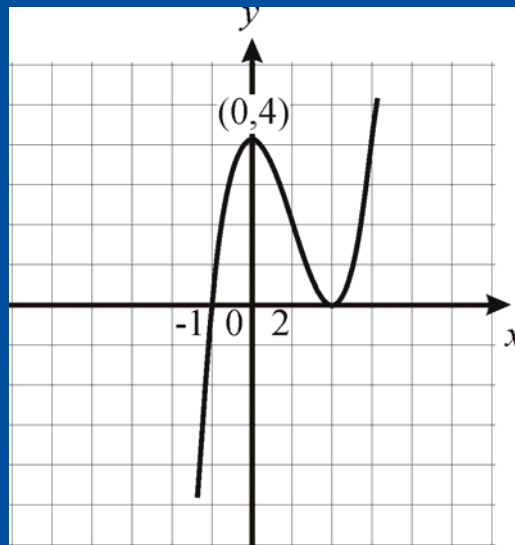
Here we look at an original paper based question and 3 different e-assessment versions – exploring the advantages and disadvantages of each.

Constructed Answers: Example

*Original Paper Question from a Higher Maths NAB.
Student constructed answer by drawing the graph.*

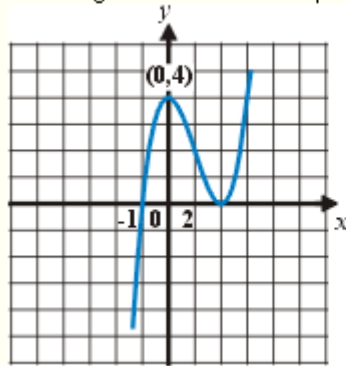
Diagrams 1 and 2 on the worksheet show part of the graph $y = f(x)$.

- (a) On Diagram 1, draw the graph of $y = -f(x)$.
- (b) On Diagram 2, draw the graph of $y = f(x + 2)$.

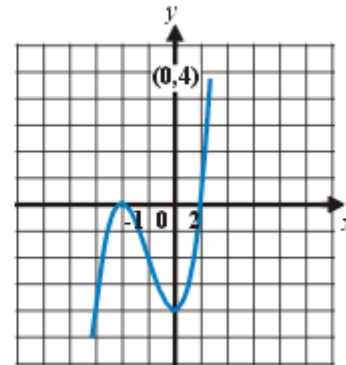
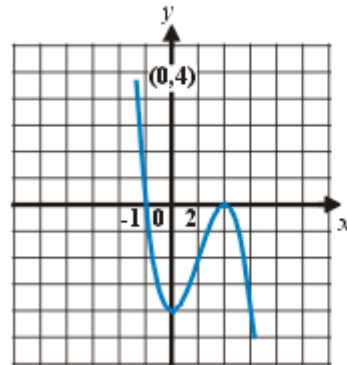
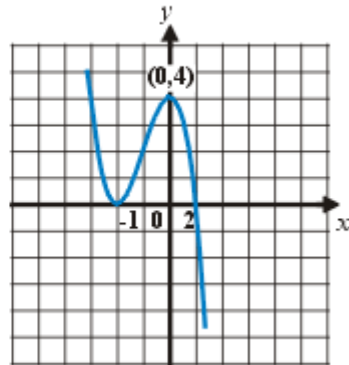
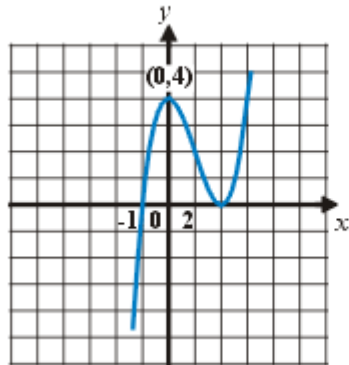


Option 1 – Multiple Choice

The diagram below shows part of the graph of $y = f(x)$.



1.1) Select the graph that represents $y = -f(x)$.



Option 1 – Multiple Choice

Advantages

- Easy to create and mark
- Easy for student to answer
- Some randomisation possible

Disadvantages

- Recognition and Elimination NOT construction
- High screen real estate required
- Limited possible answers

Option 2 - Hotspot

Unanswered question.

