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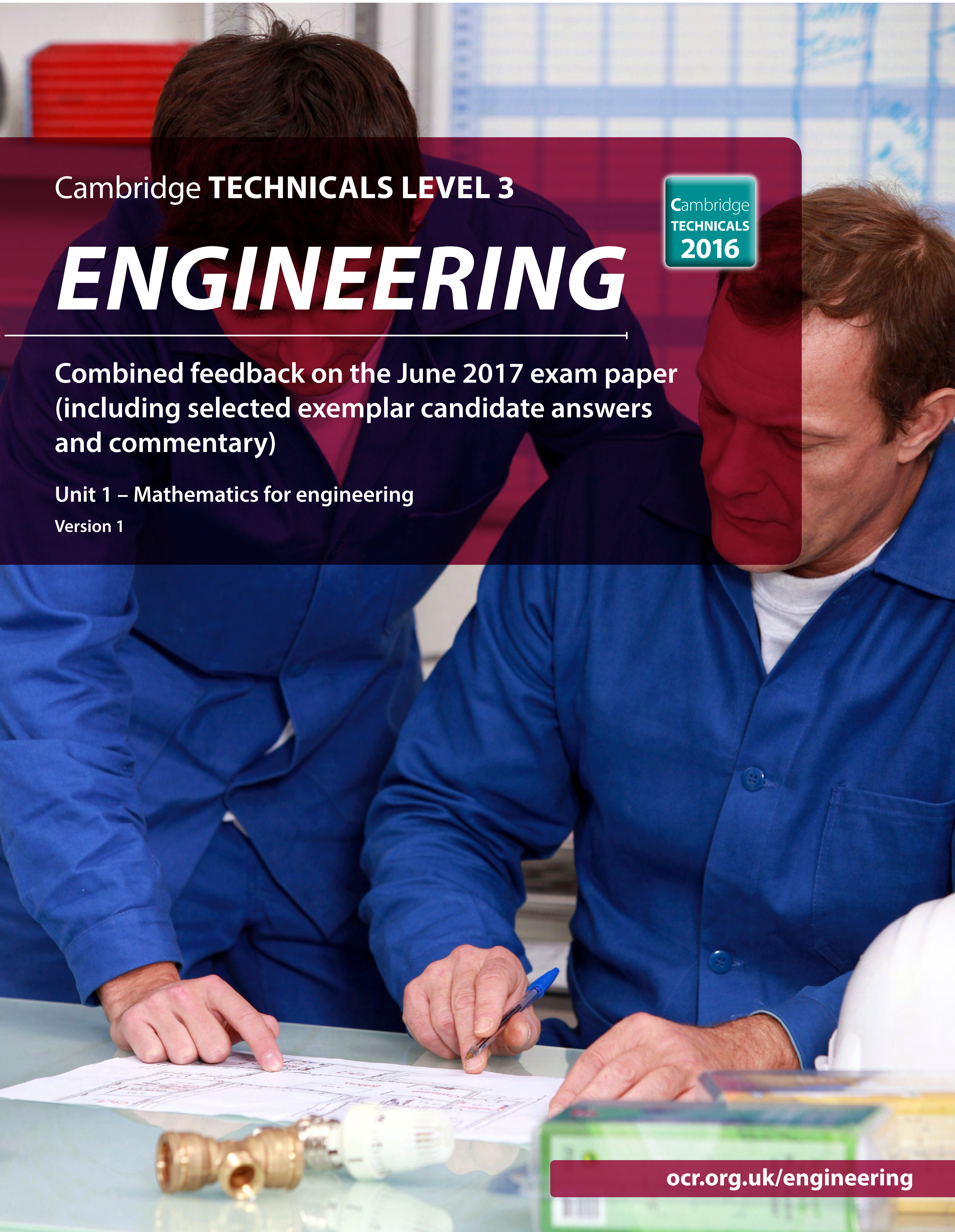


Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

ENGINEERING

Combined feedback on the June 2017 exam paper (including selected exemplar candidate answers and commentary)

Unit 1 – Mathematics for engineering

Version 1

ocr.org.uk/engineering

CONTENTS

INTRODUCTION

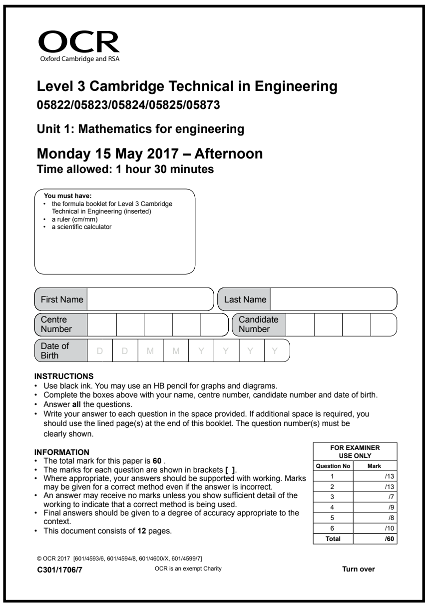
This resource brings together the questions from the June 2017 examined unit (Unit 1), the marking guidance, the examiners comments and the exemplar answers into one place for easy reference.

We have also included exemplar candidate answers with commentary for Questions 3 (i), 4b (i), (ii), (iii) and 5 (i).

The marking guidance and the examiner's comments are taken from the Report to Centre for this question paper.

The Question Paper, Mark Scheme and the Report to Centre are available from:

https://interchange.ocr.org.uk/Modules/PastPapers/Pages/PastPapers.aspx?menuindex=97&menuid=250



OCR
Oxford Cambridge and RSA

Level 3 Cambridge Technical in Engineering
05822/05823/05824/05825/05873

Unit 1: Mathematics for engineering

Monday 15 May 2017 – Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- the formula booklet for Level 3 Cambridge Technical in Engineering (inserted)
- a ruler (cm/mm)
- a scientific calculator

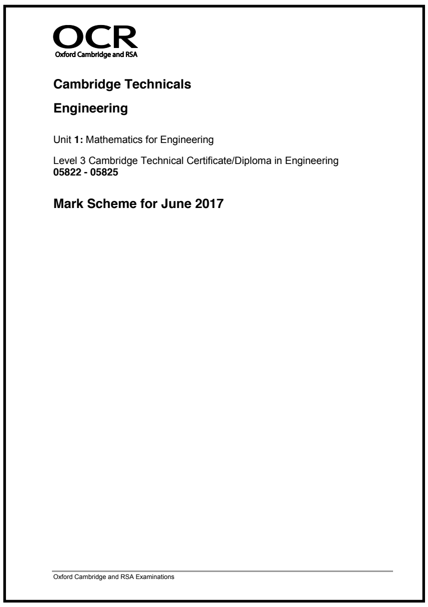
First Name | Last Name
Centre Number | Candidate Number
Date of Birth D D M M Y Y Y Y

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- An answer may receive no marks unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- This document consists of **12** pages.

FOR EXAMINER USE ONLY	
Question No	Mark
1	/13
2	/13
3	/7
4	/9
5	/8
6	/10
Total	/60

© OCR 2017 [601/4593/6, 601/4594/8, 601/4600/X, 601/4599/7]
C301/1706/7 OCR is an exempt Charity **Turn over**



