Pearson
BTEC Level 2 Technical Diploma in Engineering

First teaching September 2017

Sample Assessment Materials: Unit 1: Engineering Principles

Version 1.0

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BTEC L2 Technical Diploma in Engineering
Unit 1: Engineering Principles

Information for candidates

Instructions

- Answer all questions.
- An onscreen notepad is provided for you to make notes during the test. These notes will not be marked.
- An onscreen calculator is provided for questions which require calculation.
- An accessibility panel is provided on every screen. This allows you to magnify your screen and apply a range of colour filters

Information

- The assessment is **1 hour 15 minutes** in duration.
- The **total mark** for this test is **60.**
- The number of marks for each question is shown in brackets e.g. (2). Use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

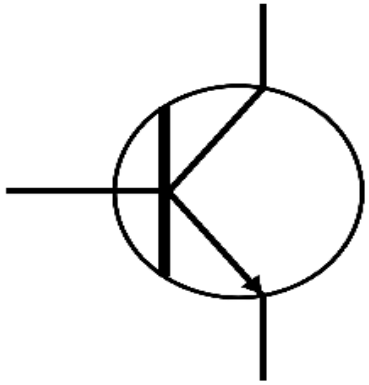
Start Test

Test Player Preview

The image shows a symbol used in a circuit diagram.

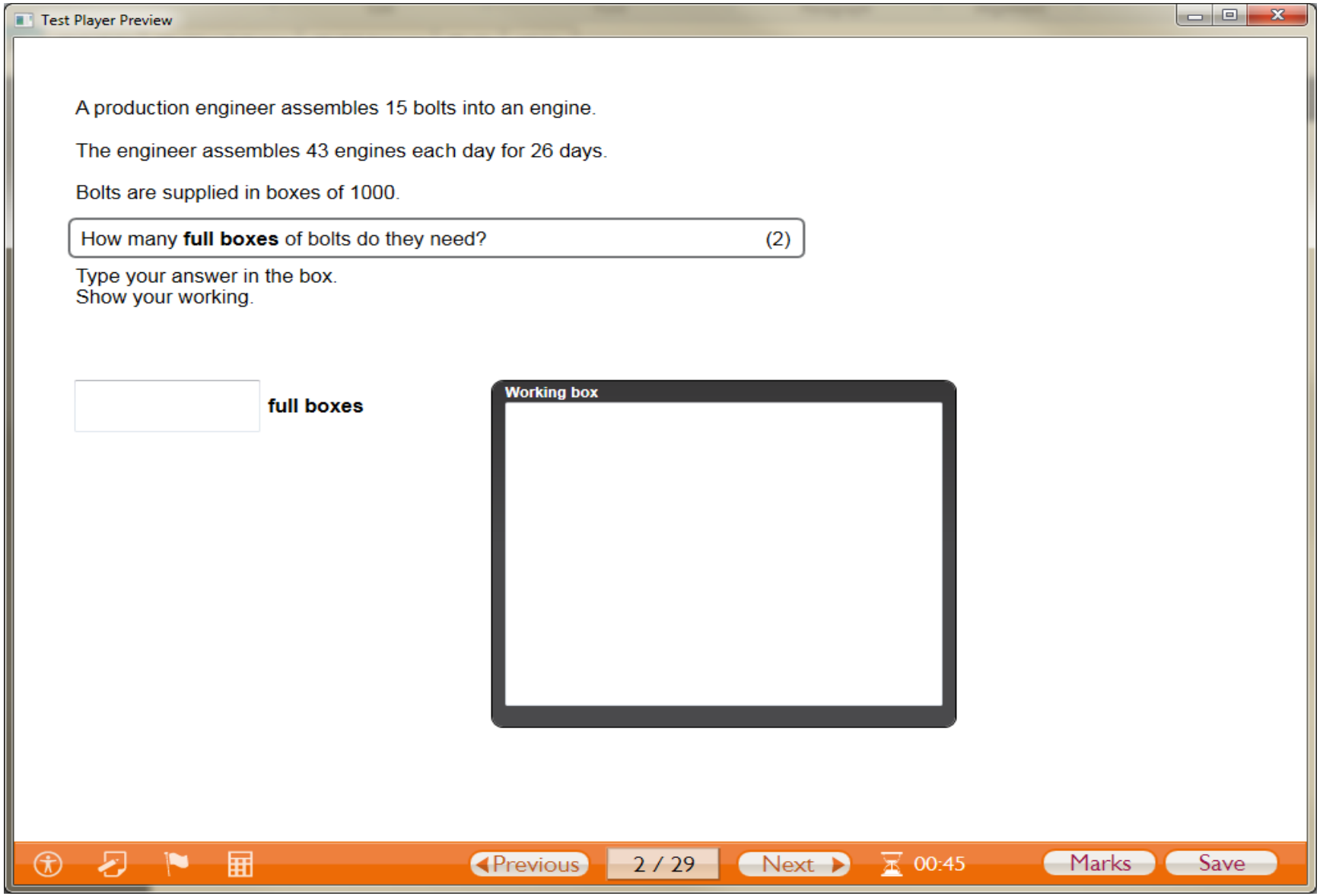
Identify the component represented by the symbol. (1)

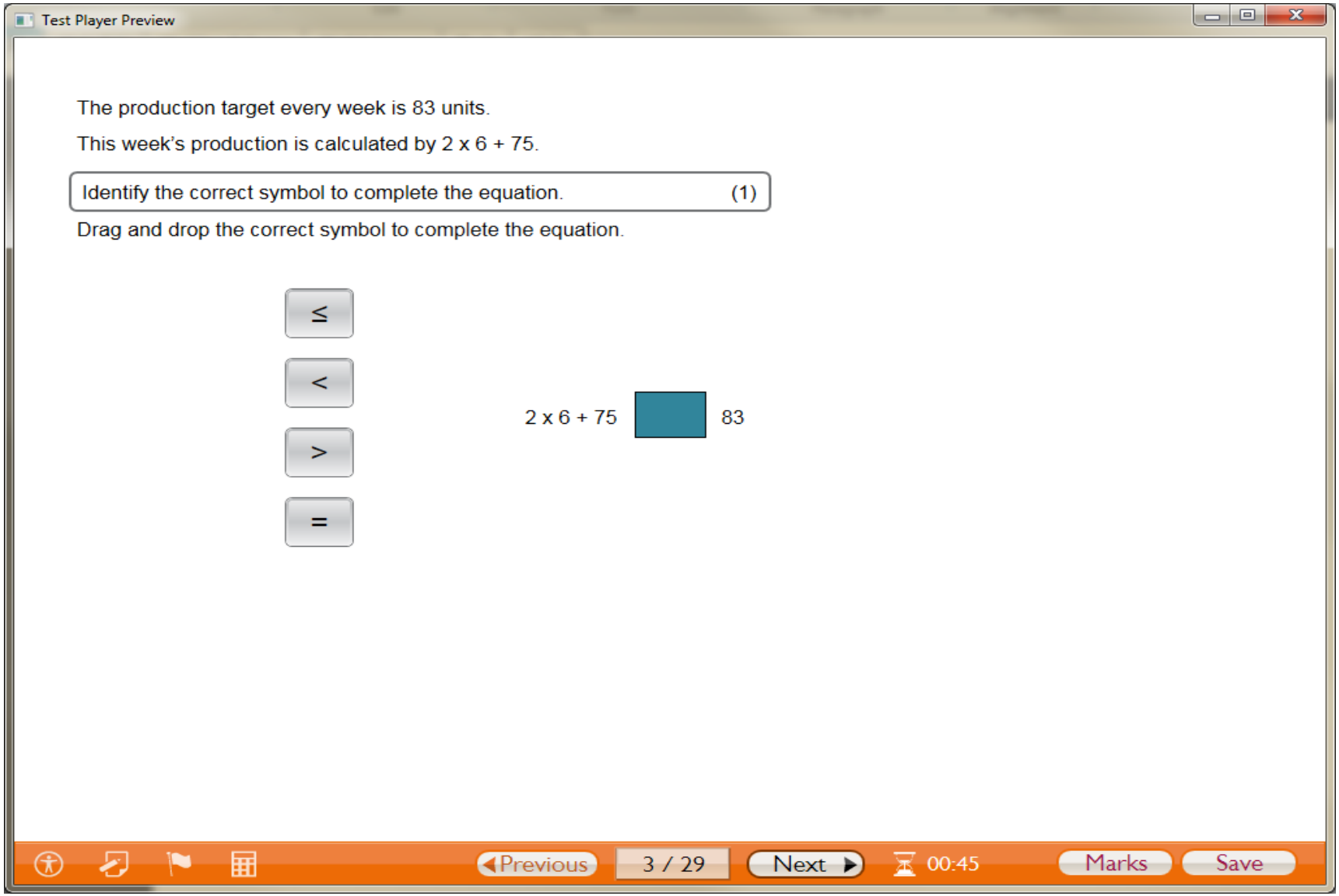
Select **one** option.

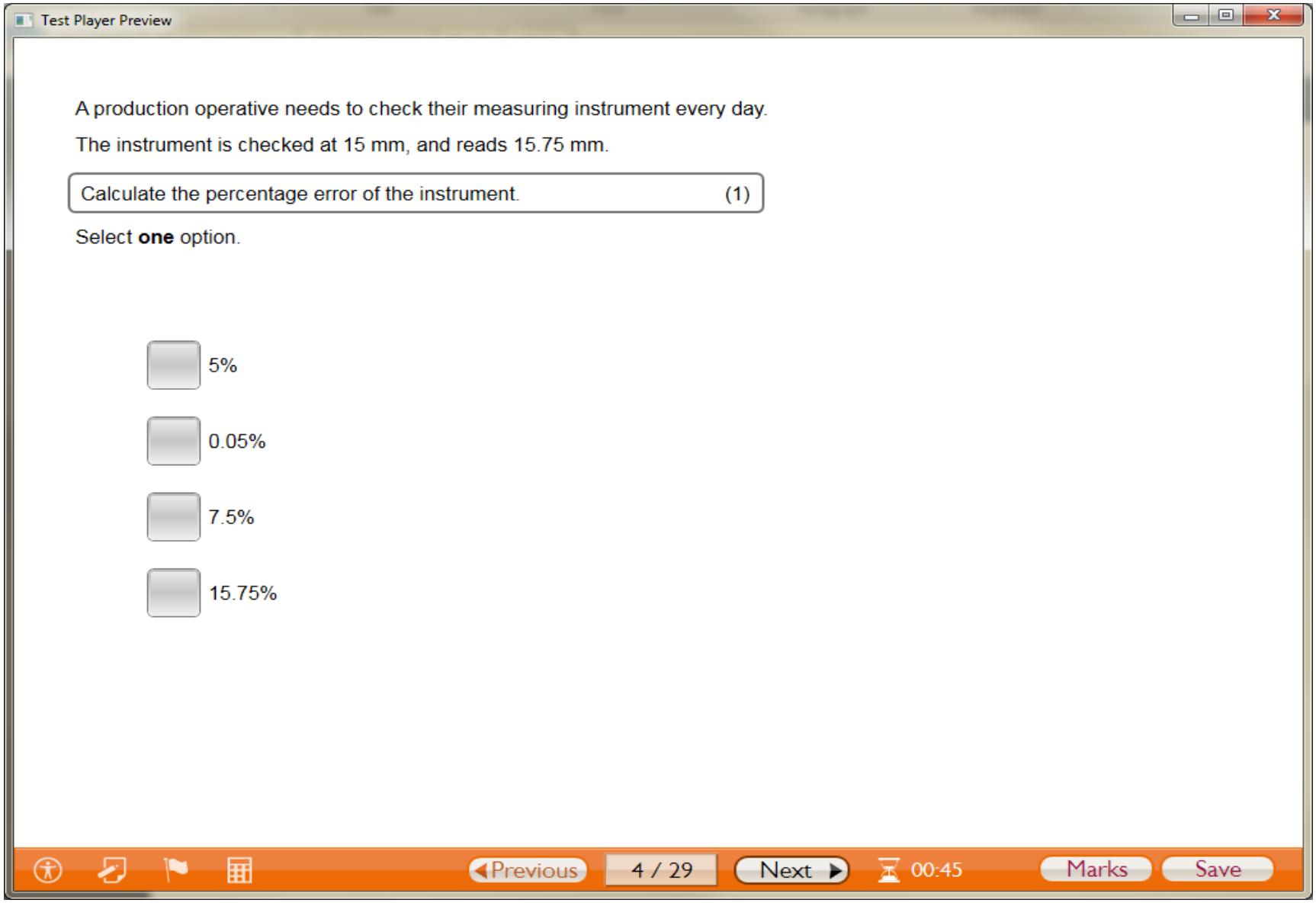


- Diode
- Lamp
- Transistor
- Ammeter

Previous | 1 / 29 | Next | 00:45 | Marks | Save


Test Player Preview
A production engineer assembles 15 bolts into an engine.
The engineer assembles 43 engines each day for 26 days.
Bolts are supplied in boxes of 1000.
How many **full boxes** of bolts do they need? (2)
Type your answer in the box.
Show your working.
full boxes
Working box
Previous
2 / 29
Next
00:45
Marks
Save


Test Player Preview
The production target every week is 83 units.
This week's production is calculated by 2 x 6 + 75.
Identify the correct symbol to complete the equation. (1)
Drag and drop the correct symbol to complete the equation.
≤
<
>
=
2 x 6 + 75
83
Previous
3 / 29
Next
00:45
Marks
Save

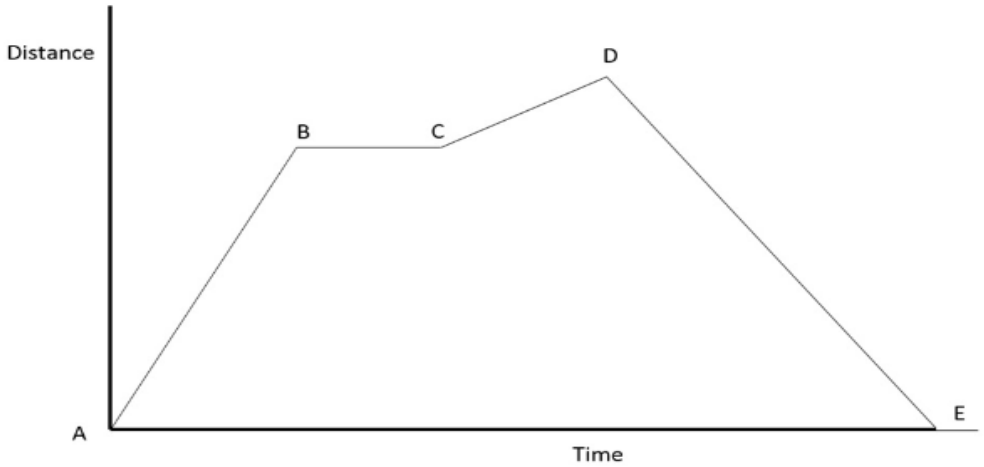

Test Player Preview
A production operative needs to check their measuring instrument every day.
The instrument is checked at 15 mm, and reads 15.75 mm.
Calculate the percentage error of the instrument. (1)
Select one option.
5%
0.05%
7.5%
15.75%
Previous
4 / 29
Next
00:45
Marks
Save

Test Player Preview

The graph below shows a vehicle's movement over time.

