L3 Lead Examiner Report 1801

January 2018

Level 3 National in Engineering
Unit 1 : Engineering Principles (31706H)

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Grade Boundaries

What is a grade boundary?

A grade boundary is where we set the level of achievement required to obtain a certain grade for the externally assessed unit. We set grade boundaries for each grade, Distinction, Merit and Pass.

Setting grade boundaries

When we set grade boundaries, we look at the performance of every learner who took the external assessment. When we can see the full picture of performance, our experts are then able to decide where best to place the grade boundaries – this means that they decide what the lowest possible mark should be for a particular grade.

When our experts set the grade boundaries, they make sure that learners receive grades which reflect their ability. Awarding grade boundaries is conducted to ensure learners achieve the grade they deserve to achieve, irrespective of variation in the external assessment.

Variations in external assessments

Each external assessment we set asks different questions and may assess different parts of the unit content outlined in the specification. It would be unfair to learners if we set the same grade boundaries for each test, because then it would not take into account that a test might be slightly easier or more difficult than any other.

Grade boundaries for this, and all other papers, are on the website via this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Unit 1: Engineering Principles.

Grade	Unclassified	Level 3		
		P	M	D
Boundary Mark	0	21	42	64

Introduction

This was the second series for the Unit 1 Engineering Principles examination, although it was the first series of the new style of examination for Engineering and as such, the first time that this mandatory unit has been assessed in this format, which is a traditional paper-based examination with a number of different styles of question.

The question paper followed the format identified in the revised sample assessment materials and additional sample assessment materials published on the Pearson website. The focus of the paper being on a range of questions that assess applied mathematics, along with mechanical, and electrical and electronic principles. The range of questions will change each examination series with the aim of covering all of the topics listed within the specification. It is important for centres to remember that, due to nature of the specification, they will need to ensure that learners are given the opportunity to become familiar with the processes of solving problems, and the mathematical skills required to arrive at solutions. Furthermore, learners should be able to identify and use the appropriate units that relate to the engineering principles being assessed.

The paper had 20 questions. Each question was based on an engineering concept, with some questions having multiple parts. Learners were required to demonstrate knowledge and understanding of a range of specification topics and to apply this knowledge to the specific question scenario. The intention was to offer as broad a coverage as possible for all areas of the unit content. Questions had varying weightings attached to them, with 1 to 4 marks for the lower demand questions and up to 7 marks for questions where an extended response was required, such as calculation that were synoptic in their assessment of either mechanical or electrical and electronic principles..

Each of the questions that involved calculations was marked using both method (M) marks and accuracy (A) marks, as shown in the mark scheme. The short written response questions were point marked against mark schemes with linked responses being required for explain questions. A small number of questions were multiple choice for which learners had to select the correct answer from four alternative options.

Introduction to the Overall Performance of the Unit

Learner performance was generally consistent across the paper, with some questions proving much more challenging than others due to their synoptic nature. Overall, there was evidence of learners having been taught well across the range of unit content, with the extended calculations allowing for differentiation across learner abilities. It was positive to see that across the cohort of learners there were examples of full marks being awarded for every question on the paper, with a very small number of learners achieving full marks on the examination.

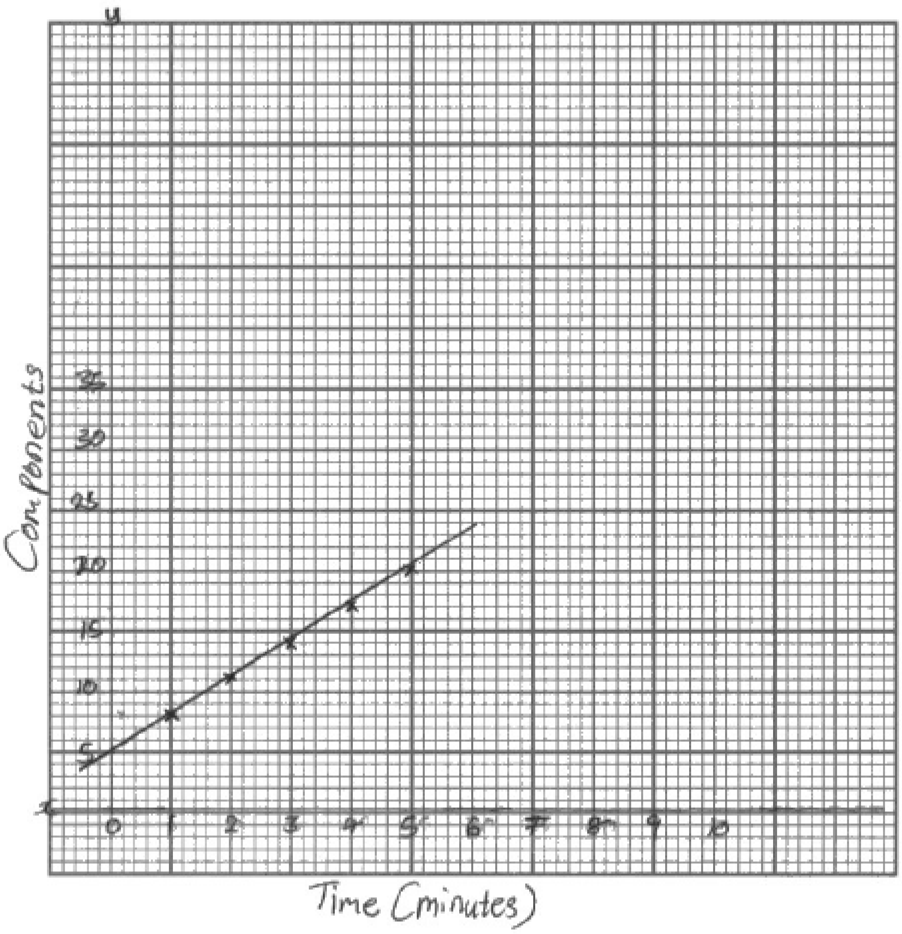
It continues to be important that learners are given the opportunity to practice responding to shorter and/or lower demand questions as well as extended calculation questions. As with the June 2017 series there were again a small number of occasions where learners did not present any working to support a numerical value that they gave as an answer. It is important to show working as this allows access to ‘method marks’ should the solution be incorrect.