OCR
Oxford Cambridge and RSA

Cambridge Technicals

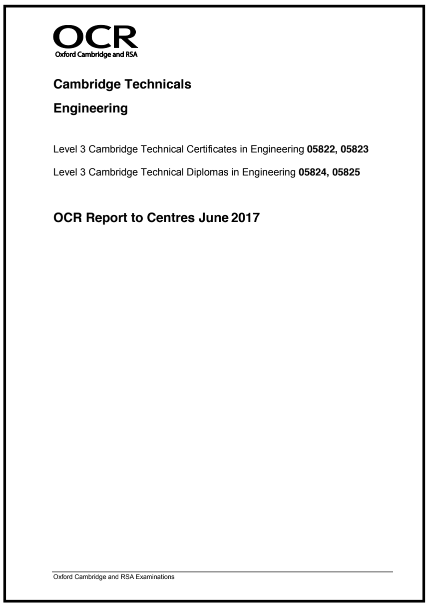
Engineering

Unit **1:** Mathematics for Engineering

Level 3 Cambridge Technical Certificate/Diploma in Engineering
05822 - 05825

Mark Scheme for June 2017

Oxford Cambridge and RSA Examinations



OCR
Oxford Cambridge and RSA

Cambridge Technicals

Engineering

Level 3 Cambridge Technical Certificates in Engineering **05822, 05823**

Level 3 Cambridge Technical Diplomas in Engineering **05824, 05825**

OCR Report to Centres June 2017

Oxford Cambridge and RSA Examinations

GENERAL EXAMINER COMMENTS ON THE PAPER

This is a mandatory unit across all qualifications in the Cambridge Technicals in Engineering suite.

It is hoped that the following points may help centres to prepare future cohorts of learners for this unit.

The expected norm for decimal answers is 3 significant figures. Sometimes fewer (e.g. 2) were accepted. However, in following through a calculation to a further answer, learners should use the best answer they have. Failure to do so results in an error that is compounded to the extent that the further answer becomes incorrect to 3 significant figures. For instance, in Question 4(b), providing the response given demonstrates the use of Pythagoras, 2.2 was an accepted answer. However, using the value 2.2 in part (iii) rather than the correct value yields an answer that does not round to 2.1 and so the final mark is lost.

Learners should generally show working for full marks. For instance, in question 5(i) the question asked for integration. If the final answer was given with no working then no marks could be earned. The answer might come from the use of an advanced calculator that is not specified in the rubric, which states only a scientific calculator is allowed, in which case no integration has been done.

Additionally, many candidates do not understand what is required when the question says 'show that....'. A 'Show that …' question is usually asked when the answer is required in a later part – by giving the answer, the later part can be done using a correct value instead of a possibly incorrect value that the candidate found in the earlier part. In a question asking for a 'Show that' it is required that candidates do show their working in such a way that they demonstrate to the examiner that they have followed a correct process. An example of this is question 3 where, without the correct expression for the area of the green carpet a candidate is unable to do part (ii), or with an incorrect quadratic expression might create a lot of extra work to produce an incorrect answer. But many candidates failed to convince examiners of the process used, it is important therefore that all workings are shown even if some might be easily done in the learners head.

It is important for answers to be written clearly, some scripts this series contained text and working that was difficult to read or understand.

While candidates generally performed to expectation, there seemed to be, as in January 2017, a number of gaps in their knowledge please refer to the comments that follow on individual questions.

Resources which might help address the examiner comments:

From the link below, you'll find 'The OCR guide to examinations' (along with many other skills guides)
http://www.ocr.org.uk/i-want-to/skills-guides/

Command verbs definitions
http://www.ocr.org.uk/Images/273311-command-verbs-definitions.pdf

Questions 1(a), (b) and (c)

Answer **all** the questions.

1 (a) Solve the equation $2(x+2)-5=9$.

$2x + 4 = 14$

$\Rightarrow 2x = 10$

$\Rightarrow x = 5$

[3]

(b) Write as a single fraction.

$$\frac{2x+1}{3}+\frac{3x-2}{6}$$

$$\frac{2x+1}{3}+\frac{3x-2}{6}=\frac{4x+2}{6}+\frac{3x-2}{6}$$

$= \frac{7x}{6}$ oe

[3]

(c) The period, T seconds, of a pendulum of length L is given by the formula $T = 2\pi\sqrt{\frac{L}{g}}$.
Rearrange this formula so that L is the subject.