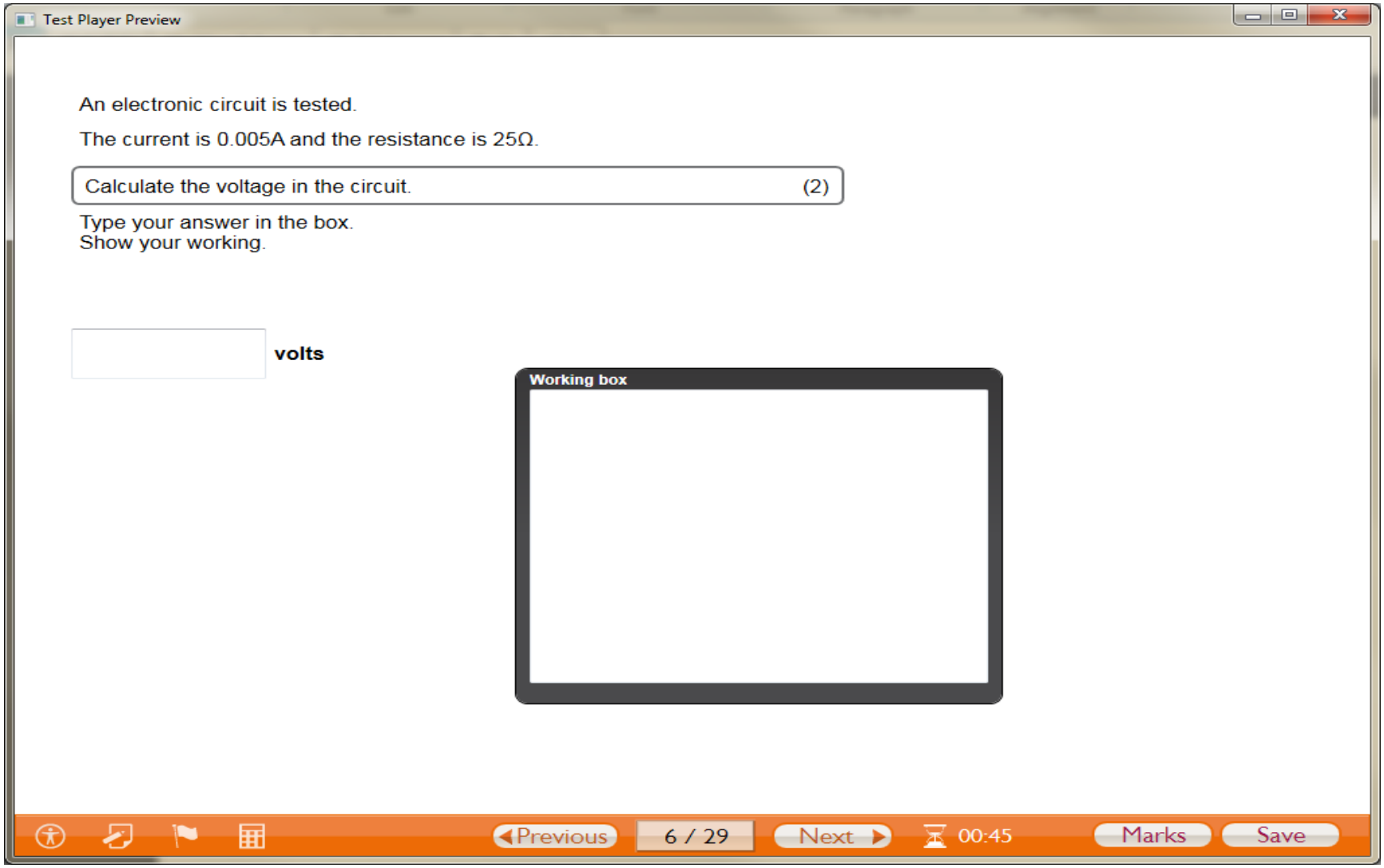
Which term describes the vehicle's movement between points **B** and **C** of the graph? (1)

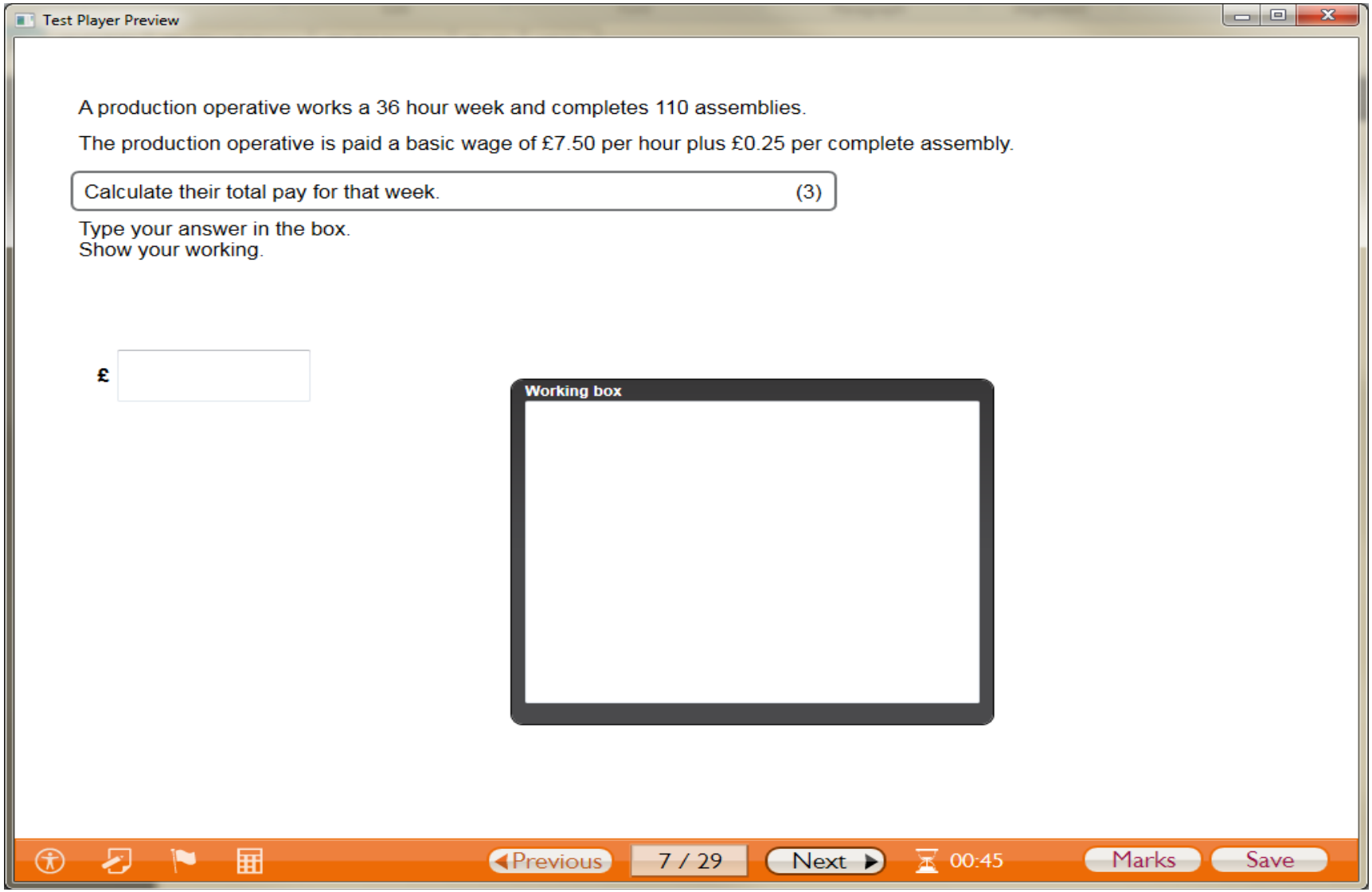
Select **one** option.



- constant velocity
- stationary
- acceleration
- deceleration

Previous 5 / 29 Next 00:45 Marks Save


Test Player Preview
An electronic circuit is tested.
The current is 0.005A and the resistance is 25Ω.
Calculate the voltage in the circuit. (2)
Type your answer in the box.
Show your working.
volts
Working box
Previous
6 / 29
Next
00:45
Marks
Save

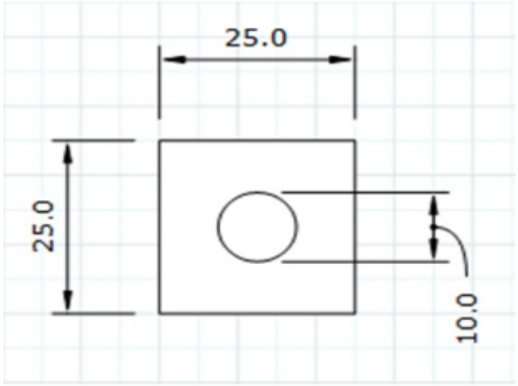

Test Player Preview
A production operative works a 36 hour week and completes 110 assemblies.
The production operative is paid a basic wage of £7.50 per hour plus £0.25 per complete assembly.
Calculate their total pay for that week. (3)
Type your answer in the box.
Show your working.
£
Working box
Previous
7 / 29
Next
00:45
Marks
Save

Test Player Preview

The image shows a drawing of a plate with a hole drilled in the centre.

All dimensions are in mm.

Select **one** option for each of (a), (b) and (c)



W is the side length

d is the diameter of the hole

r is the radius of the hole

(a) Calculate the area of the plate before drilling. (1)

- ☐ 50 mm^2
- ☐ 60 mm^2
- ☐ 250 mm^2
- ☐ 625 mm^2

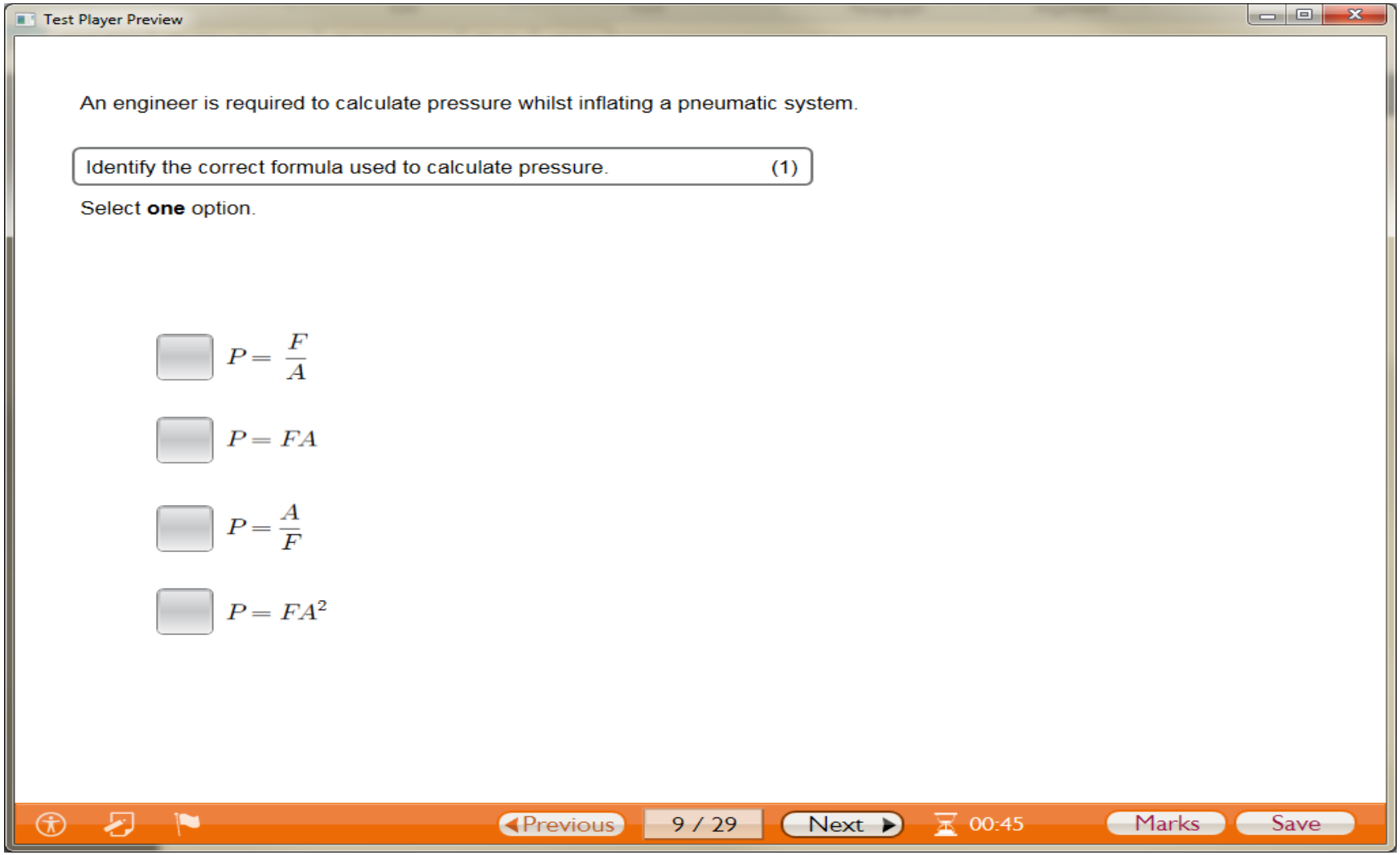
(b) What is the area of the drilled hole? (1)