Learners responded well and provided more clear responses to the majority of the questions in the examination with many being able to achieve some of the marks that were available for the various calculations even when the correct solution was not found. It was again noted that a number of learners were less comfortable with the written answers than the calculations although there was evidence that some learners were able to provide linked responses to questions that required explanations. As noted in the previous series it is important that learners are prepared fully for the examination and have the opportunity to practice short-open response questions of the form that was used in this paper and both of the sample assessment materials.

Individual Questions

The following section considers each question on the paper, providing examples of learner responses and a brief commentary of why the responses achieved the marks they did. This section should be considered with the live external assessment and corresponding mark scheme.

Question 1
This question was generally answered a large proportion of learners. In the majority of cases learners were able to select and use an appropriate scale for the two axes and labelled these appropriately. Most learners were also able to plot a straight line graph through points plotted on the graph. Where learners did not achieve full marks the reasons for this tended to be either failure to plot the line through the correct intercept at y=5 or from mis-plotting points and thus arriving at an incorrect gradient.



In this response the learner has drawn axes and added suitable values for the scale, however the axes have both been labelled incorrectly. The plotted line has the correct intercept at y=5 and the gradient of the line is 3. This response achieved 3 marks.

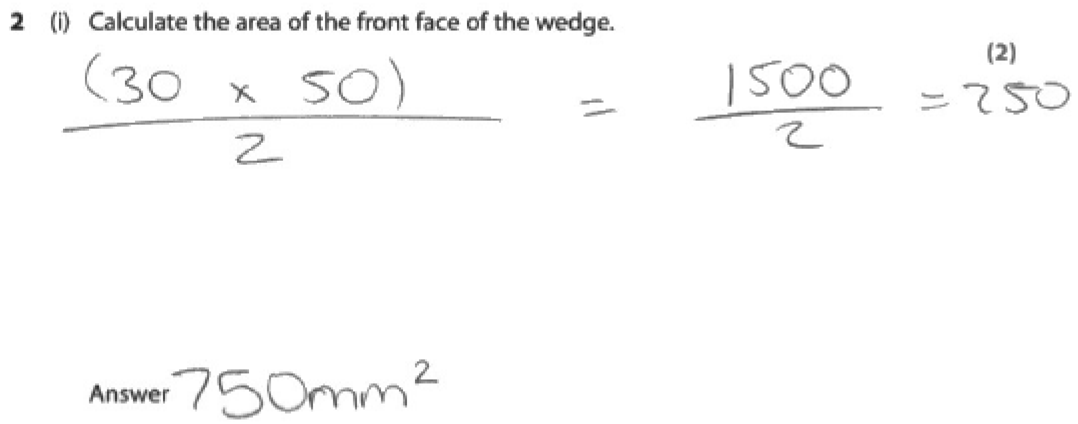
Question 2

This question had two parts, part (i) where learners needed to calculate the area of the triangular surface of a wedge, and part (ii) which required learners to calculate the volume of the wedge. It was somewhat disappointing that a significant minority of learners failed to calculate the area of the triangular face of the wedge correctly. In a number of cases they calculated the area of a rectangle, whilst others attempted to use either Pythagoras' Theorem or trigonometry to arrive at a solution.

In a number of cases learners who did not achieve the marks available for part (i) were able to access the marks for part (ii) through the application of the 'follow through' approach where incorrect previous working did not result in a further loss of marks.

In most cases learners also presented their working in full which allowed some partial credit for the method used even where the answer provided was incorrect.

Question 2(i)


2 (i) Calculate the area of the front face of the wedge.

(2)

$\frac{(30 \times 50)}{2} = \frac{1500}{2} = 750$

Answer $750mm^2$

This response achieves both of the marks available. The learner has clearly substituted the correct values in the equation for the area of a triangle to be awarded one method mark. An accuracy mark has also been awarded for the correct solution. In questions such as this learners will be given full credit for answers in a range of formats including m^2, mm^2 and those presented in standard form. This response achieved 2 marks.

Question 2(ii)

(ii) Calculate the volume of the wedge.

(2)

V = 750 x 5

= ~~350~~ 3750

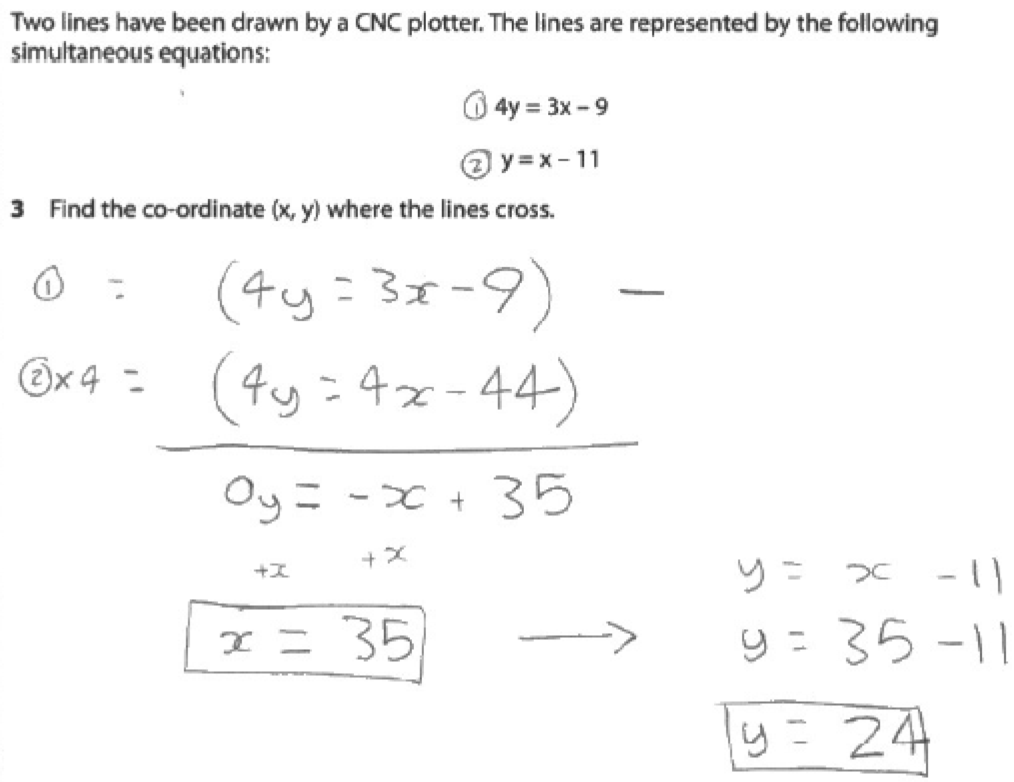
Answer

$3750\ mm^3$

The various two-part questions were designed for learners to ‘take forward’ their response from part (i) and then use this in their working for part (ii). In this example the learner has done this, although a significant proportion restarted their calculations again. This therefore resulted in extra work being completed, although in the majority of cases the working was correct. This response achieved 2 marks.