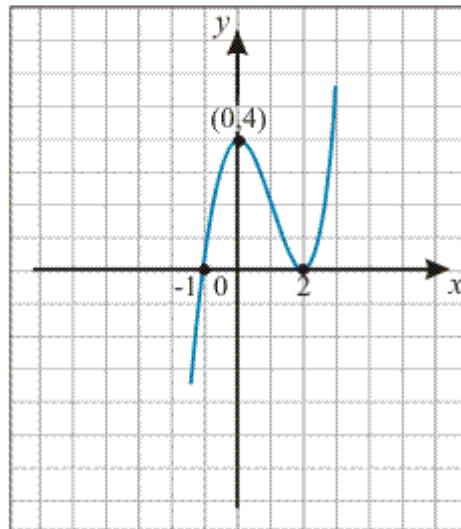
Diagrams 1 and 2 below both show part of the graph of $y = f(x)$.

Identify the features of the graphs of $y = -f(x)$ and $y = f(x + 3)$ requested below.

- 2.1) On Diagram 1, click where $y = -f(x)$ has its turning points and where it intersects with the axes.

Note that marks will only be given when all points have been identified.

Diagram 1



Option 2 - Hotspot

Answered question.

Question after it is answered with red circles show turning points and intersections.

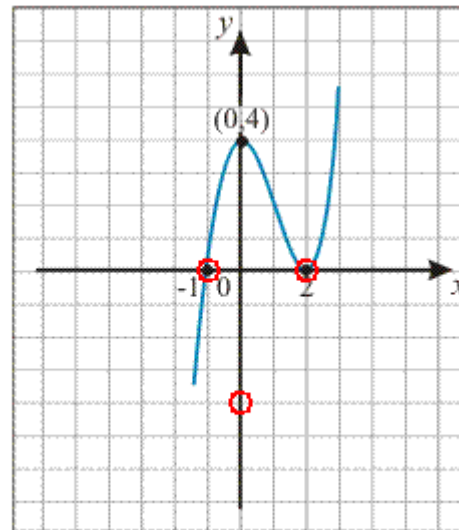
Diagrams 1 and 2 below both show part of the graph of $y = f(x)$.

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- 2.1) On Diagram 1, click where $y = -f(x)$ has its turning points and where it intersects with the axes.

Note that marks will only be given when all points have been identified.

Diagram 1



Option 2 - Hotspot

Advantages

- Many possible answers
- Construction of an answer
- Lower screen real estate
- Easy to mark

Disadvantages

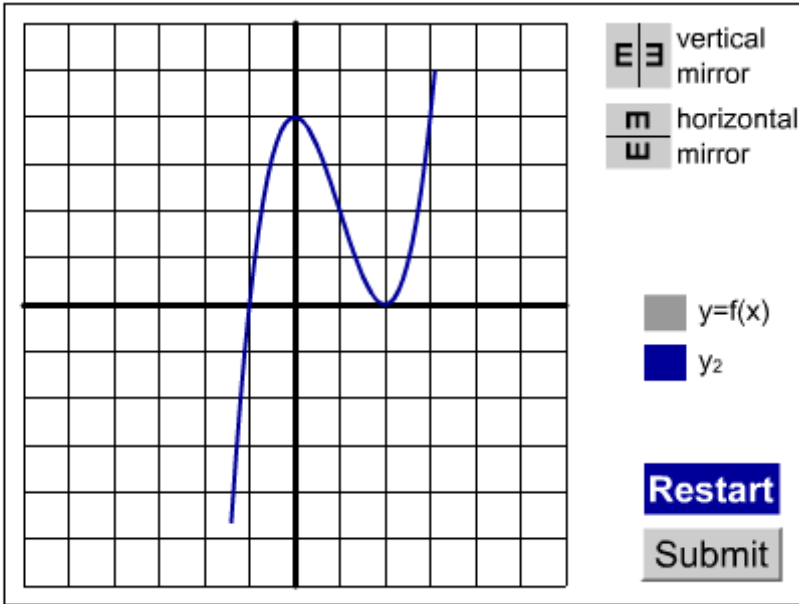
- Could be fiddly for student to answer
- Time consuming to create
- Low reusability
- No randomisation
- High server communication and load

Option 3 - Flash

User can move blue curve with mouse or graph, and can use buttons to mirror the curve vertically or horizontally.