$\Rightarrow T^2 = \frac{4\pi^2 L}{g}$

$\Rightarrow L = \frac{gT^2}{4\pi^2}$ oe

[3]

Question 1(d)

(d) (i) You are given the cubic function $f(x) = x^3 - 13x + 12$.

Show that $f(x)$ can be written as $(x-1)(x^2+x-12)$.

Long division or "build up" method

[2]

(ii) Hence factorise $f(x)$ completely.

$x^2 + x - 12 = (x \pm 4)(x \pm 3)$

$\Rightarrow (f(x)) = (x - 1)(x + 4)(x - 3)$

[2]

Mark scheme guidance

Question 1(a):

Remove brackets (i.e. sight of $2x + 4$ or $2x - 1$).

Collect terms together.

Accept $x = 5$ www for 3 marks.

Question 1(b):

Sight of 6 (or multiple of 6) as common denominator.

Correct numerators.

Question 1(c):

Square both sides.

Make L the subject.

$L = \dfrac{gT^2}{4\pi^2}$ is M1 M1 A0

Question 1(d)(i):

Evidence of multiplication (includes a 2×2 table).

All algebra correct.

Question 1(d)(ii):

Evidence of attempt to factorise soi.

All algebra correct isw.

Examiners comments

Part (a) was generally well answered. In part (b) most candidates obtained a common denominator (though the use of 18 rather than 6 demonstrated a general lack of understanding of what they were doing) but many did not obtain correct numerators.

In part(c) there were numerous errors seen, usually caused by the square root and the failure to square the whole of the function.

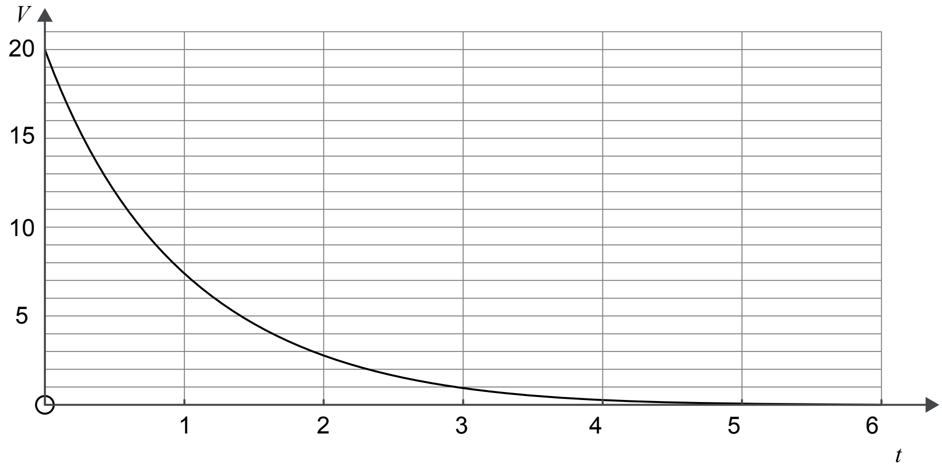
In part (d)(i) many failed to answer the question properly, quoting the remainder theorem to (correctly) demonstrate that $f(1) = 0$ and hence $(x - 1)$ was a factor of $f(x)$. The question, however, was to do with finding the other, quadratic factor. Multiplying out the given factorised expression was acceptable; long division often caused problems because of the lack of a squared term in $f(x)$. This caused problems particularly for those candidates who drew up a 2×3 table.

Many candidates failed to answer part (ii) properly. Some wrote $(x - 3)(x + 4)$, omitting the $(x - 1)$ already found. Others gave an answer $x = 1, 3, -4$ answering the question "Solve $f(x) = 0$".

Question 2(a)

2 **(a)** The graph below represents the voltage decay in a capacitor circuit.

The equation of the curve is $V = ke^{at}$ where V is measured in volts and t is the time in seconds.