Question 3

This question was well answered by a large number of learnerss with approximately half of all learners achieving full marks. Where learners did not achieve all of the marks that were available the causes of this was generally arithmetic errors, for example the incorrect subtraction of a negative number - in most cases the working was similar to that shown in the example below, however learners incorrectly subtracted -9 from -44 and arrived at -53 as opposed to -35. Method marks would however have been awarded for multiplying one of the equations by an appropriate value (3 or 4 depending on the equation selected) and the second variable (x or y) providing it was arithmetically correct based on the incorrect working.



Two lines have been drawn by a CNC plotter. The lines are represented by the following simultaneous equations:

① $4y = 3x - 9$

② $y = x - 11$

3 Find the co-ordinate (x, y) where the lines cross.

① = $(4y = 3x - 9)$ −

②×4 = $(4y = 4x - 44)$

$0y = -x + 35$

+x +x

$x = 35$ ⟶ $y = x - 11$

$y = 35 - 11$

$y = 24$

The learner has demonstrated good practice by showing their working clearly and concisely. One method mark has been awarded for multiplying equation 2 by 4, and a second method mark for correctly subtracting one equation from the other. Two accuracy marks have also been awarded for the correct solution, one mark for the value of x and one mark for the value of y. This response achieved 4 marks.

Question 4

As with question 2, the format of the question was in two parts where the answer from part (i) could be taken forward to answer part (ii).

Learners performed well on both parts of this question with the vast majority being able to calculate the required angle in radians and subsequently the arc length of the shaded sector. Where learners did not achieve marks the reasons for this tended to be either they used a diameter rather than the radius in part (i) or used the value of the angle in degrees in part (ii). In many cases learners were able to gain partial credit if they made substitution errors and solutions were arithmetically correct or vice-versa rather than giving the value of A, or they used a calculator to solve the equation. As with question 2, learners were required to show evidence of the use of the laws of logarithms, therefore answers derived using a calculator attracted no marks.

Question 4(i)

The diagram shows a metal circle of steel where a sector has been marked out so it can be cut.

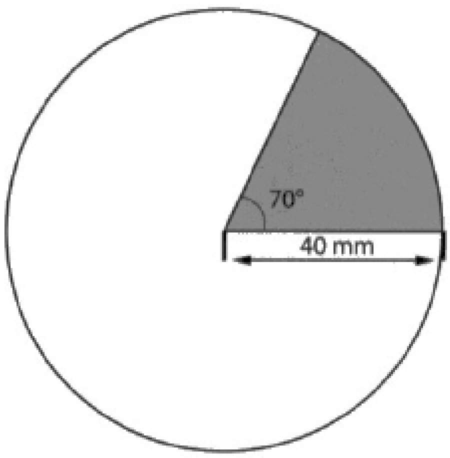


Diagram not to scale

4 (i) Convert 70° into radians.

(2)

$\theta = \frac{2\pi 70}{360}$ $\theta = \frac{2 \times \pi \times \text{degrees}}{360}$

$\theta = 1.22$

Answer 1.22 radians

This response has been awarded two marks. The working is clear, with the learner demonstrating how they arrived at the value for the angle. The formula has been populated correctly and the answer given to an appropriate degree of precision. It should be noted that learners are not penalised for the number of decimal places to which they provide their solutions, however they should be encouraged to give answers to a degree of precision that is suitable for the quantity being determined.

Part (ii) of the question required learners to calculate the arc length of the shaded sector using their answer from part (i). Whilst the majority of learnerss did this effectively, a small minority calculated the area of the sector instead, or performed the calculation using the angle in degrees.

Question 4(ii)

(ii) Calculate the arc length of the shaded sector.

(2)

Arc length = θ × Radius
= 1.22 × 40
= 48.8 mm

Answer

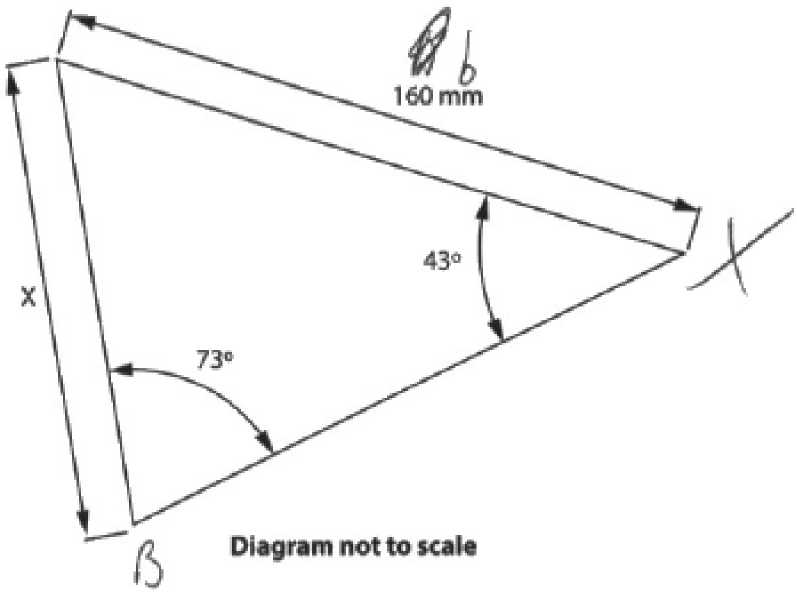
48.8 mm

In this example both of the marks available have been awarded. The learner has shown their working clearly; they have presented the formula they intended to use and then populated this with the correct values. This approach is to be encouraged as it allows learners to access method marks for partial working. The final answer has also been presented to an appropriate degree of precision for the question. This response achieved 2 marks.

Question 5
Learners performed with general success on this question with marks being awarded across the full range available. Learners tended to achieve either 4 marks, although there was a significant minority who were awarded between 1 and 3 marks. A range of approaches were seen to determine the required dimension, although the vast majority of learners correctly identified the sine rule as the most appropriate. A small number of learners used the cosine rule to arrive at the correct answer to achieve full marks.