- ☐ 10 mm^2
- ☐ 31.42 mm^2
- ☐ 78.54 mm^2
- ☐ 314.16 mm^2

(c) Identify the formula to calculate the area of the plate after drilling. (1)

- ☐ $W \times \pi d$
- ☐ $W^2 + \pi d^2$
- ☐ $W^2 - \pi r^2$
- ☐ $W + \pi r^2$

Previous 8 / 29 Next 00:45 Marks Save


Test Player Preview
An engineer is required to calculate pressure whilst inflating a pneumatic system.
Identify the correct formula used to calculate pressure. (1)
Select one option.
$P = \frac{F}{A}$
$P = FA$
$P = \frac{A}{F}$
$P = FA^2$
Previous
9 / 29
Next
00:45
Marks
Save

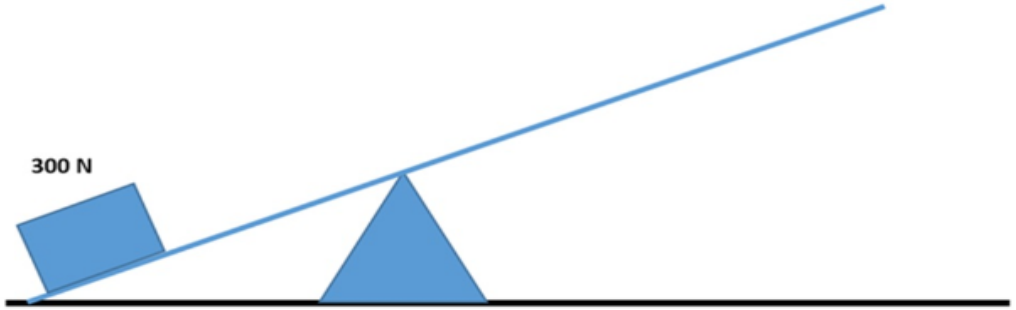
Test Player Preview

The diagram shows a lever system with a box on one end.

The effort applied to the lever is 120 N.

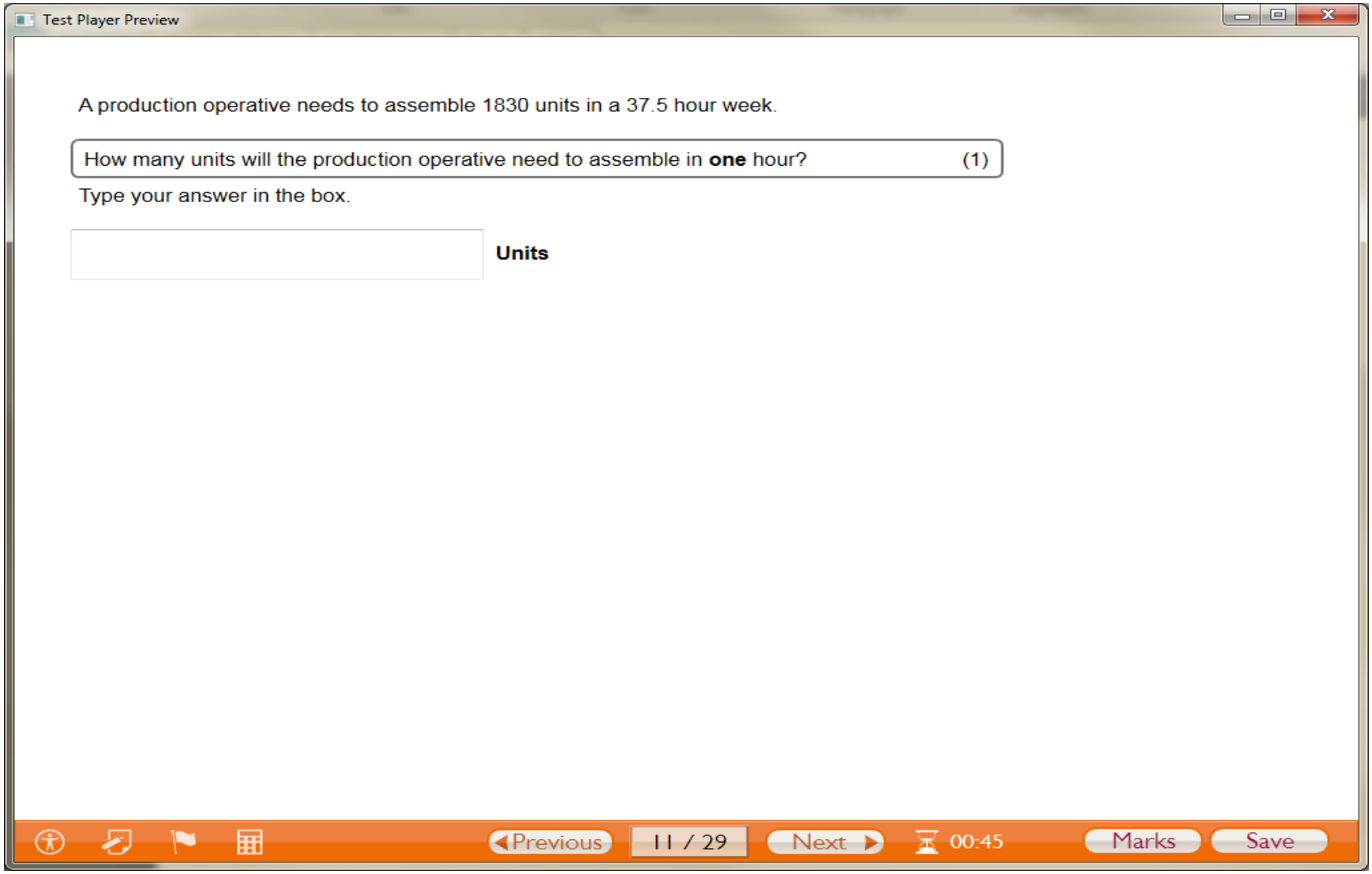
Calculate the mechanical advantage that the lever gives. (1)

Select **one** option.