(i) Identify the value of k and explain what it represents.

$k = 20$
It represents the initial voltage

[2]

(ii) The curve passes through the point (3, 1). Find the value of a.

$1 = 20e^{3a} \Rightarrow 3a = 1n0.05$

$\Rightarrow a = \frac{1}{3} 1n0.05 = -0.999 \approx -1$

[3]

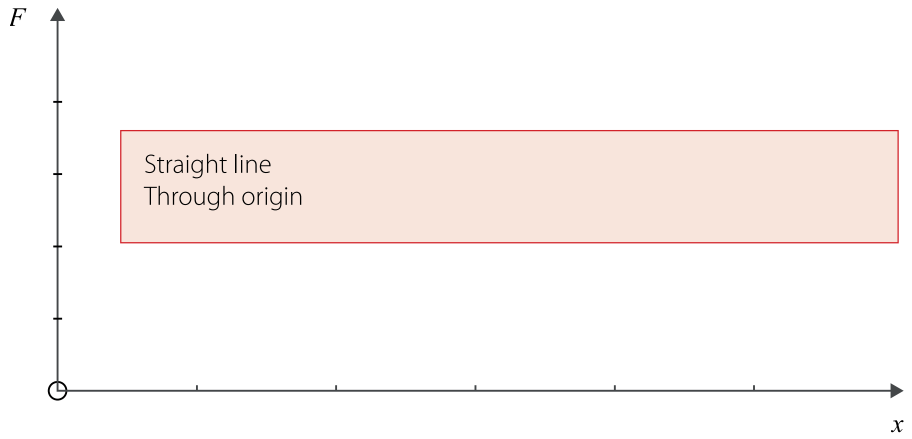
Question 2(b) and (c)

(b) The force, F, required to compress a coil spring a distance x from its natural length is given by

$$F = kx$$

where k is a constant.

Sketch a graph of $F = kx$ on the axes below.



[2]

(c) On a coordinate grid the point A has coordinates (2, 5) and the point B has coordinates (6, 9).

Find

(i) the midpoint of AB,

$$\left(\frac{2+6}{2}, \frac{5+9}{2}\right) = (4,7)$$

[2]

(ii) the gradient of the line AB,

$$g = \frac{9-5}{6-2} = 1$$

[2]

(iii) the equation of the line AB.

y = their g x + anything
Or y = anything $x + 3$
$y = x + 3$

[2]

Mark scheme guidance

Question 2(a)(i):

(award if seen in (ii)).

Or voltage at $t = 0$

Accept "Peak voltage" or "highest voltage".

Question 2(a)(ii):

Use of logs.

Correct substitution of 3 and 1 using their k.

Question 2(b):

Give this mark even if you cannot award the first one.

Question 2(c)(i):

Attempt to find mean of values soi by sight of 4 or 7.

Question 2(c)(ii):

Change in y over change in x.

Accept ans of 1 www for 2 marks.

Question 2(c)(iii):

For both: Ans has 3 terms only.

Examiners comments

As in previous series this question was not well answered.

The value of k is the initial value or the value of V when $t = 0$ but this was rarely given. In part (ii) the substitution was also quite poorly done with an inability to solve the resulting equation using logs.

In part (b) the context caused difficulty, for the question merely asked for a sketch of $F = kx$ which is a straight line through the origin.

In part (c)(i) it was expected that candidates would find the mean of coordinates; many seemed to need the opportunity to plot the points on a graph that was not given to them. Some did sketch small diagrams in the space available; others used the extra space at the end of the paper or even additional answer books. Unfortunately some used the graph of the previous part, thus making the answer to part (i) difficult to understand.

There are various ways to find the equation of the line AB and all were of course acceptable. The use of the gradient is the most popular and so in part (ii) this value was required. Using the gradient in part (iii) was generally well done.