A number of learners attempted to answer the question using the sine or cosine ratio, and a minority approached the question using Pythagoras' Theorem. In general learners were able to correctly substitute values in the formula, however where incorrect substitutions or rearrangements had taken place, the 'follow through' approach was taken and marks awarded for answers that were arithmetically correct.

The diagram shows a stamped angled plate.



5 Calculate the length of dimension X.

$$\frac{x}{\sin(43)} = \frac{160\times10^{-3}}{\sin(73)}$$

$$x = \frac{160\times10^{-3} \times \sin(43)}{\sin(73)} = 0.114\,m$$

This learner has correctly identified the sine rule to solve the problem and has correctly substituted values in to the formula in step one. The formula has then been correctly rearranged to arrive at the value for x. As with question 2(i) above, answers in metres or millimetres were acceptable. This response achieved 4 marks.

Question 6

Question 6 was the first of the questions that assessed learners' understanding of mechanical principles. This was the first of four multiple choice questions on the paper that are intended to allow learners to select the correct answer from a range of options.

This question asked learners to identify the unit of measure for electrical power. Approximately half of the cohort of learners correctly selected watts, although a significant proportion of those who did not get the answer correct chose newtons. It is important that learners are familiar with the units that are used for the various quantities that are included in the unit content.

Question 7

Learner performance on this multiple choice question was better than that seen for question 6, with a large proportion of learners correctly identifying Young's modulus as the ratio of tensile stress to tensile strain in a material. A minority of learners selected rigidity modulus in error, however it was pleasing to note that most learners had an understanding of Young's modulus.

Question 8

Question 8 was the first short open written response question on the examination and was worth one mark. Somewhat disappointingly only a relatively small proportion of learners were able to identify one of the methods of producing a mechancial advantage that was included in the mark scheme and the unit content. Some variations on these were seen such as providing a description of a lever as opposed to stating 'lever' and these responses were awarded the one mark available.

Common errors included 'applying more force' or 'using more power', neither of which was appropriate.

8 State **one** method that can produce a mechanical advantage.

(1)

Using of a pulley.

In this example the learner has stated 'using of a pulley' to be awarded one mark. As a 'state' question short answers such as this are appropriate; there is no requirement for learners to provide extended written answers for 'state' questions. This response achieved 1 mark.

Question 9

This question was another that had two parts, with part (i) requiring learners to calculate the cross sectional area of a circular pipe, and part (ii) which tasked learners with calculating the mass flow rate of a fluid. In general the two parts of the question proved to be accessible for many learners, with a large proportion achieving full marks. Learners had a good understanding of the approach to take to find the area of the pipe. Common errors included using the diameter as opposed to the radius. As with other two-part questions in the examination credit was given in part (ii) for the correct working and arithmetic answer derived from an incorrect value from part (i).

Question 9(i)

9 (i) Calculate the cross sectional area of the outlet. **(2)**

$A = \pi r^2 = \pi \times (60/2)^2$

$= \pi \times 30^2 = 900\pi \text{ mm}^2$

$= 2827 \text{ mm}^2$

Answer 2800 mm^2 to 2 significant figures.

The learner has correctly calculated the area of the pipe outlet. They have shown their working in full, which is to be commended. They have substituted the correct values into the formula and have presented their answer in a suitable form. This response achieved 2 marks.

Question 9(ii)

Answer 5654.97m²

(ii) Calculate the mass flow rate of the fluid (mass flow rate = ρAv).

(2)

1006 × 5654.97 × 2 = 11309940

Answer 11309940

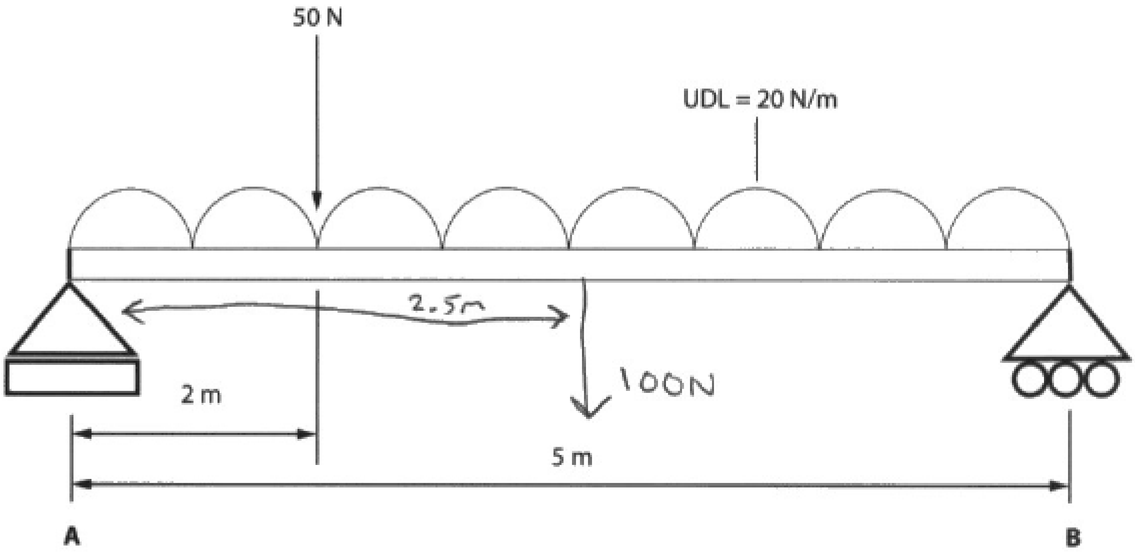
(Total for Question 9 = 4 marks)

As noted above learners were able to access both of the marks available for part (ii) despite making errors in their previous working. In this example the learner has a solution of $5654.97m^2$ for part (i). They have however substituted this correctly into the given equation for mass flow rate and then presented an answer that is arithmetically correct. As a result both the method mark for substitution and the accuracy mark for the final answer have been awarded. This response has achieved 2 marks.

Question 10
As both sections B and C progress, the complexity of the questions increases with relation to the nature of the problems that need to be solved or the procedures that need to be followed.

This question proved to be challenge for many learners, although a large proportion were able to achieve marks for either taking moments or reducing the UDL to a point load. The award of some method marks was typical for learners across all ability ranges, although there were a significant number of learners who achieved full marks. Often for these learners their answers were logically structured and working straight forward and easy to follow.