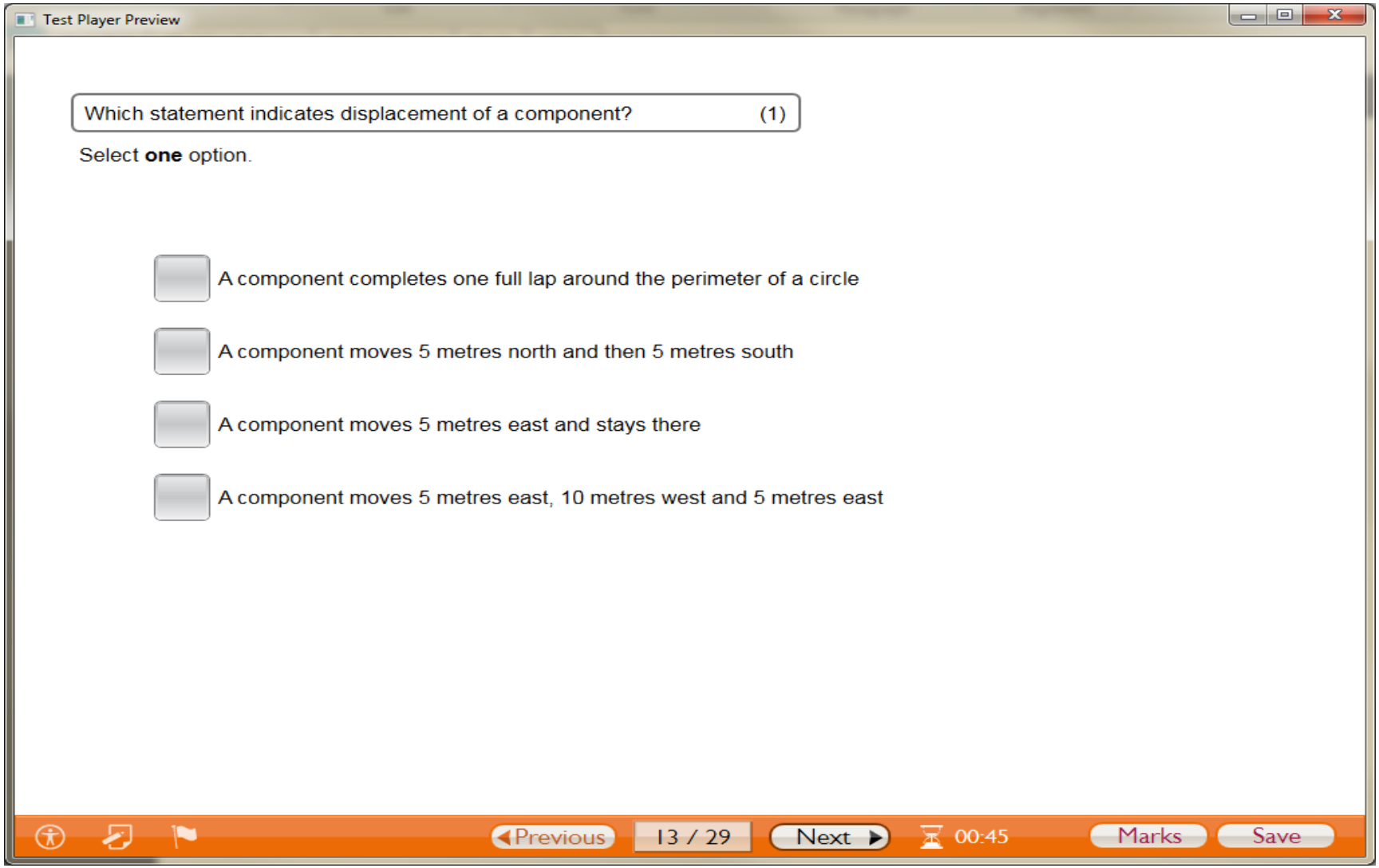


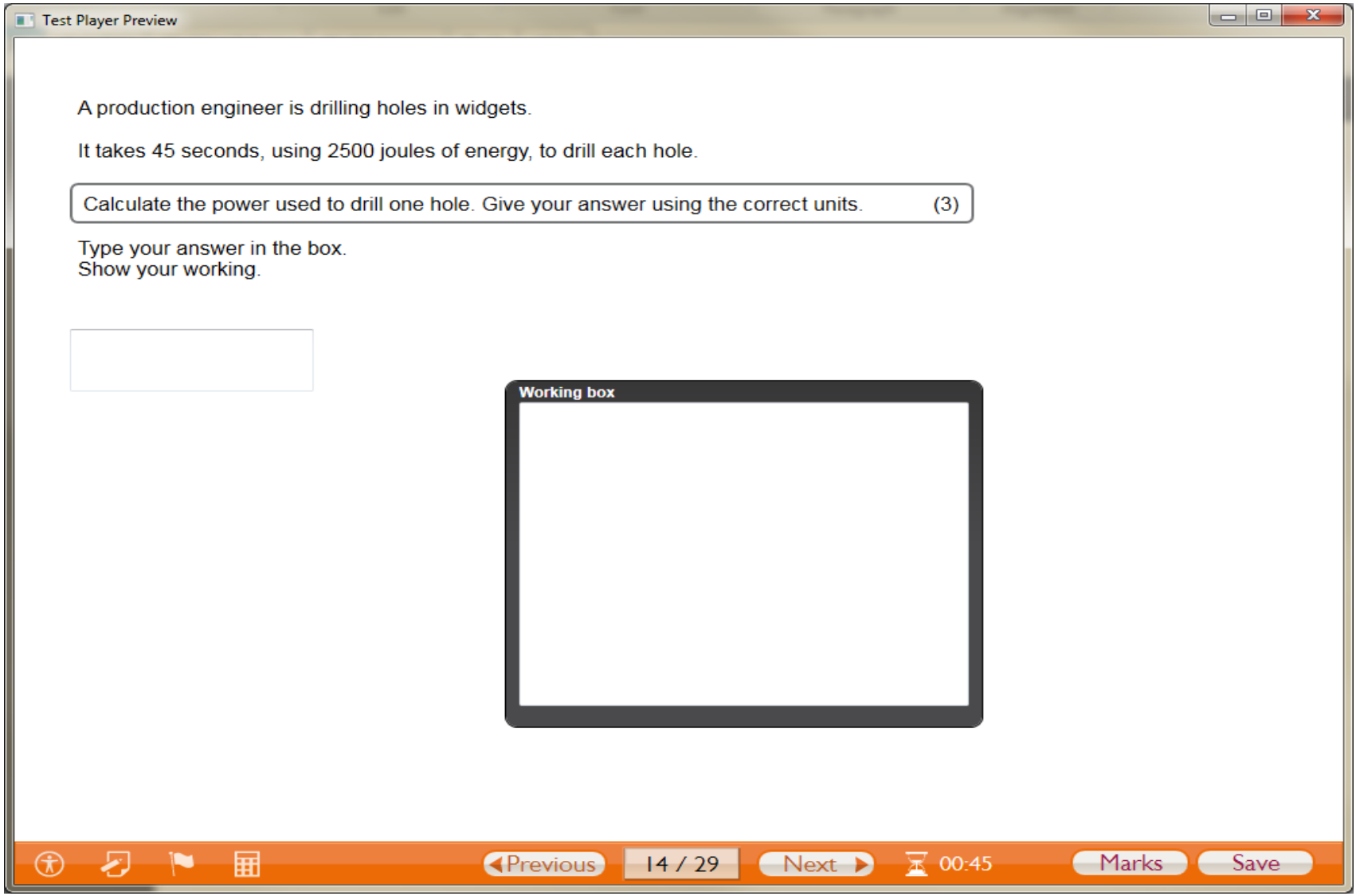
- 0.4
- 2.5
- 180
- 420

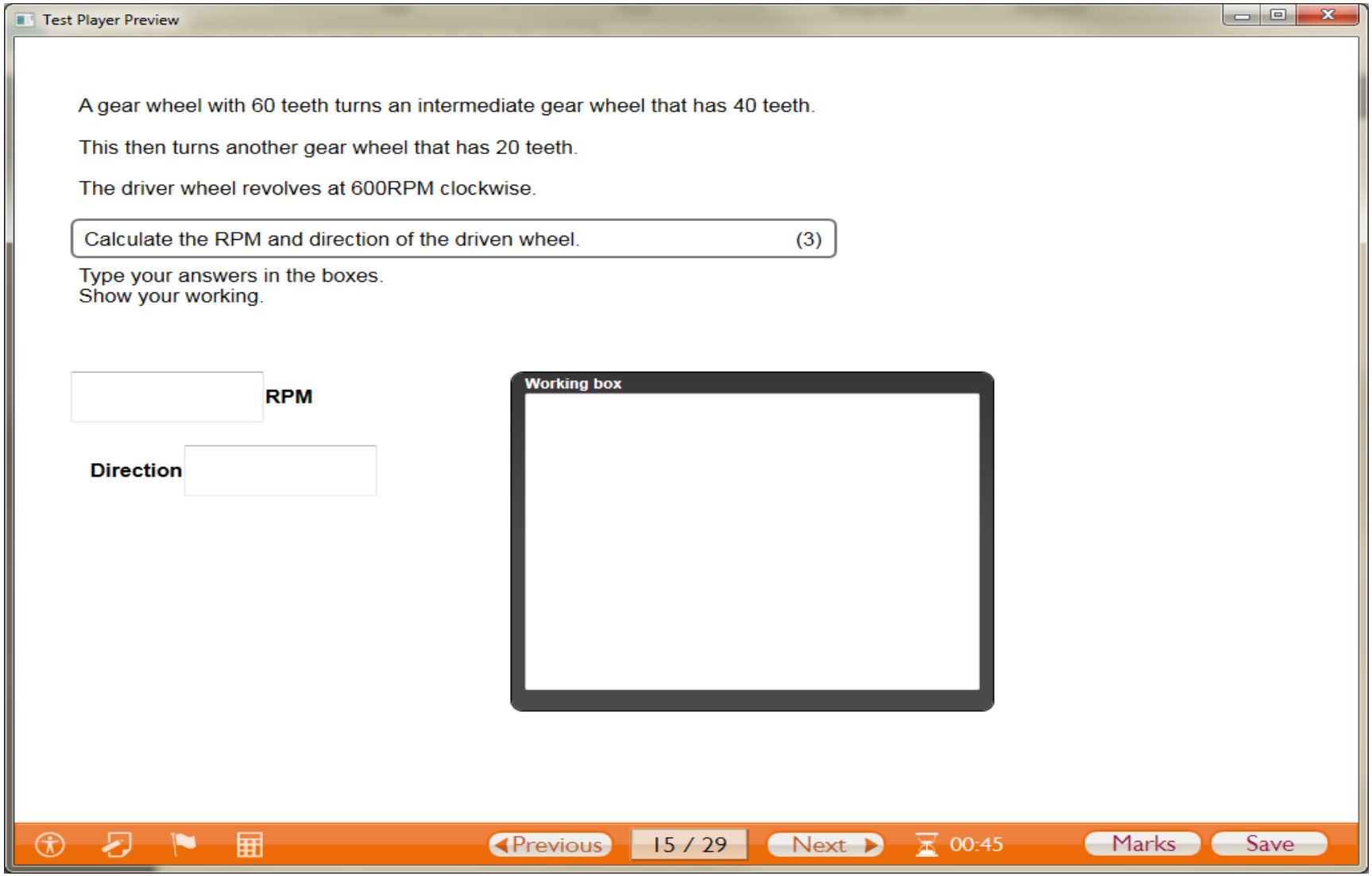
Previous 10 / 29 Next 00:45 Marks Save

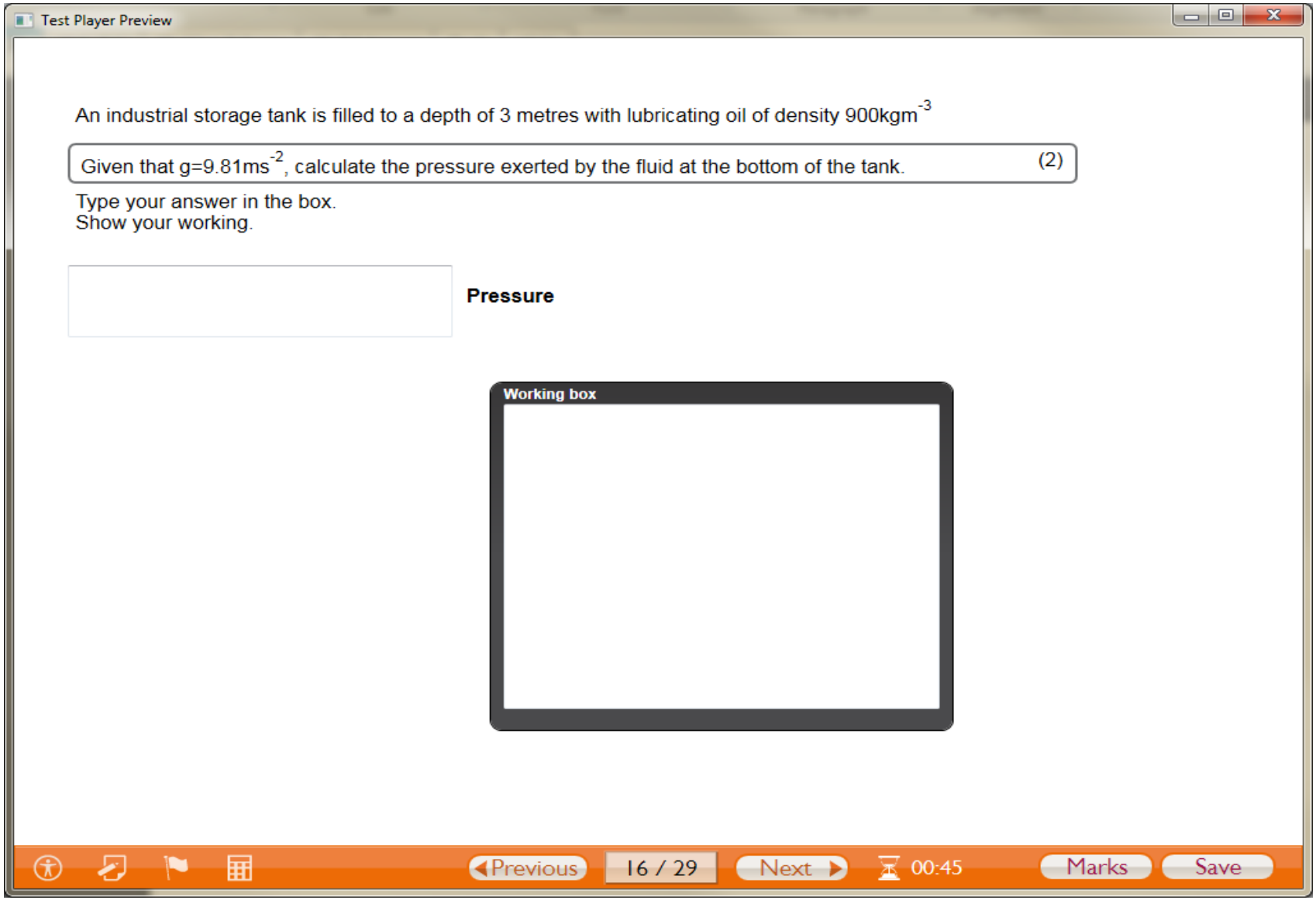

Test Player Preview
A production operative needs to assemble 1830 units in a 37.5 hour week.
How many units will the production operative need to assemble in **one** hour? (1)
Type your answer in the box.
Units
Previous
11 / 29
Next
00:45
Marks
Save


Test Player Preview
Identify the formula used to calculate velocity. (1)
Select **one** option.
v = s / t
v = sp + i
v = a / t
v = u + at
Previous
12 / 29
Next
00:45
Marks
Save


Test Player Preview
Which statement indicates displacement of a component? (1)
Select one option.
A component completes one full lap around the perimeter of a circle
A component moves 5 metres north and then 5 metres south
A component moves 5 metres east and stays there
A component moves 5 metres east, 10 metres west and 5 metres east
Previous
13 / 29
Next
00:45
Marks
Save


Test Player Preview
A production engineer is drilling holes in widgets.
It takes 45 seconds, using 2500 joules of energy, to drill each hole.
Calculate the power used to drill one hole. Give your answer using the correct units. (3)
Type your answer in the box.
Show your working.
Working box
Previous
14 / 29
Next
00:45
Marks
Save


Test Player Preview
A gear wheel with 60 teeth turns an intermediate gear wheel that has 40 teeth.
This then turns another gear wheel that has 20 teeth.
The driver wheel revolves at 600RPM clockwise.
Calculate the RPM and direction of the driven wheel. (3)
Type your answers in the boxes.
Show your working.
RPM
Direction
Working box
Previous
15 / 29
Next
00:45
Marks
Save

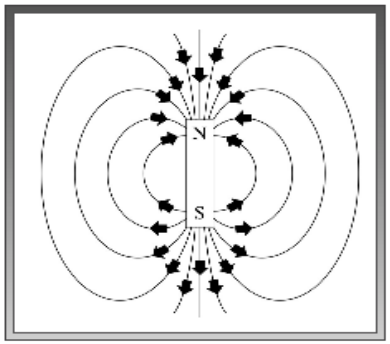

Test Player Preview
An industrial storage tank is filled to a depth of 3 metres with lubricating oil of density 900kgm-3
Given that g=9.81ms-2, calculate the pressure exerted by the fluid at the bottom of the tank. (2)
Type your answer in the box.
Show your working.
Pressure
Working box
Previous
16 / 29
Next
00:45
Marks
Save

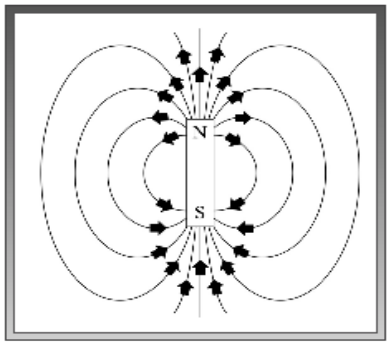
Test Player Preview

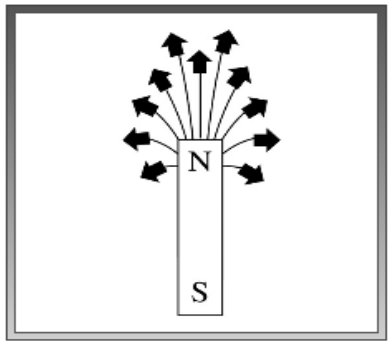
A bar magnet is surrounded by a magnetic field, containing lines of force.

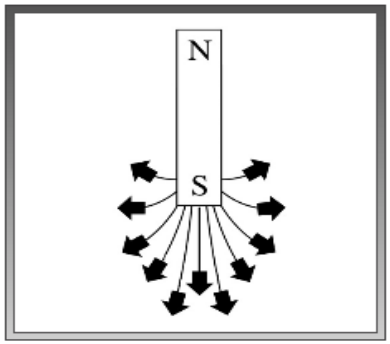
Which diagram shows the correct orientation of the lines of force around a bar magnet? (1)

Select **one** option.