The graph shows the function $y=f(x)$.

3.1) Manipulate the blue curve to show $y_2 = -f(x)$.



E \exists vertical mirror
m horizontal mirror
W

$y=f(x)$
 y_2

Restart
Submit

Option 3 - Flash

Advantages

- Many possible answers
- Construction of an answer
- Lower screen real estate
- Easy to mark
- Randomisation possible
- High reuse
- Low server and communication load
- Increased accessibility

Disadvantages

- Creation requires multimedia authoring skills

Appropriate Learning Outcome

Solving simultaneous linear equations...

(a) algebraically

(b) graphically

Partly answered question
Showing feedback.

Solve the system of equations

$$2x + 6y = 22$$
$$5x - y = 39$$

2.1) What is the value of x ?

Your currently accepted answer:
String Format:

2.2) What is the value of y ?

Your currently accepted answer:
String Format:

The line $x + 3y = 6$ is drawn on the graph.

a) On the same graph, plot the line $x + y = 4$

b) Use the graph to solve the system of equations $x + 3y = 6$ & $x + y = 4$

Solution is: $x =$ \times $y =$ \times

Click on the graph to mark two points for the second line. You can drag the points to move them. Enter the solution to the equations in the grey boxes.

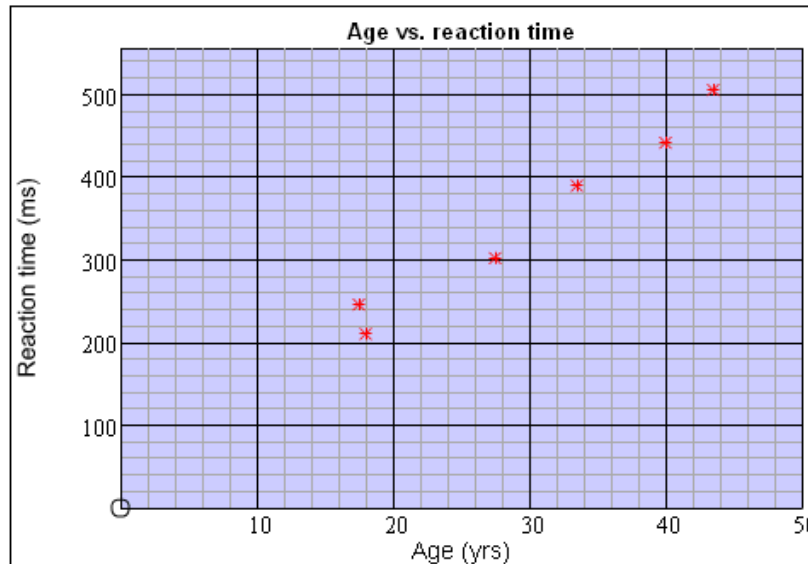
[2 out of 3 marks]

Graphically, student must demonstrate they can draw the appropriate graph.

Appropriate Marking

Follow through: allowing students to gain credit even if they make an initial mistake.

A group of people of different ages test their reaction times. The scatter graph shows the results i
Mark two points on the graph to indicate your best fit line. You can drag the points to change their location. Work out the equation of your line and use it to find the estimated value.



Age (years)	Reaction time (ms)
17.5	246
18	210.8
27.5	302
27.5	302
33.5	389.6
40	442
43.5	505.6

The equation of the line is $y = \text{[]}x + \text{[]}$

From the equation, the reaction time of a person of 10 years of age is:

restart

reveal

submit

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[0 out of 6 marks]