Where learners failed to achieve marks this was as a result of not considering the UDL as a point load, making arithmetic errors for the length of the beam or not considering each of the forces acting on the beam.



10 Calculate the reaction force at point B.

from A

CW — ACW

$(50 \times 2) + (2.5 \times 100) = (5 \times R_b)$

$350 = 5R_b$

$R_b = \frac{350}{5} = 70N$

In this response the learner has annotated the given diagram to show the magnitude and line of action of the UDL when it has been reduced to a point load. The learner has taken moments around A and has carried out their calculations with accuracy to determine the reaction force at B.

Working is clearly presented and is accurate; therefore full marks have been awarded.

Question 11

Many learners showed evidence of confusion in their answers with a large number providing detailed descriptions of conservation of energy rather than conservation of momentum. In questions where a description is asked for a number of points will need to be made. In this case learners had to provide two points related to conservation of momentum. Most learners who achieved marks tended to focus on the total momentum before a collision being equal to the total momentum after a collision, with some learners making reference to elastic collisions or the lack of external forces.

11 Describe the principle of conservation of momentum.

(2)

Energy can neither be created or destroyed, only transformed given that momentum is a form of energy the same principal is applied in that should two ~~body~~ bodies with different momentums colide, the final momentum of the collided bodies is equal to the sum of the original momentums ~~ignoring [illegible]~~

The learner has provided an extended answer that includes some text that does not contribute significantly to the award of the marks; however the final three lines of the response provide an accurate description of the principle of conservation of momentum and have been awarded two marks.

Question 12

Question 12 is a further two part question in which learners need to calculate the potential energy of a truck in part (i) and its velocity in part (ii). Most learners were correctly able to calculate the potential energy of the truck, however a large proportion did not state an appropriate unit (joules or kilojoules) for the numerical answer given. In some questions learners are asked to state their answer in an appropriate unit - this is awarded one mark providing it accompanies a related numerical solution. In many cases the reason why learners did not achieve the 3 marks available for part (i) was that they had not used an appropriate unit in their answer.

Learners tended to follow one of two approaches for part (ii), either conservation of energy or they recognised that the use of equations of motion was suitable given that acceleration would be constant.

Question 12(i)

12 (i) Calculate the potential energy of the truck at the top of the slope.

Give your answer in an appropriate unit.

GPE = mgh

= 500 x 9.81 x 20

= 98100 J

Answer 98100 J

The learner has correctly populated the formula for potential energy and has calculated the answer as 98 100. They have also stated the correct unit (J) to be awarded the third mark. Variations of the solution, i.e. 98.1 x 10^3 J or 98.1 kJ were also awarded full marks provided the unit given was appropriate for the numerical answer. This response has achieved 3 marks.

Question 12(ii)

(ii) Calculate the velocity of the truck as it passes through the speed detector.

The effects of friction can be ignored.

$$KE = \frac{1}{2}mv^2 \Rightarrow \sqrt{\frac{2KE}{m}} = v$$

$$\Rightarrow v = \sqrt{\frac{98100 \times 2}{500}} = 19.8 \text{ m/s}$$

Answer 19.8 m/s

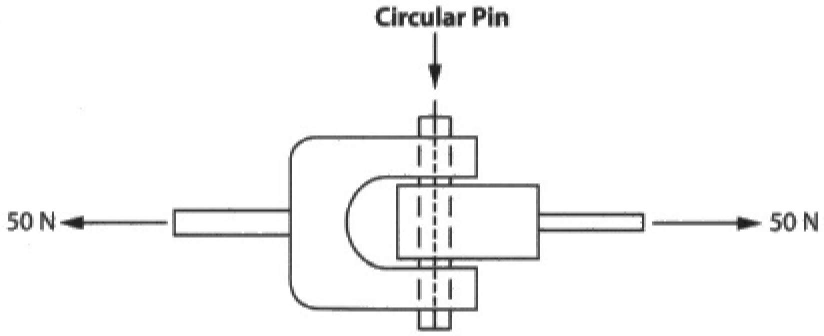
The learner has recognised that conservation of energy can be used to solve the problem and has been awarded one method mark for this. A further two method marks have been awarded for the rearranging of the formula to make 'v' the subject and the correct substitution of values. The final accuracy mark has been awarded for the correct answer. This response has achieved 4 marks.

Question 13

Question 13 is the final question that assesses mechanical principles and is synoptic across the various mechanical topics in the unit content. A large proportion of learners achieved between one and four marks for this question; where marks were lost this was as a result of not recognising that the pin was in double shear therefore the area needed to be doubled, or the misconception that the force of 50 N needed to be doubled. A significant number of learners achieved full marks, often presenting working that was well structured and precise.

A pin is used as part of a connection between two rods in a framework.

The shear stress of the pin is limited to 50 kPa.



13 Calculate the minimum suitable diameter for the pin.

$\tau = \frac{F}{A}$

$50{,}000 = \frac{25}{A}$

$50{,}000A = 25$

$A = \frac{25}{50{,}000}$

$A = 500 \times 10^{-6}\ m^2$

$A = 500\ \mu m^2$

$A = \pi r^2$

$500 \times 10^{-6} = \pi r^2$

$\frac{500 \times 10^{-6}}{\pi} = r^2$

$\sqrt{\frac{500 \times 10^{-6}}{\pi}} = r$

$r = 12.61mm$

$D = 25.23mm$

This learner has indicated the various formulae that they will use before populating them with values; this is good practice and allows the examiners to confirm that the correct calculation is being performed. The learner has recognised the pin is in double shear (showing a force of 25 N rather than 50). All stages of the working are shown, and they are accurate. As a result the full 7 marks can be awarded.

Question 14
This was the first question in section C where knowledge of electrical/electronic principles were assessed. As with section B the first two questions were multiple choice.