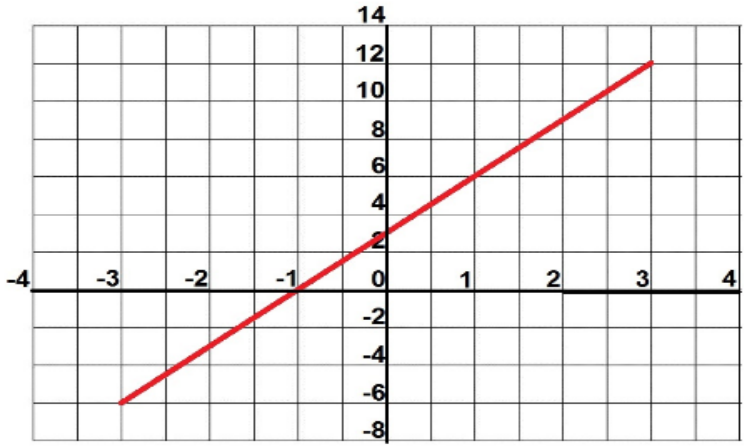


Previous 17 / 29 Next 00:45 Marks Save

Test Player Preview

The diagram shows a straight line graph of the test results of a motor.

Select **one** option for each of (a) and (b)



(a) What are the coordinates of the *y* axis intercept? (1)

- ☐ (−3, 0)
- ☐ (0, 3)
- ☐ $(0, \frac{1}{3})$
- ☐ $(\frac{1}{3}, 0)$

(b) What is the gradient of the straight line? (1)

- ☐ $\frac{1}{3}$
- ☐ 3
- ☐ $-\frac{1}{3}$
- ☐ −3

Previous 18 / 29 Next 00:45 Marks Save

Test Player Preview

Scenario A should be used to answer questions 19 – 23.

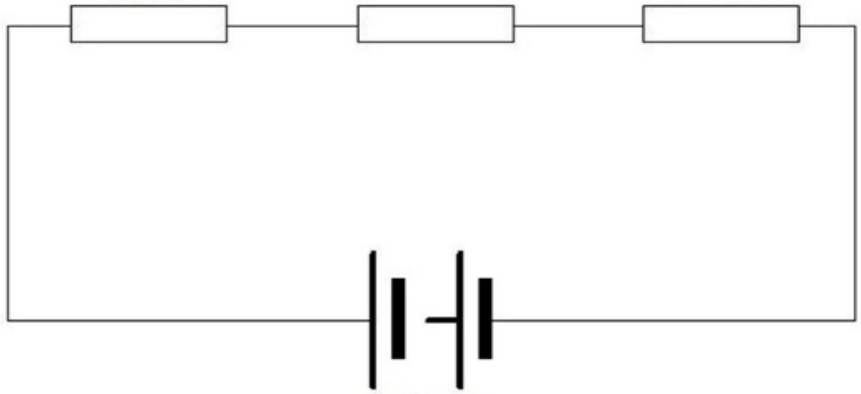
Read **scenario A** carefully before beginning the questions.

The scenario will be available on each question by clicking on the scenario

Scenario A

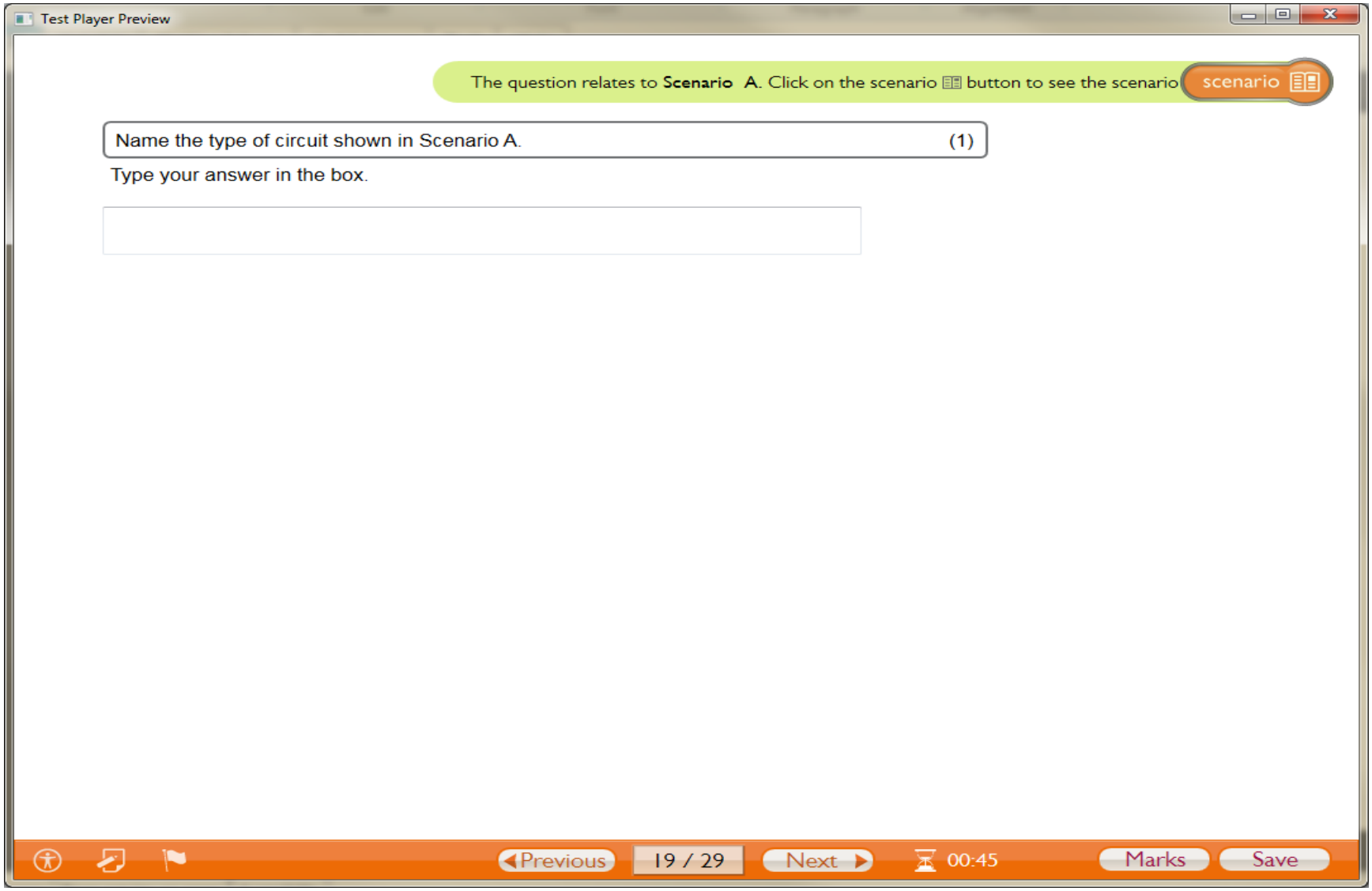
A production operative is working in the assembly department of an electronics engineering company. As part of their role they work with electronics and electromagnetics. The operative must ensure that the assembled products are safe and that quality is maintained.

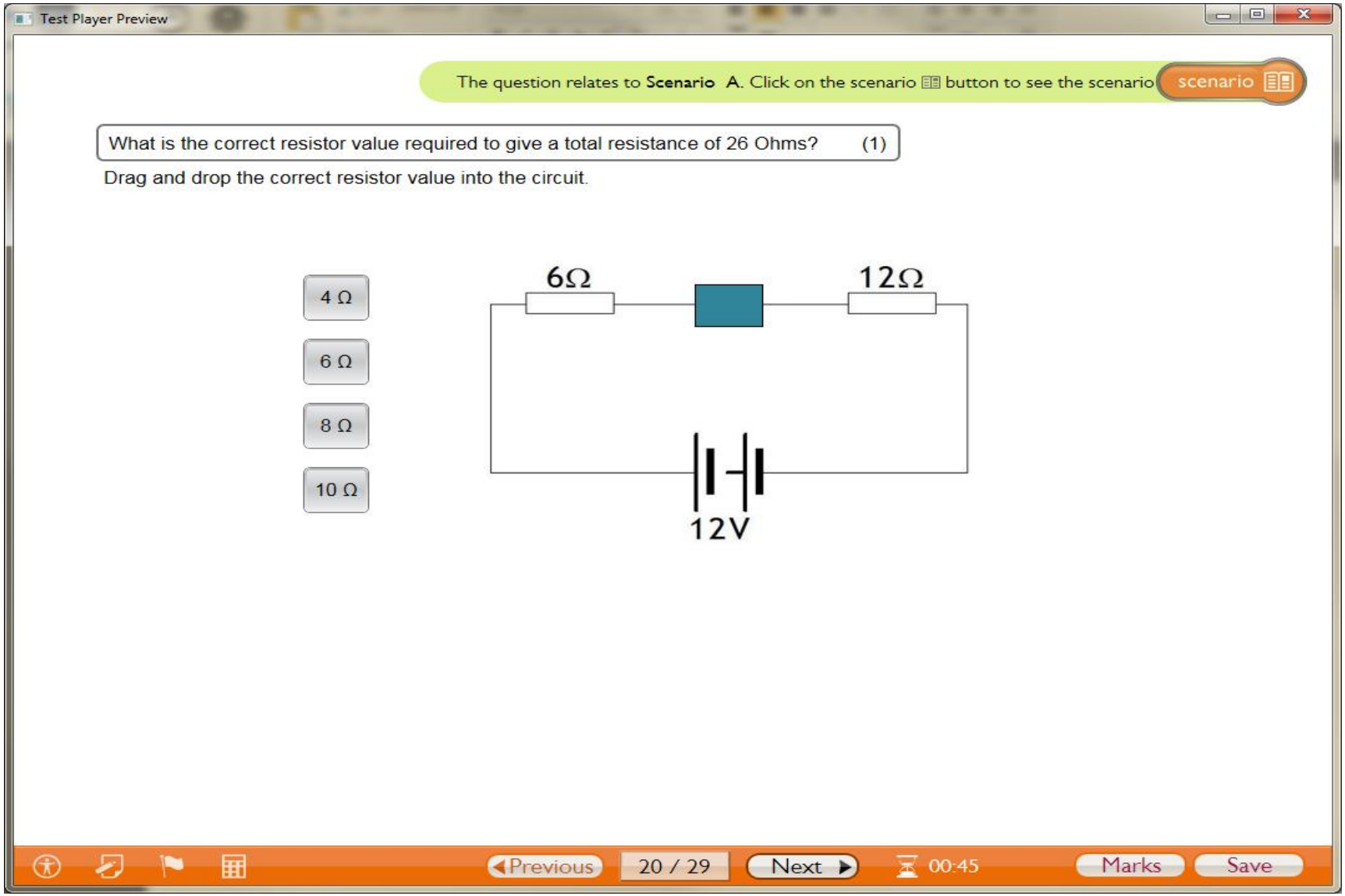
The diagram shows a circuit which is used to check test equipment.

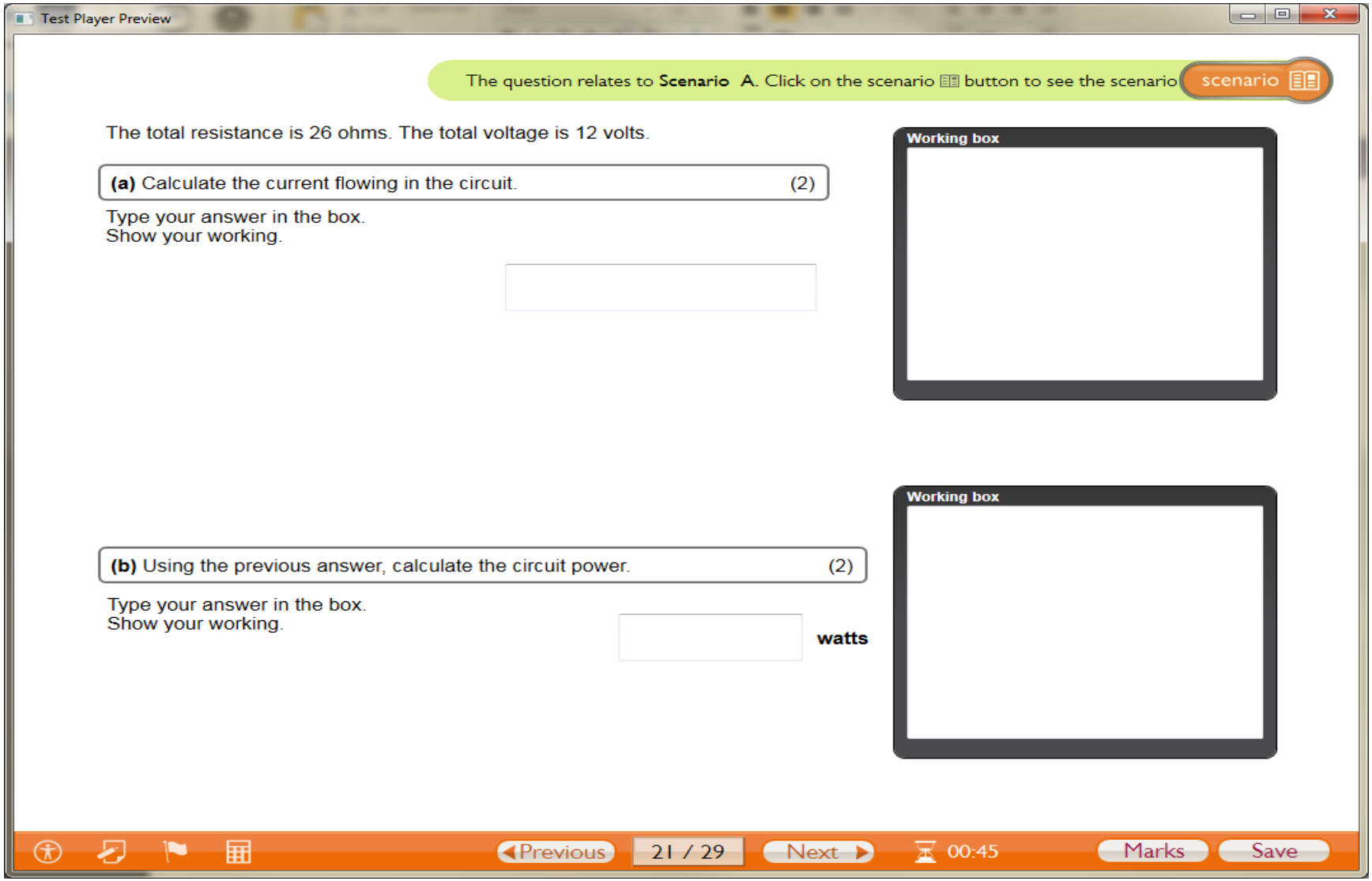


Back

Previous 19 / 29 Next 00:45 Marks Save


Test Player Preview
The question relates to Scenario A. Click on the scenario button to see the scenario
scenario
Name the type of circuit shown in Scenario A. (1)
Type your answer in the box.
Previous
19 / 29
Next
00:45
Marks
Save