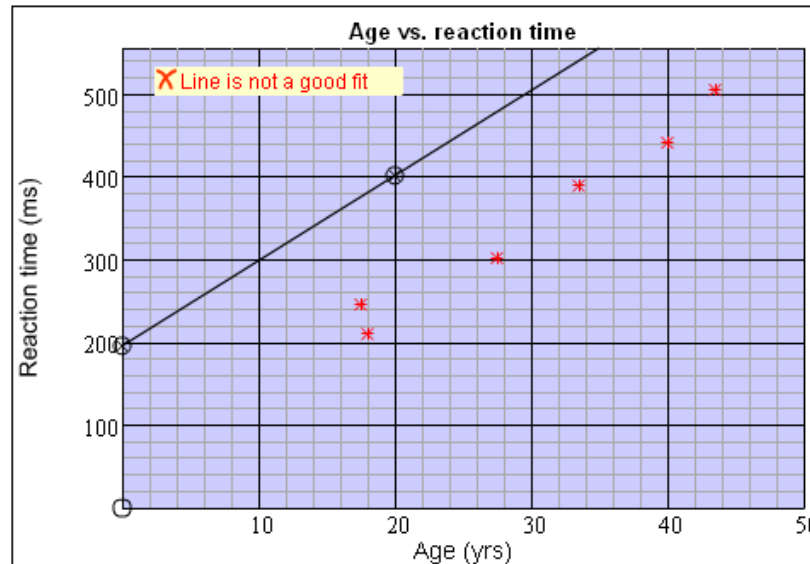
Appropriate Marking

Partly answered question showing follow through and feedback.

Here the best fit line is incorrect, but the appropriate equation of this line has been entered.

Feedback and marks are given as appropriate.

A group of people of different ages test their reaction times. The scatter graph shows the results. Mark two points on the graph to indicate your best fit line. You can drag the points to change their location. Work out the equation of your line and use it to find the estimated value.



Age (yrs)	Reaction time (ms)
17.5	246
18	210.8
27.5	302
27.5	302
33.5	389.6
40	442
43.5	505.6

Feedback

Your line is not a good best fitting line. The trend of your line is reasonable, but the line has the wrong intercept with 7 points one side of the line and 0 the other.

Try to draw a better one.

The equation of the line is $y = 10x + 200$

From the equation, the reaction time of a person of 10 years of age is:

restart

reveal

submit

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[3 out of 6 marks]

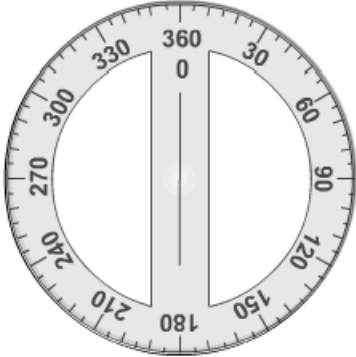
Creating a Piechart

Unanswered Question

A survey was conducted in which 180 people were asked which *movie type* they preferred.

Complete the third column of the table and draw a pie chart to illustrate the data.

Favourite Movie Type



Movie Type	Number	Angle
Romance	86	
Fantasy	42	
Western	52	

Key

- Romance
- Fantasy
- Western

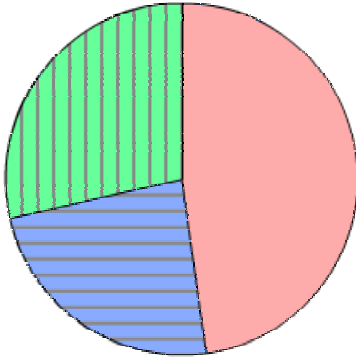
Buttons: Help, [0 out of 4 marks], Reveal, Submit

Answered Question

A survey was conducted in which 180 people were asked which *movie type* they preferred.

Complete the third column of the table and draw a pie chart to illustrate the data.

Favourite Movie Type



Movie Type	Number	Angle
Romance	86	172
Fantasy	42	84
Western	52	104

Key

- Romance
- Fantasy
- Western

Table: ✓
Angles: ✓
Key: ✓

Buttons: Help, [4 out of 4 marks], Reveal, Submit

Reporting

Real time feedback in assessments plus...

- Student reporting system
 - Individual reflection on progress
- Teacher reporting system
 - Individual or Class reflection on progress
 - Enables identification of misconceptions
 - Data available at a variety of levels, i.e. by Outcome, Question, Student etc.