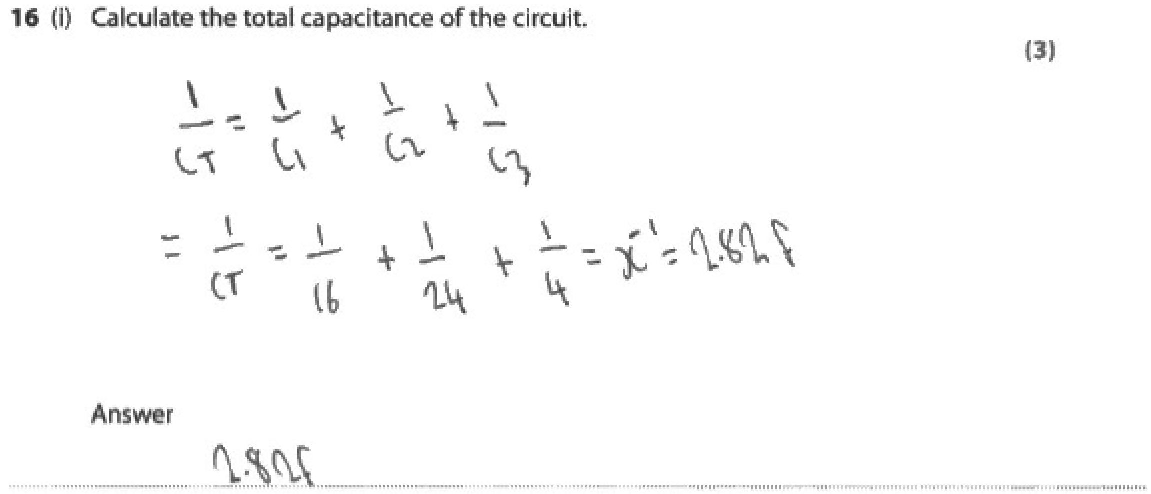
In this question learners were generally successful and were able to identify the useful form of energy produced by an electric motor is kinetic energy.

Question 15
Another multiple choice question in which learners generally performed well. A large number of learners correctly identified weber as the unit of magnetic flux. Common errors however included the selection of henry by a large proportion of those who answered incorrectly.

Question 16
As with a number of questions in Sections A and B this was an example of a two part question. In most cases learners performed well and were able to identify and use the correct formulae from the information booklet to answer both parts of the questions.

Learners generally performed well on part (i) of the question, with marks being awarded across the entire mark range. Those learners who achieved lower marks often substituted the correct values in to the formula and calculated the value of 1/C but did not then calculate the inverse to find the total capacitance in the circuit. As with other similar questions the mark scheme allowed for a 'follow through' for incorrect answers from part (i) to be used in part (ii) and full marks for the section to be awardable. As with question 12(i) learners were required to state their answer with an appropriate unit in part (ii).

Question 16(i)


16 (i) Calculate the total capacitance of the circuit.

(3)

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$= \frac{1}{C_T} = \frac{1}{16} + \frac{1}{24} + \frac{1}{4} = x^{-1} = 2.82f$$

Answer 2.82f

The learner has written out the formula they intend to use in full, and have then populated this correctly. Although one intermediate stage has been omitted from the working (the value for 1/CT) the final answer is correct, therefore full marks are awardable. This response has achieved 3 marks.

Question 16(ii)
As noted above, the follow through rule was applied to this question. This allowed learners who had made errors in part (i) the opportunity to be awarded both of the available marks for part (ii).

Answer 44 F ~~(farads)~~

(ii) Calculate the total charge stored on the capacitors.

Give your answer in an appropriate unit.

(3)

$Q = CV$

$230 \times 44 = 10120$

Answer 10120 coulombs

In this example the learner has made an error in part (i) with a solution of 44. The learner has however substituted this incorrect value into the correct formula and has calculated the correct arithmetic answer. As a result, both of the available marks can be awarded.

Question 17

A large proportion of learners attempted the question with success being somewhat limited for the majority. A larger number of learners were able to complete the conversion of kilowatts to watts to be awarded one method mark. A further method mark was often achieved for rearranging the formula to make 'R' the subject or performing the correct substitution. Where learners did not achieve full marks this was due to either an error being made during the rearranging of the formula or the substitution of values. This was potentially due to unfamiliarity with the formulae to be used and the values that needed to be entered. A large proportion made an error in the population of the formula because they halved the distance between the two particles and entered r as 0.6m rather than 1.2m. Other values tended to be used correctly, however the aforementioned incorrect value of r resulted in an answer that was inaccurate.

An electric motor is supplied with a 230 V supply and has a power rating of 12 kW.

The motor is operating at full power.

17 Calculate the resistance of the motor windings.

(4)

$V = IR$ so $R = \frac{V}{I}$

$P = IV$

$I = \frac{P}{V}$

$I = \frac{12 \times 10^3}{230}$

$I = \frac{1200}{23}$ A

$R = \frac{230}{\left(\frac{1200}{23}\right)}$

$R = \frac{529}{120}$

$R = 4.408\dot{3}$

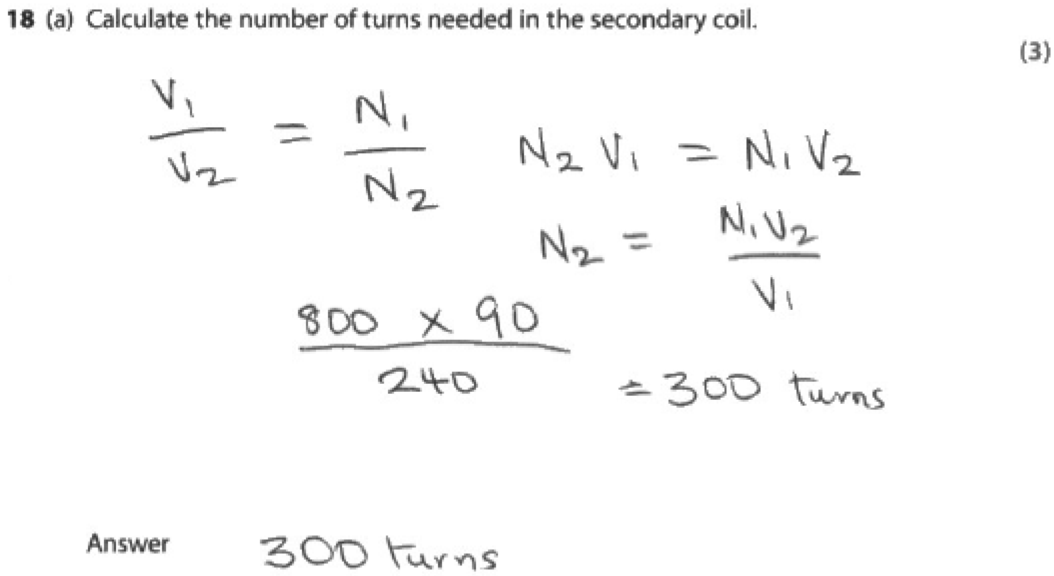
Answer

$4.41\,\Omega$

This learner has used an alternative approach to the one expected and has first calculated the current in the circuit and then the resistance using Ohm's Law. Although the working is not as expected, full marks can nonetheless be awarded. The correct conversion to watts has been completed, and all working is accurate. Moreover, the final numerical answer is correct therefore full marks can be awarded.