Test Player Preview
The question relates to Scenario A. Click on the scenario button to see the scenario
scenario
What is the correct resistor value required to give a total resistance of 26 Ohms? (1)
Drag and drop the correct resistor value into the circuit.
4 Ω
6 Ω
8 Ω
10 Ω
6Ω
12Ω
12V
Previous
20 / 29
Next
00:45
Marks
Save

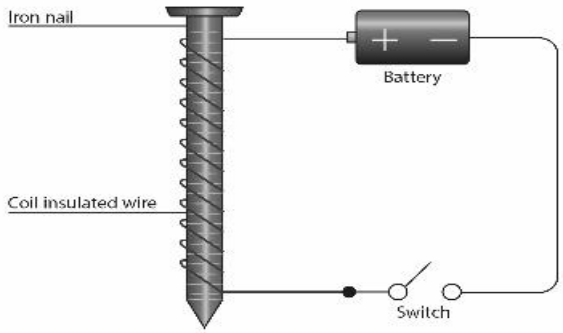

Test Player Preview
The question relates to Scenario A. Click on the scenario button to see the scenario
scenario
The total resistance is 26 ohms. The total voltage is 12 volts.
(a) Calculate the current flowing in the circuit. (2)
Type your answer in the box.
Show your working.
Working box
(b) Using the previous answer, calculate the circuit power. (2)
Type your answer in the box.
Show your working.
watts
Working box
Previous
21 / 29
Next
00:45
Marks
Save

Test Player Preview

The question relates to **Scenario A**. Click on the scenario button to see the scenario scenario

The production operative has been asked to assemble a simple electromagnetic product.

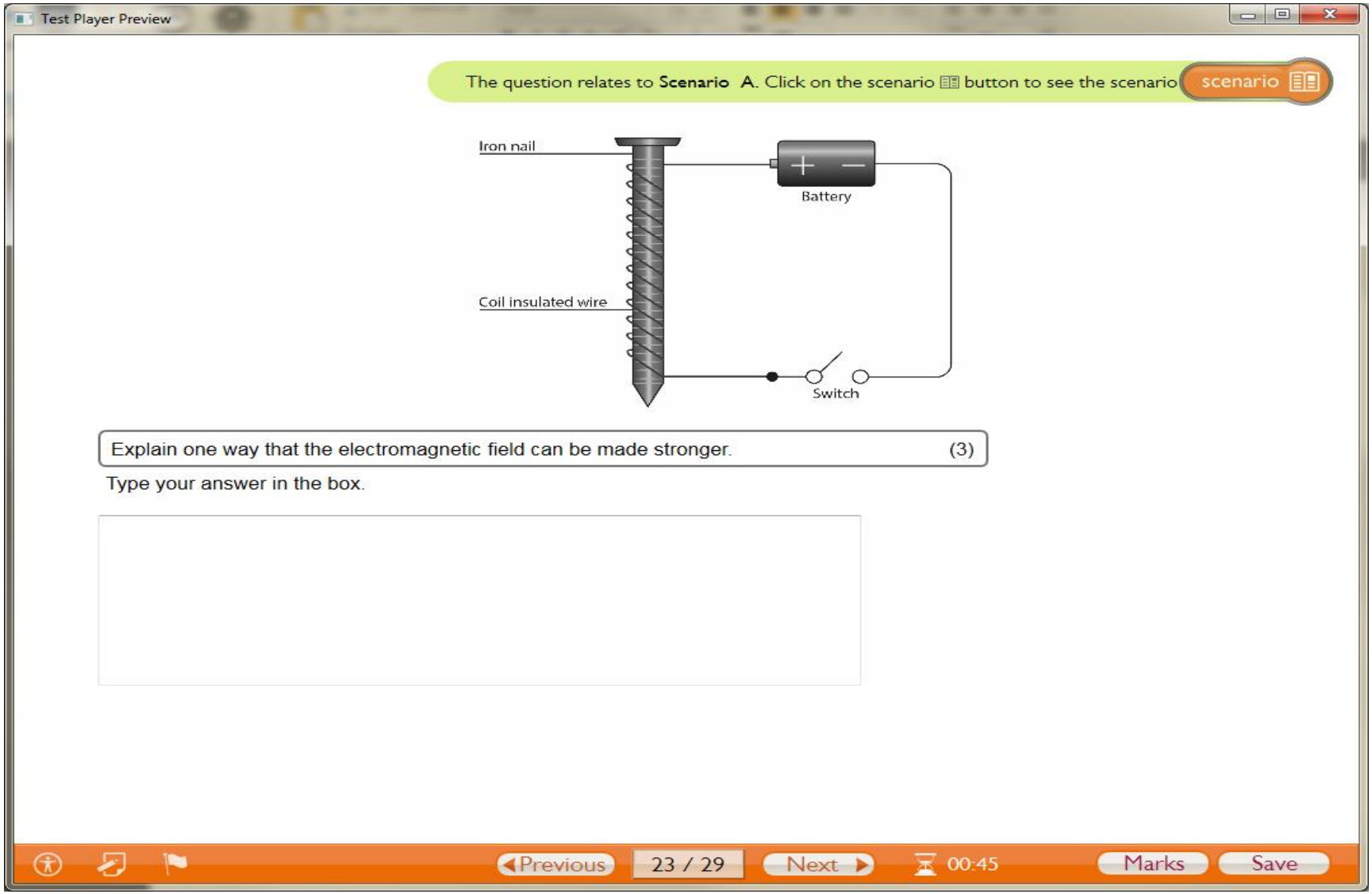
A diagram of the product is shown.

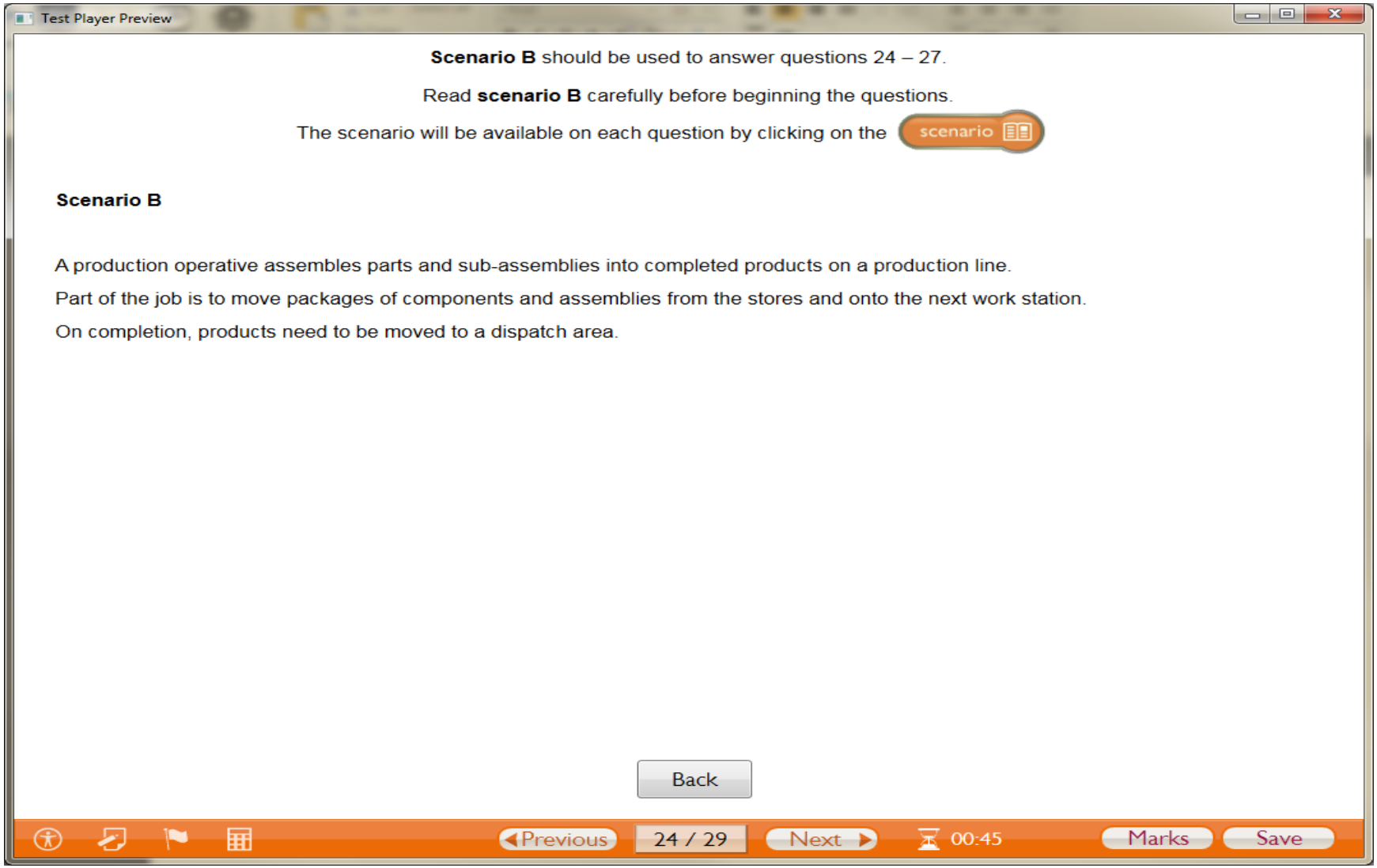


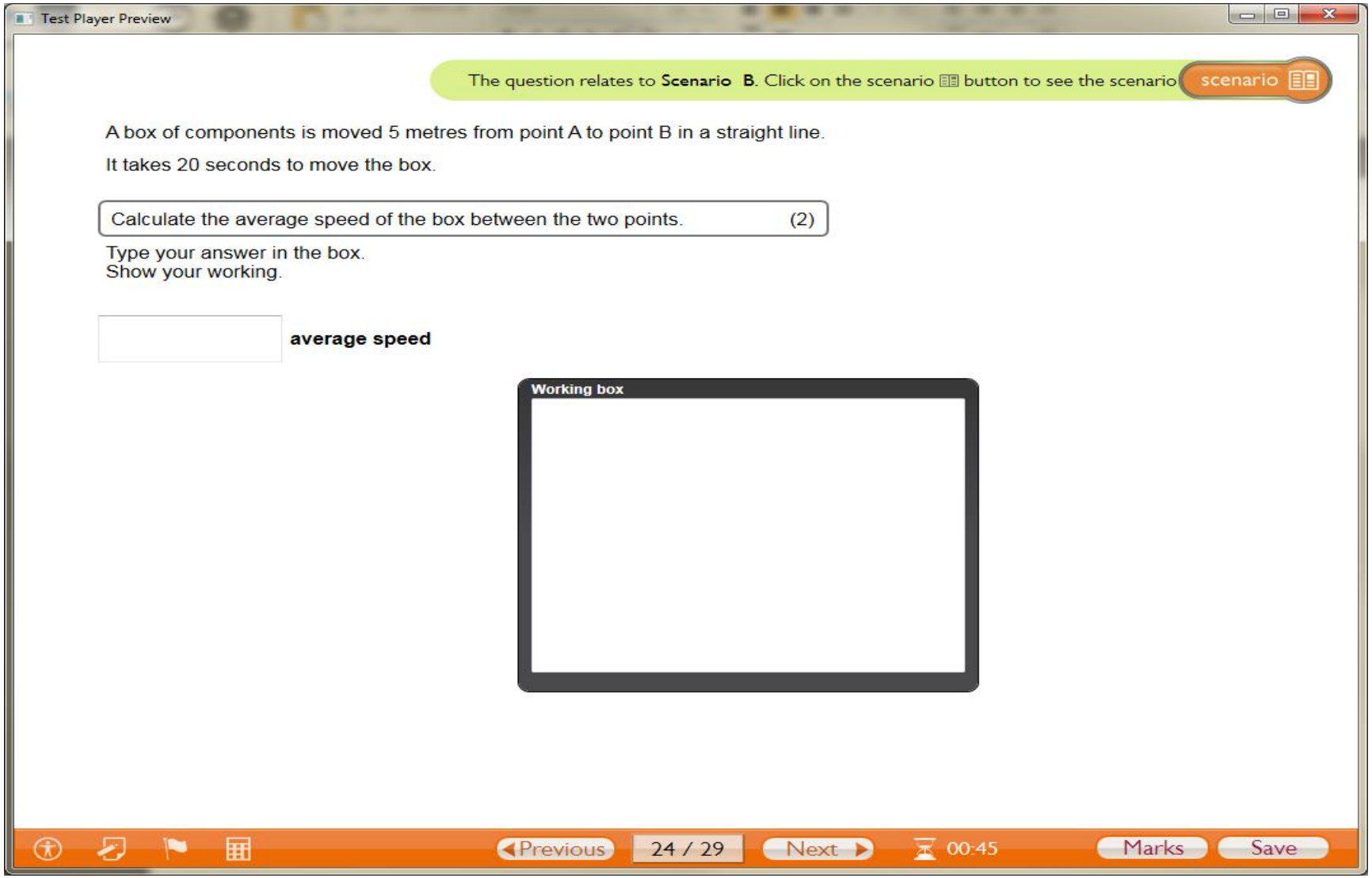
Explain why the electromagnet is constructed with an iron core and copper coil. (3)

Type your answer in the box.