Question 3

3 An exhibition stand is to be carpeted using red and green carpet.

The red carpet is rectangular of size 4 m by 7 m. It is to be surrounded by a green carpet border of constant width, as shown in Fig. 1.

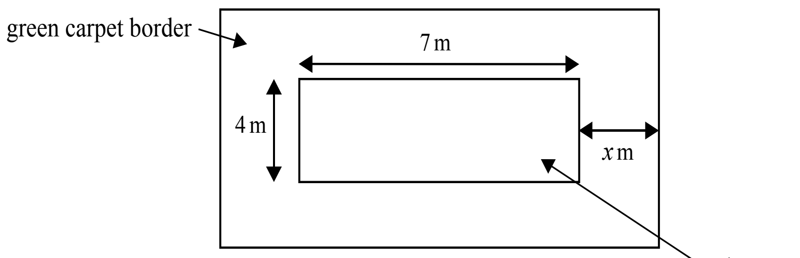


Fig. 1

The width of the green carpet is x m.

(i) Show that the area of green carpet is $4x^2 + 22x$.

Large rectangle =
$(7 + 2x)(4 + 2x) = 28 + 22x + 4x^2$
$\Rightarrow$ Surround $= 28 + 22x + 4x^2 - 28$
$= 4x^2 + 22x$

[3]

(ii) The area of green carpet is 42 m^2.

Find the value of x.

$4x^2 + 22x = 42$
$\Rightarrow 2x^2 + 11x - 21 = 0$
$\Rightarrow (2x - 3)(x + 7) = 0$
$\left(\text{or } x = \frac{3}{2} \text{ and } x = -7\right)$

$\Rightarrow x = \frac{3}{2}$ oe

[4]

Mark scheme guidance

Question 3(i):

Large rectangle minus small rectangle.

Or any acceptable method of splitting the surround into rectangles and squares.

N.B. AG so working must be seen.

Question 3(ii):

Correct quadratic equation.

Solve their quadratic by correct formula or factorisation or completing the square 2 roots or factors soi.

($x = -7$ can be discarded anywhere but it must be discarded).

Alternative: Trial and error.

Examiners comments

Part (i) demonstrated the problems that candidates have when they are given the answer and told to "show that...". There are two ways to obtain the result. The first is to take the smaller area from the larger, and this was done by many candidates. The other is to split the border into a set of squares and rectangles. It was this method that was not clearly explained by candidates and many gave way to temptation and wrote down the answer at the end (which was given in the question) instead of following through their working carefully to ensure that it was correct.

In part (ii) most were able to obtain the quadratic equation that had to be solved. Many solved using the formula, others were able to factorise correctly. However, the process of solving the quadratic equation yields two answers and it was necessary to acknowledge that there were two answers, one of which was practically impossible being a negative number. The rejection of $x = -7$ was explicitly stated by many candidates but others "lost" it on the way. Those that solved the quadratic by trial and error all failed to find and reject this value; their working therefore resulted in the first value found without any recognition that there was another possible value which might have been a solution to the problem.

Exemplar Candidate Work

Question 3(i) – low level answer

3 An exhibition stand is to be carpeted using red and green carpet.

The red carpet is rectangular of size 4 m by 7 m. It is to be surrounded by a green carpet border of constant width, as shown in Fig. 1.

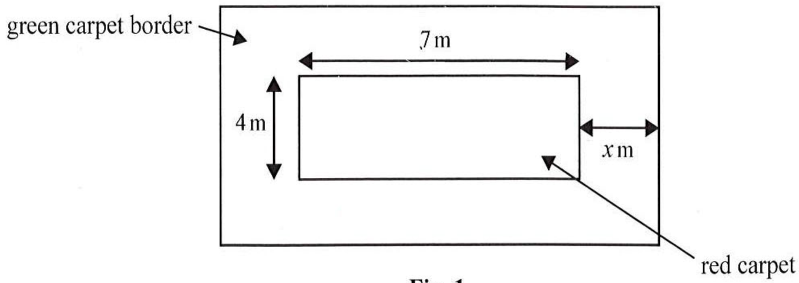


Fig. 1

The width of the green carpet is x m.