Question18a

Learners performed well on this question, with the vast majority of learners being awarded full marks for their solutions. Where learners failed to achieve three marks they tended to either make errors in their rearranging of the formula, or they made arithmetic errors in the calculation. A range of different approaches were seen to the rearranging of the formula, however in the majority of cases these were completed with accuracy.



18 (a) Calculate the number of turns needed in the secondary coil.

(3)

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} \qquad N_2 V_1 = N_1 V_2$$

$$N_2 = \frac{N_1 V_2}{V_1}$$

$$\frac{800 \times 90}{240} = 300 \text{ turns}$$

Answer 300 turns

In this example the learner has correctly rearranged the formula and populated this correctly. The learner has not shown any values from intermediate stages of the working, therefore there are no rounding errors to carry forward. In questions such as this learners should be encouraged to avoid rounding at intermediate stages as this can often lead to inaccuracies in the final answer. This response achieved 3 marks.

Question 18b

Learners performed relatively poorly on this question with only a small proportion of learners achieving both of the marks available. Many learners were able to identify one method of reducing power losses from a transformer, but only a limited number stated two.

There were a number of common misconceptions and incorrect answers, mostly focussing on 'increasing the number of coils' or 'increasing the voltage'.

(b) State **two** methods of reducing power losses from a transformer.

(2)

1 eddy currents can be stopped by laminating the core

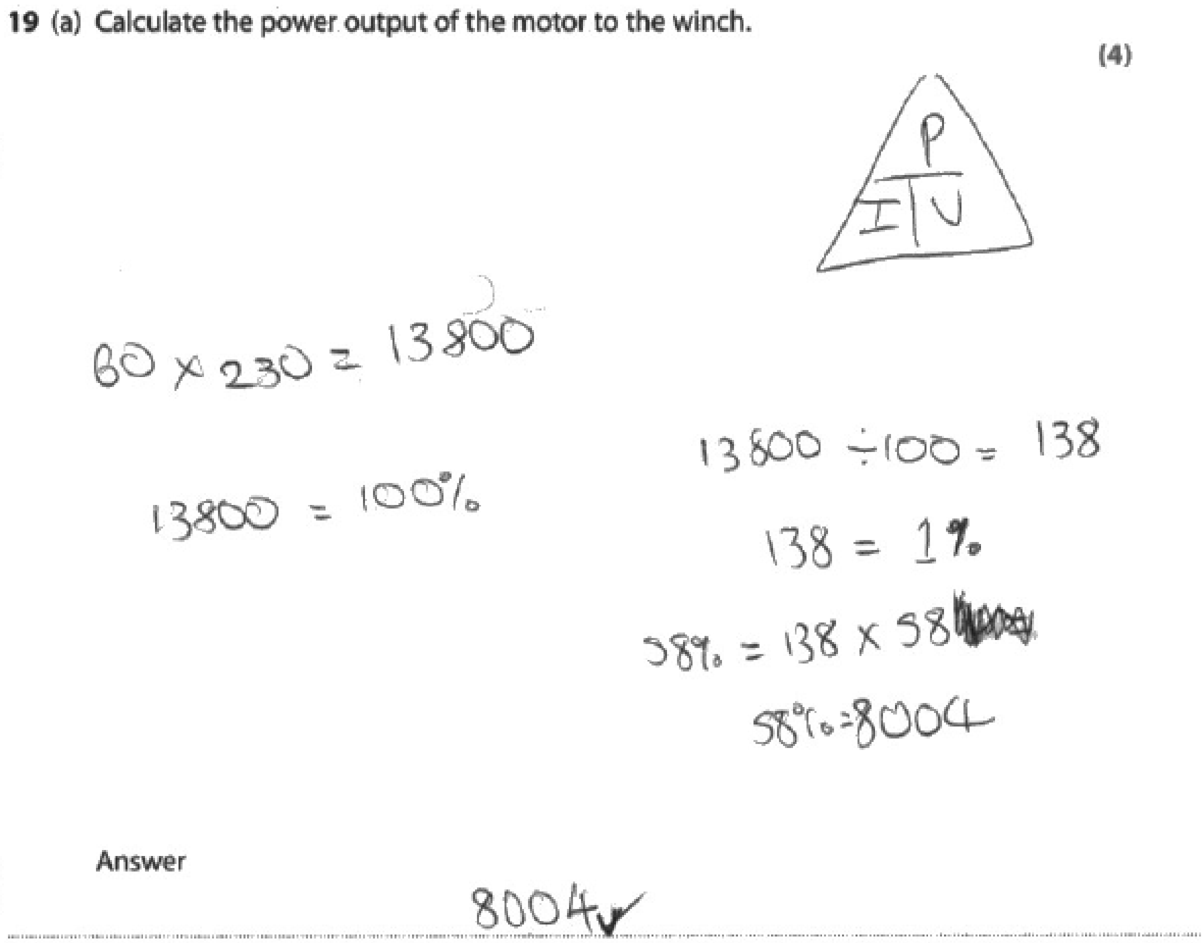
2 A material with a narrow hysteresis loop can be used.

This learner has stated two appropriate methods of reducing power losses (laminating the core and using a material with a narrow hysteresis loop) both of which are interpretations of marking points in the mark scheme. This response achieved 2 marks.

This question required more than a one-word answer, however there was no requirement to provide a description of how the method stated reduces power losses.

Question 19a

A large proportion of learners achieved four marks for this question, with the majority of learners showing full working in their answers. Where learners failed to achieve all of the marks this was as a result of only calculating the input power from the information given.



19 (a) Calculate the power output of the motor to the winch. **(4)**

60 x 230 = 13800

13800 = 100%

13800 ÷ 100 = 138

138 = 1%

58% = 138 x 58

58% = 8004

Answer 8004 ✓

The learner has presented their working in full and has broken the calculation down into three stages. One method mark and one accuracy mark have been awarded for calculating the input power. A further method and accuracy mark have then been awarded for calculating the power outputted to the winch. The learner has given their answer with an incorrect unit however this carries no penalty in the majority of questions. This response achieved 4 marks.