Previous 22 / 29 Next 00:45 Marks Save


Test Player Preview
The question relates to Scenario A. Click on the scenario button to see the scenario
scenario
Iron nail
Battery
Coil insulated wire
Switch
Explain one way that the electromagnetic field can be made stronger. (3)
Type your answer in the box.
Previous
23 / 29
Next
00:45
Marks
Save


Test Player Preview
Scenario B should be used to answer questions 24 – 27.
Read scenario B carefully before beginning the questions.
The scenario will be available on each question by clicking on the scenario
Scenario B
A production operative assembles parts and sub-assemblies into completed products on a production line.
Part of the job is to move packages of components and assemblies from the stores and onto the next work station.
On completion, products need to be moved to a dispatch area.
Back
Previous
24 / 29
Next
00:45
Marks
Save


Test Player Preview
The question relates to Scenario B. Click on the scenario button to see the scenario
scenario
A box of components is moved 5 metres from point A to point B in a straight line.
It takes 20 seconds to move the box.
Calculate the average speed of the box between the two points. (2)
Type your answer in the box.
Show your working.
average speed
Working box
Previous
24 / 29
Next
00:45
Marks
Save

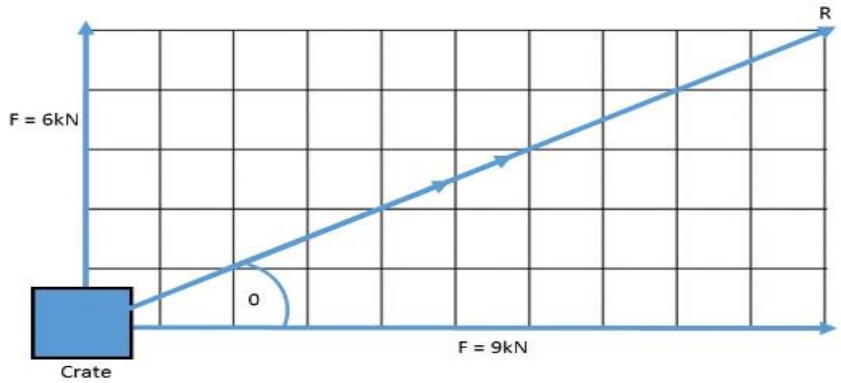
Test Player Preview

The question relates to **Scenario B**. Click on the scenario button to see the scenario

scenario

The manager has asked the production operative to move a crate of assembled components.

The image shows the forces (F) applied at right angles to the crate.



Using the formula $c = \sqrt{a^2 + b^2}$, calculate the magnitude. (2)

Type your answer in the box.
Show your working.

N

Working box

Previous 25 / 29 Next 00:45 Marks Save

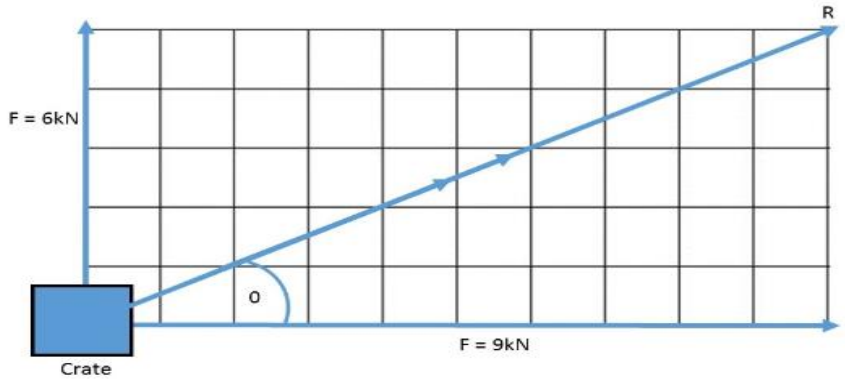
Test Player Preview

The question relates to **Scenario B**. Click on the scenario button to see the scenario

scenario

The manager has asked the production operative to move a crate of assembled components.

The image shows the forces (F) applied at right angles to the crate.



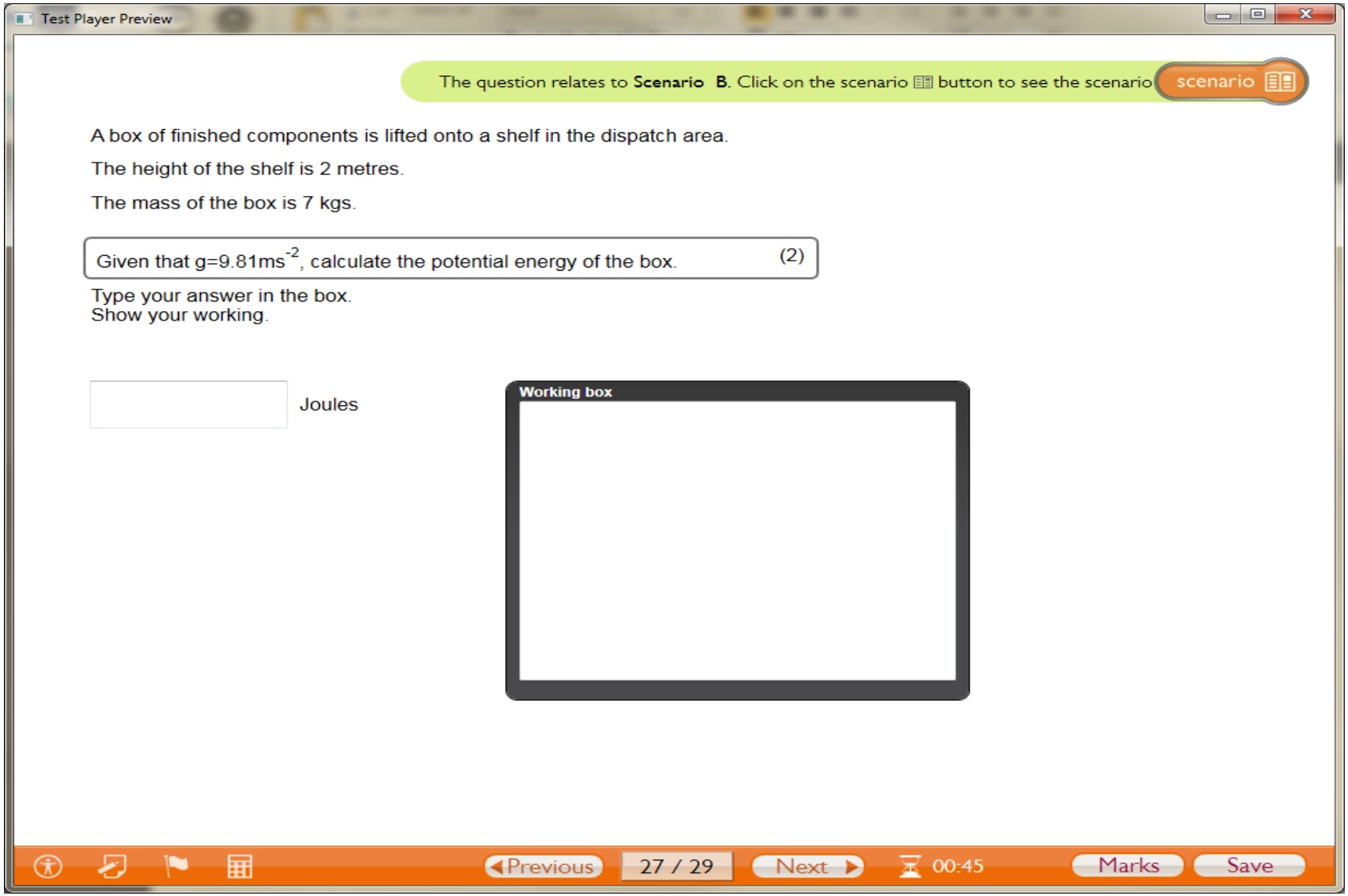
Using Tan, calculate the direction of the resultant force. (2)

Type your answer in the box.
Show your working.

degrees

Working box

Previous 26 / 29 Next 00:45 Marks Save


Test Player Preview
The question relates to Scenario B. Click on the scenario button to see the scenario
scenario
A box of finished components is lifted onto a shelf in the dispatch area.
The height of the shelf is 2 metres.
The mass of the box is 7 kgs.
Given that g=9.81ms-2, calculate the potential energy of the box. (2)
Type your answer in the box.
Show your working.
Joules
Working box
Previous
27 / 29
Next
00:45
Marks
Save

Test Player Preview

Scenario C should be used to answer questions 28 – 30.

Read **scenario C** carefully before beginning the questions.

The scenario will be available on each question by clicking on the scenario

Scenario C

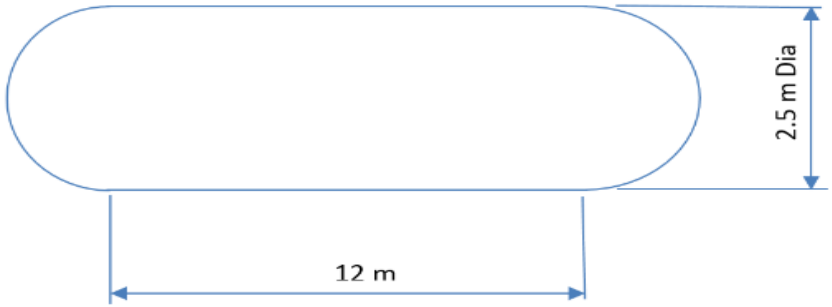
An apprentice fabricator is employed by an engineering organisation. One of the responsibilities is to make sure that there are enough materials available in the stores to complete all tasks. The company fabricates large vessels that are made from steel plates, and the apprentice is required to ensure that there are enough materials to meet production needs.

A supplier delivers flat sheets of steel that are **8 feet long** and **4 feet wide**. Due to the global nature of the business, operatives often have to convert between metric and imperial units of measurement.

The diagram shows the dimensions of one of the fabricated vessels in metres.

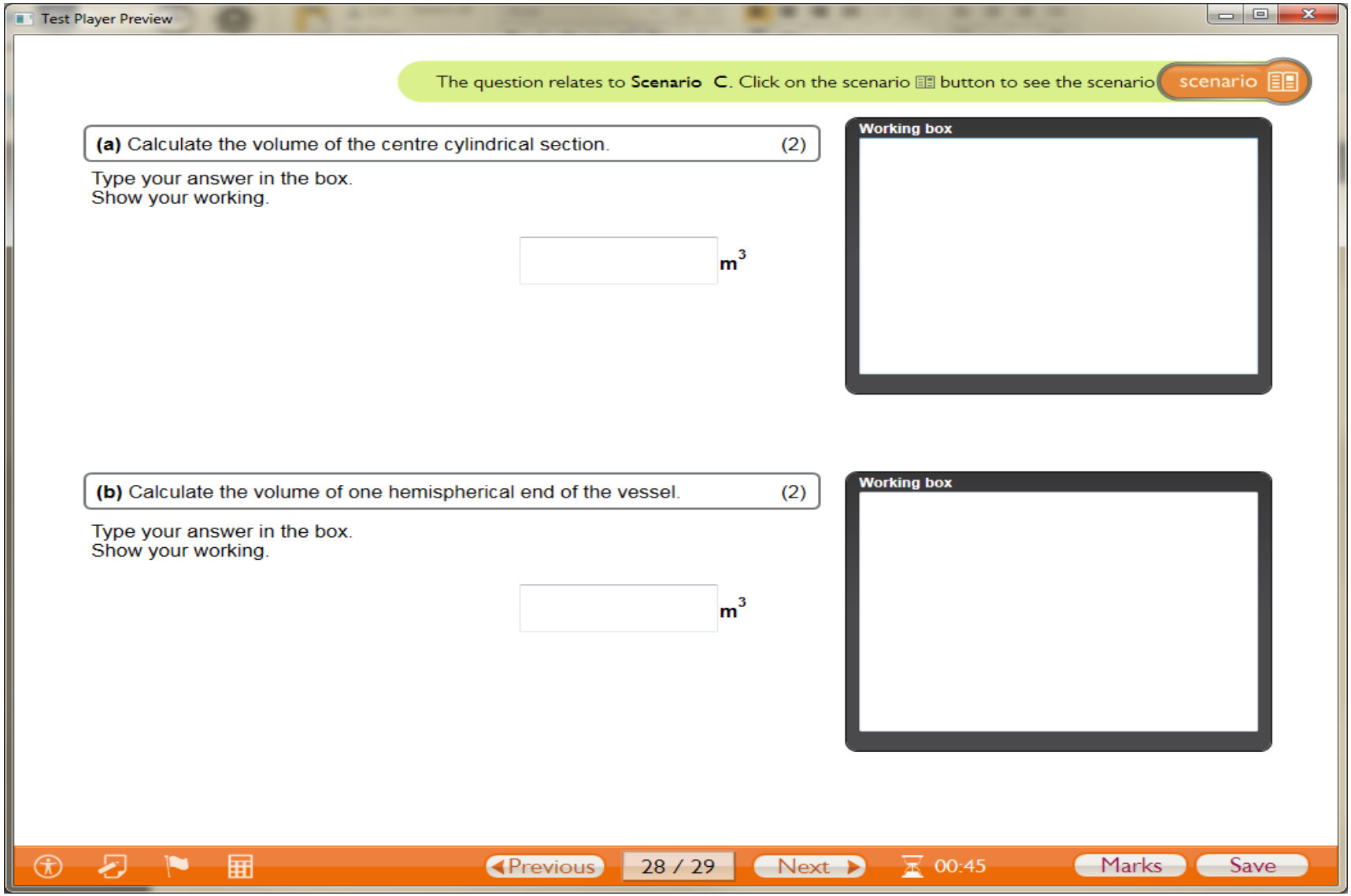
The vessel has a cylindrical centre and hemispherical ends.