(i) Show that the area of green carpet is $4x^2 + 22x$.

$4x^2 + 22x \rightarrow 2x(2x + 11)$

....

.... **[3]**

Commentary

The process for this question is to find the area of each carpet in terms of the dimensions given, starting from what is known to achieve the required result.

This can be done in two ways: (i) finding the area of the total rectangle and subtracting the area of the red carpet or (ii) splitting the area of the green carpet into squares and rectangles and summing their areas. Candidates can then progress via some algebra to the given answer.

Exemplar Candidate Work

Question 3(i) – high level answer

3 An exhibition stand is to be carpeted using red and green carpet.

The red carpet is rectangular of size 4 m by 7 m. It is to be surrounded by a green carpet border of constant width, as shown in Fig. 1.

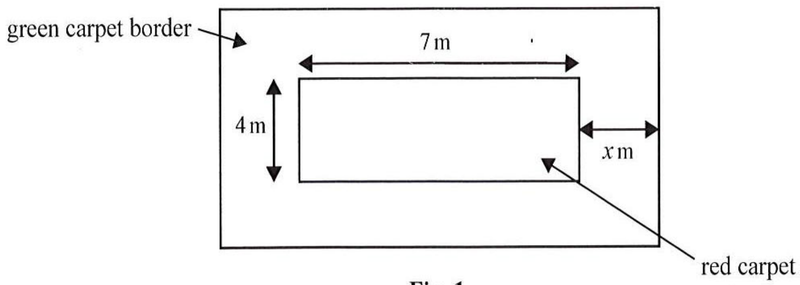


Fig. 1

The width of the green carpet is x m.

(i) Show that the area of green carpet is $4x^2 + 22x$.

length of whole carpet $= 4 + x + x \quad = 4 + 2x$

width of whole carpet $= 7 + x + x \quad = 7 + 2x$

area of whole carpet $= (4+2x)(7+2x) \quad = 28 + 8x + 14x + 4x^2$ **[3]**

$= 28 + 22x + 4x^2$

area of red carpet $= 7 \times 4 = 28$. $\quad 28 + 22x + 4x^2 - 28 = 22x + 4x^2 \quad = 4x^2 + 22x$.

Commentary

A medium level answer does not include all the steps. When the answer is given it is vital that a candidate writes down all the steps in the algebraic manipulation.

For instance, this answer does not fulfil this demand.

Splitting the green carpet into 4 rectangles, area of green carpet = $2(7 + 2x)x + 2(4x) = 4x^2 + 22x$.

This solution requires the expansion of brackets to be completed successfully and this response does not demonstrate that. To attain full marks the candidate must show every step of the algebra.

In a high level response the candidate will record all steps in the algebraic process so that the answer is achieved from the working and not just by writing down the given answer.