Question 19b

This was an example of an 'explain' question where learners were asked to identify one method of improving the efficiency of an electric motor and then expand upon this by explaining how the method increases efficiency. In general learners performed with limited success on this question, with only a small proportion of learners achieving one or two marks.

(b) Explain **one** method of improving the efficiency of the electric motor that powers the winch.

(2)

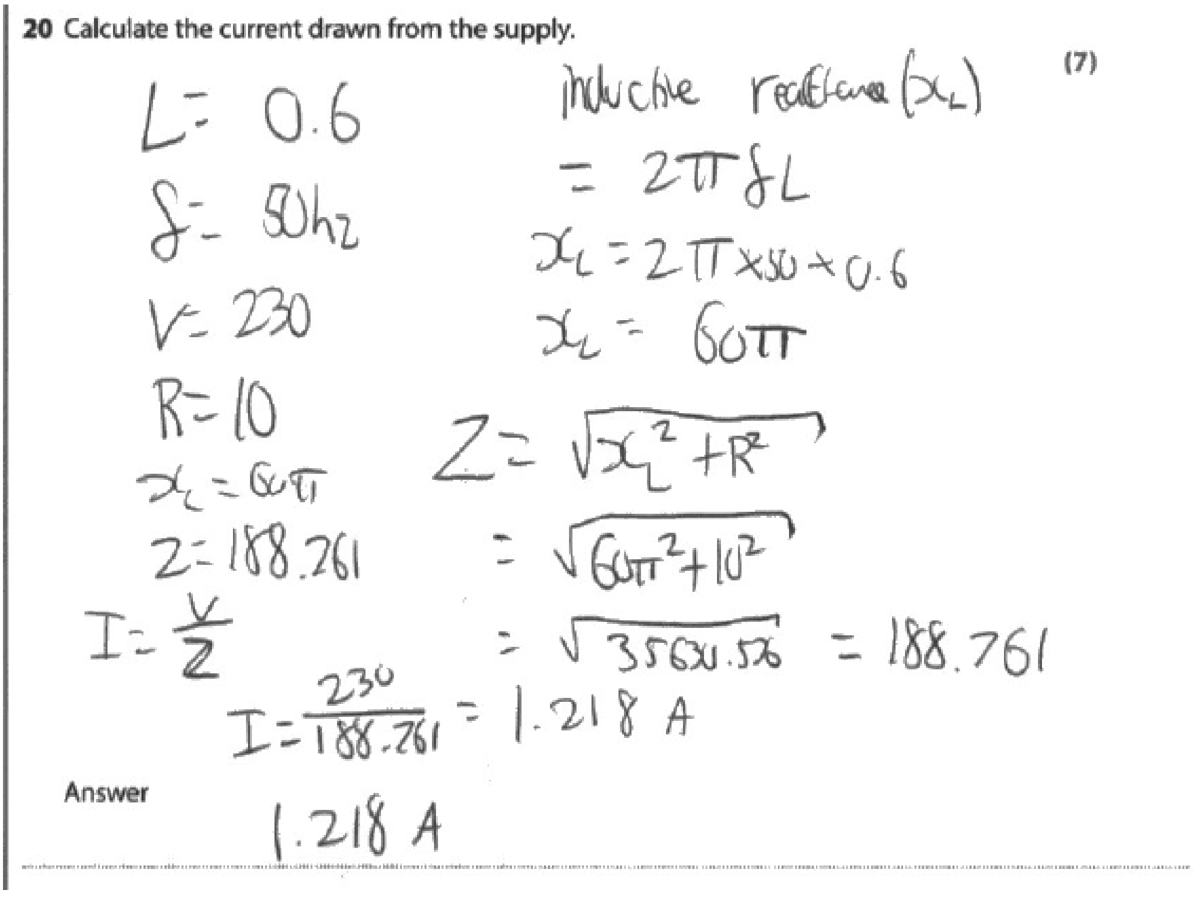
Reduce the amount of [illegible] heat energy the motor generates by using a cooling system. This will [illegible] improve the amount of power going out of the motor as electrical other than heat energy.

(Total for Question 19 = 6 marks)

The learner has correctly identified that one method of improving the efficiency of the motor would be to reduce the amount of heat generated. This is expanded upon by the learner who has suggested the use of a cooling system to achieve this. This is an example of a linked response therefore both of the marks available can be awarded. This response achieved 2 marks.

Question 20

As with the mechanical principles questions, the later electrical and electronic principles questions tend to be more demanding. As such, this question proved to be challenging for many learners as a number of stages were required in order to arrive at the solution. Although learners were able to identify the information provided in the stem of the question, they often selected an incorrect formula at some of the stages, or they provided only partial solutions. Learners were given credit for the stages of the calculation where they performed well, and as with other questions on the paper, a ‘follow through’ approach was taken to prevent further penalties for errors or omissions in early stages of the calculation.



20 Calculate the current drawn from the supply. **(7)**

L= 0.6

f= 50hz

V= 230

R= 10

x_L = 60π

Z= 188.261

I= V/Z

inductive reactance (x_L)

= 2πfL

x_L = 2π×50×0.6

x_L = 60π

Z= √(x_L^2 + R^2)

= √(60π² + 10²)

= √35630.526 = 188.761

I = 230/188.261 = 1.218 A

Answer

1.218 A

The learner has shown each of the stages of the calculation clearly and logically and has shown the intermediate values calculated (x_L and Z) which is good practice. It is clear in the working that these values have been correctly substituted into the various formulae to calculate Z and then I. The calculations have been performed with accuracy, with the final answer being presented to an appropriate degree of precision. This response achieved 7 marks.

Summary

Based on their performance on this paper, learners should:

- attempt all questions on the paper as method marks are often awarded for partial solutions.
- show working in full as again this allows access to method marks. If arithmetic errors are made then marks can still be awarded
- Avoid excessive rounding at intermediate stages of calculations.
- provide linked responses for ‘explain’ questions. An initial lead point should always be expanded upon with either an expansion or a justification.
- make effective use of space when drawing charts or diagrams
- ensure that axes on graphs or charts are labelled with both titles and values

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