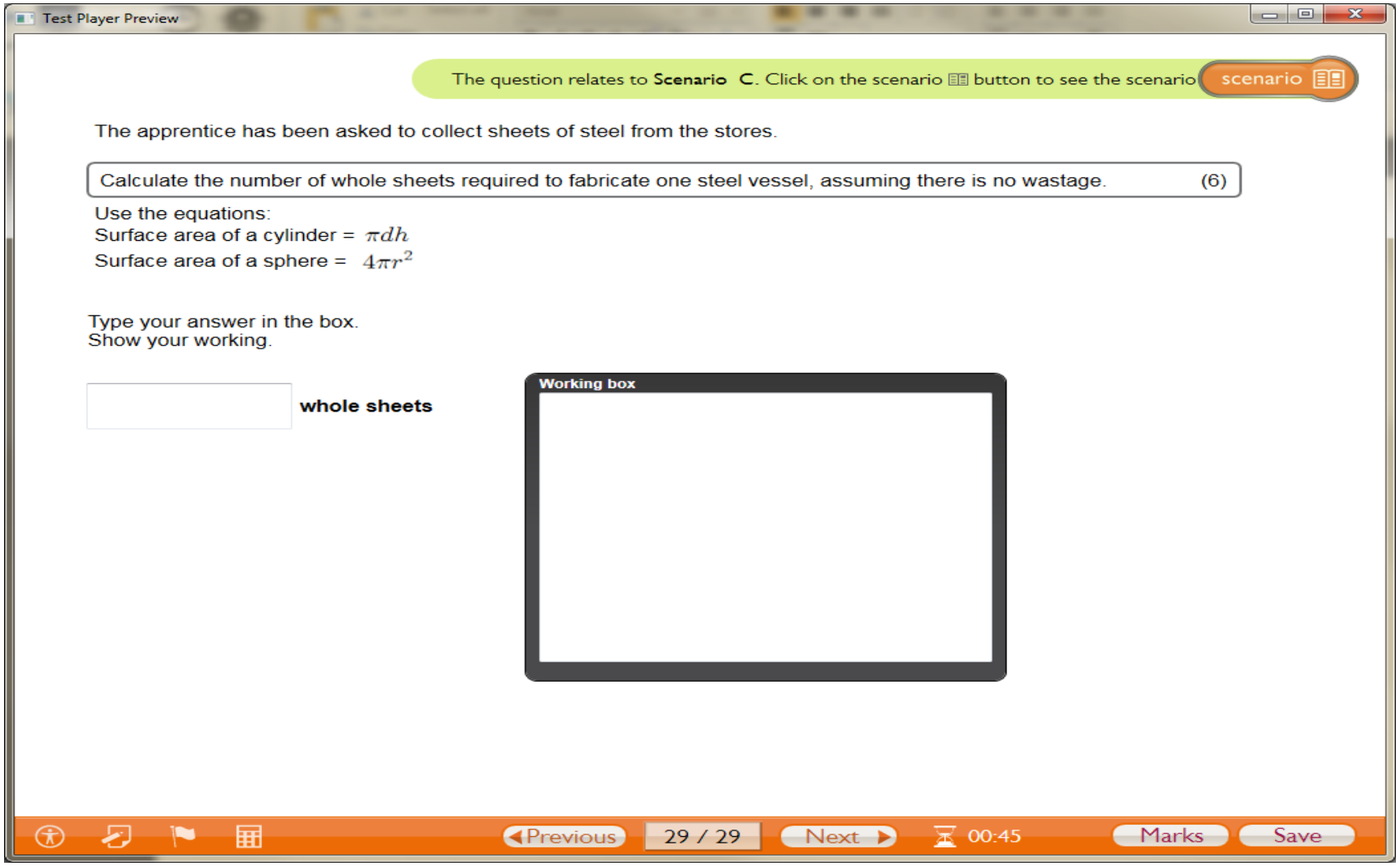
Side View of the Fabricated Vessel



Back

Previous 28 / 29 Next 00:45 Marks Save


Test Player Preview
The question relates to Scenario C. Click on the scenario button to see the scenario
scenario
(a) Calculate the volume of the centre cylindrical section. (2)
Type your answer in the box.
Show your working.
m3
Working box
(b) Calculate the volume of one hemispherical end of the vessel. (2)
Type your answer in the box.
Show your working.
m3
Working box
Previous
28 / 29
Next
00:45
Marks
Save


Test Player Preview
The question relates to Scenario C. Click on the scenario button to see the scenario
scenario
The apprentice has been asked to collect sheets of steel from the stores.
Calculate the number of whole sheets required to fabricate one steel vessel, assuming there is no wastage. (6)
Use the equations:
Surface area of a cylinder = πdh
Surface area of a sphere = $4\pi r^2$
Type your answer in the box.
Show your working.
whole sheets
Working box
Previous
29 / 29
Next
00:45
Marks
Save

Unit 1: Engineering Principles
Sample Mark Scheme

General marking guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the mark scheme, not according to their perception of where the grade boundaries may lie.
- All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Full marks should be awarded for correct answers with no workings shown.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the candidate has replaced it with an alternative response.

Abbreviations used

- CAO – correct answer only.
- AWRT – answers which round to.
- ECF – error carried forward.
- dp – decimal places.
- sf – significant figures.

Section A

Question number	Answer	Mark
1	Transistor	**(1)**

Question number	Answer	Mark
2	1 mark for correct number of bolts (1): 15 × 43 × 26 = 16770 1 mark for division into boxes (1): $\frac{16\,770}{1000}$ = 16.77 17 full boxes needed. CAO, ECF	**(2)**

Question number	Answer	Mark
3	Symbol for 'greater than': >	**(1)**

Question number	Answer	Mark
4	5%	**(1)**

Question number	Answer	Mark
5	Stationary	**(1)**

Question number	Answer	Mark
6	1 mark for formula (1): $V = IR$ 1 mark for correct answer (1) V = 0.005 × 25 0.125 volts CAO	**(2)**

Question number	Answer	Mark
7	1 mark for calculating total hourly pay (1) £7.50 × 36 = £270 1 mark for calculating total assembly completion bonus (1) 110 × £0.25 = £27.50 1 mark for final pay (1) £270 + £27.50 = £297.50 ECF	**(3)**

Question number	Answer	Mark
8(a)	625 mm²	**(1)**

Question number	Answer	Mark
8(b)	78.54 mm²	**(1)**

Question number	Answer	Mark
8(c)	$W^2 - \pi r^2$	**(1)**

Question number	Answer	Mark
9	$P = \frac{F}{A}$	**(1)**

Question number	Answer	Mark
10	2.5	**(1)**

Question number	Answer	Mark
11	48.8 CAO	**(1)**

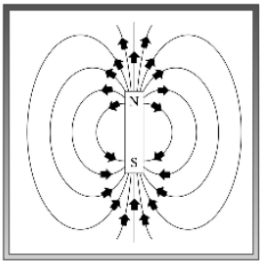
Question number	Answer	Mark
12	$v = u + at$	**(1)**

Question number	Answer	Mark
13	A component moves 5 metres east and stays there	**(1)**

Question number	Answer	Mark
14	1 mark for correct formula (1): $P = \frac{E}{t}$ $\frac{2500}{45} = P$ 1 mark for correct value of P (1): P = 55.5 1 mark for correct units (1): 55.5 watts CAO, ECF	**(3)**

Question number	Answer	Mark
15	1 mark for working out ratio of driven to driver (1): 60 : 20 Accept 3 : 1, 6 : 2 1 mark for working out output speed (1): 600 RPM ÷ $\frac{1}{3}$ = 1800 RPM CAO 1 mark for correct direction (1): clockwise ECF	**(3)**

Question number	Answer	Mark
16	1 mark for recall of formula (1): $P = \rho g h$ 1 mark for correct answer (1): 26 487 Accept 0.264 87 bar	**(2)**

Question number	Answer	Mark
17		**(1)**

Question number	Answer	Mark
18(a)	(0, 3)	**(1)**

Question Number	Answer	Mark
18(b)	3	**(1)**

Section B

Question number	Answer	Mark
19	Series	**(1)**

Question number	Answer	Mark
20	8 Ω	**(1)**

Question number	Answer	Mark
21(a)	1 mark for rearrangement of formula (1): $V = IR$ to $I = \frac{V}{R}$ 1 mark for evaluation (1): $\frac{12}{26}$ =0.4615 amps AWRT 0.46	**(2)**

Question number	Answer	Mark
21(b)	1 mark for use of correct formula (1): $P = VI$ or $P = I^2R$ 1 mark for correct answer (1): 12 × 0.4615 = 5.538 W (using $P = VI$) or 0.4615^2 × 26 = 5.5375 W (using $P = I^2R$) Allow ECF from 19(c). Accept any reasonable answer within +/−0.1 W	**(2)**

Question number	Answer	Mark
22	1 mark for each point up to a maximum of 3 marks. The iron is ferrous so can become magnetic (1), however the copper carries a current but does not itself become magnetic (1), which together magnetises the iron core and creates a magnetic field (1).	**(3)**

Question number	Answer	Mark
23	1 mark for identification and 1 mark for each point of expansion, up to a maximum of 3 marks. • One way could be to **increase the number of coils** (1), which increases the length of the conductor (1) so the flux density of the magnetic field increases (1). • One way could be to **increase the power of the battery** (1), which increases the current flow through the coil (1) so the flux density of the magnetic field increases (1). • One way could be to **increase the diameter of the iron core** (1), which increases the length of the conductor (1) so the flux density of the magnetic field increases (1). Any other reasonable answer.	**(3)**

Question number	Answer	Mark
24	1 mark for recall of formula (1): $\text{speed} = \frac{\text{distance}}{\text{time}}$ 1 mark for correct answer (1): $\text{speed} = \frac{5}{20}$ average speed = $0.25\,\text{ms}^{-1}$ CAO	**(2)**

Question number	Answer	Mark
25	1 mark for application of formula for magnitude (1): $c = \sqrt{a^2 + b^2}$ $c = \sqrt{6^2 + 9^2}$ $c = \sqrt{117}$ 1 mark for correct answer (1): resultant magnitude = 10.8167 N AWRT 10.8	**(2)**

Question number	Answer	Mark
26	1 mark for application of formula for direction of resultant (1): $\tan^{-1} = \frac{\text{opp}}{\text{adj}}$ $\tan^{-1} = \frac{6}{9}$ $\tan^{-1} = 0.6$ 1 mark for correct answer (1): direction = θ = 33.69 degrees AWRT 33.7	**(2)**

Question number	Answer	Mark
27	1 mark for recall of formula (1): $E_p = mgh$ 1 mark for correct answer (1): E_p = 2 × 9.81 × 7 potential energy = 137.34 Joules AWRT 137.3	**(2)**

Question number	Answer	Mark
28(a)	1 mark for recall of formula (1): $V = \pi r^2 h$ 1 mark for correct answer (1): $V = \pi \times 1.25^2 \times 12$ Volume = 58.905 m^3 AWRT 58.9 m^3	**(2)**

Question number	Answer	Mark
28(b)	1 mark for recall of formula (1): volume of sphere = $\frac{4}{3}\pi r^3$ 1 mark for correct answer (1): volume of sphere = $\frac{4}{3}\pi \times 1.25^3$ volume of sphere = 8.181 m^3 volume of hemisphere = 4.0906 m^3 AWRT 4.1 m^3	**(2)**

Question number	Answer	Mark
29	1 mark for calculating length and width of sheet in metres (1): 8 ft = 8 × 12 × 0.0254 = 2.438 m 4ft = 1.219 m 1 mark for calculating area of sheet in metres (1): area = 2.438 × 1.219 = 2.9719 m^2 1 mark for calculating surface area of the centre cylindrical section of the vessel (1): cylinder = πdh = π × 2.5 × 12 =94.2477m^2 1 mark for calculating surface area of two hemispheres (1): sphere = $4\pi r^2$ = 4π × 1.25^2 = 19.63495 m^2 Allow calculation of a hemisphere multiplied by 2. 1 mark for calculating total surface area (1): 94.2477 + 19.634 95 = 113.882 65 m^2 1 mark for calculating total number of whole sheets (1): $\frac{113.882\,65}{2.9719}$ =38.31 39 whole sheets required CAO ECF	**(6)**