Outcome Overview

Last Name	Total Mark (43)	L01	L02	L03	L04
Class Average	30.38				
Beevers R	25.6	✓	✓	✓	
Black K	43	✓	✓	✓	✓
Brown E	41	✓	✓	✓	✓
Brown G	38.6	✓	✓	✗	✓
Cassidy R	23.6	✓	✗	✗	✗
Clark B	16	✓			✓
Clarke S	42	✓	✓	✓	✓
Cunningham D	16	✓	✓	✗	
Davidson M	26.5	✓	✗	✓	✗
Dunbar J	41.5	✓	✓	✓	✓
Hunter C	39.5	✓	✓	✓	✓

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Assessment Progress

By Total Mark

Name	Percentage Graph
Class Average	
Beevers R	
Black K	
Brown E	
Brown G	
Cassidy R	
Clark B	
Clarke S	
Cunningham D	
Davidson M	
Dunbar J	
Hunter C	

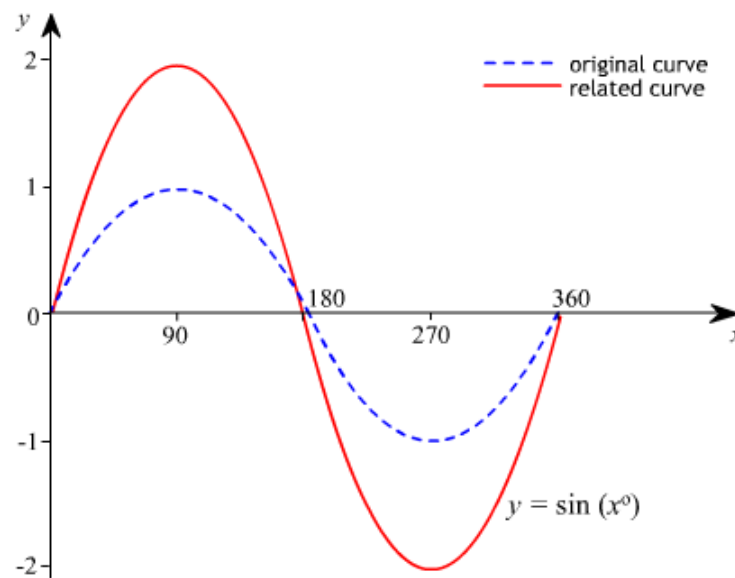
By Question Mark

Name	Q1 (4)	Q2 (2)	Q3 (3)
Class Average			
Beevers R			
Black K			
Brown E			
Brown G			
Cassidy R			
Clark B			
Clarke S			
Cunningham D			
Davidson M			
Dunbar J			
Hunter C			

By Question

The diagram below shows part of the graph of $y = \sin(x)$ (drawn as a broken line), where x is in degrees, and the graph of a related function (drawn as a solid line).

Input the equation of the related graph.



[1]

6.1) The equation of the related graph is $y =$

Submit

Correct	Student Answer	Expected Answer	Attempts
✗	3sin(x)	sin(3*x)	1
✗	3sin(x)	sin(3x)	1
✓	2sin(x)	2*sin(x)	1
✓	2sin(x)	2sin(x)	1
✗	2sin(x)	sin(2*x)	1
✗	2sin(x)	sin(2x)	1
✓	cos(2x)	cos(2*x)	2
✓	cos(2x)	cos(2x)	2
✗	3cos(x)	cos(3*x)	1
✗	3cos(x)	cos(3x)	1
✗	2sin(x)	sin(2*x)	1
✗	2sin(x)	sin(2x)	1
✗	2Sin(x)	sin(2*x)	1
✗	2sin(x)	sin(2x)	1
✓	3cos(x)	3*cos(x)	1
✓	3cos(x)	3cos(x)	1


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By Student

Question No. 1. The score was 0 out of 3 marks

Part	Steps Used	Correct	Student Answer	Expected Answer	Attempts
1			$x-1$ $x - 1$	$-x+1$ $-x + 1$	1

Question No. 2. The score was 0 out of 1 marks

Part	Steps Used	Correct	Student Answer	Expected Answer	Attempts
1			$\sin(x)-2$ $\sin(x) - 2$	$\sin(x)-3$ $\sin(x) - 3$	1

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What is important?

- Constructed Answers
- Appropriate Questions
- Repeated Practice
- Feedback & Reporting

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Further Information

SCHOLAR examples

<http://scholar.hw.ac.uk>

Choose Wales > Try SCHOLAR

JISC article

Exploring e-Assessment: A practitioner's perspective

<http://www.elearning.ac.uk/features/eassessment>

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Any Questions?