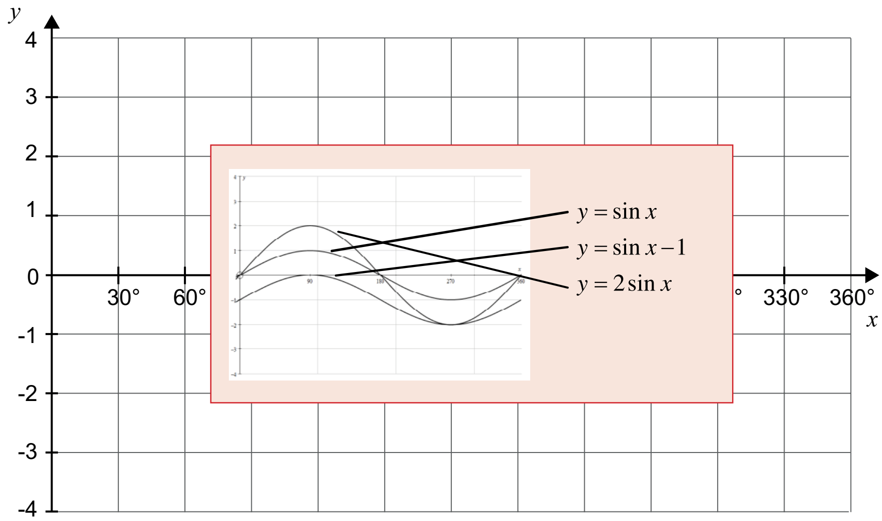
In the response given, the answer is achieved by finding the area of the large rectangle and subtracting the area of the small rectangle. The dimensions of the large rectangle are explained and the area found, including the expansion of brackets. This candidate also does not just take away 28 to achieve the answer required but explains where that value comes from as well. Every step is therefore explained and full marks awarded.

Question 4(a)

4 **(a)** On the grid below, sketch the graphs of

- $y = \sin x$,
- $y = \sin x - 1$,
- $y = 2\sin x$.

Label each graph clearly.



[3]

Question 4(b)

(b) A window has the shape of a square ABCD with a curved top BC as shown in Fig. 2.

The curved top BC is the arc of a circle with centre M.

M is the midpoint of the base AD. AB = DC = AD = 2 m.

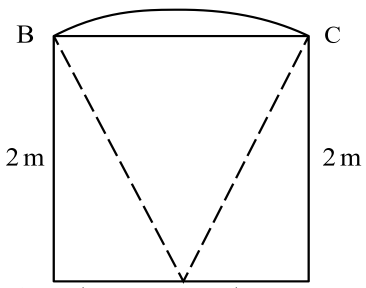


Fig. 2

(i) Find the length MB.

$BM^2 = 2^2 + 1^2 = 5$
$\Rightarrow BM = \sqrt{5}$

.... **[2]**

(ii) Show that the angle BMC is approximately 53^0.

Angle BMA = Angle CMD $\tan^{-1} 2 = 63.40°$
$\Rightarrow$ Angle BMC = $180° - 2 \times 63.4° = 53.1°$
Alternatively: Drop perpendicular to BC from M giving half the angle $\tan^{-1} 0.5 = 26.6$. Giving angle 53.1.
Alternatively: Use of triangle BMC and sin.
Alternatively: Use correct cosine rule.
Alternatively: Use areas.

.... **[2]**

(iii) Hence find the length of the curved side, BC.

Arc length $= 2\pi \times MB \times \frac{53}{360}$
$= 2.07....$

.... **[2]**

Mark scheme guidance

Question 4(a):

Each graph correct and clearly labelled.

S.C. All 3 correct but none labelled.

Question 4(b)(i):

Pythagoras

Accept 2.2, 2.23, 2.24, 2.236....

Question 4(b)(ii):

Sight of 63.4.

Question 4(b)(iii):

Correct formula using their MB and 53 or their 53.

Anything that rounds to 2.1www.

Examiners comments

In part (a), many incorrect graphs were seen including incorrect amplitude, frequency or phase. Most graphs were labelled as requested. It was not always clear however which label was attached to which graph.

In part (b)(i), most candidates were able to give the correct answer from Pythagoras, but some rounded this to 2.2. In this part this was accepted but the use of this rounded value created larger errors later on. There were many correct answers to part (ii) with a variety of methods to get there. Working backwards from the given answer always failed, and this is because the angle BMC was not 53º but only approximately this value.

Finding the sector of the circle in part (iii) was usually well done.

Exemplar Candidate Work

Question 4(b)(i),(ii) and (iii) – low level answers

(b) A window has the shape of a square ABCD with a curved top BC as shown in Fig. 2.

The curved top BC is the arc of a circle with centre M.

M is the midpoint of the base AD. AB = DC = AD = 2 m.

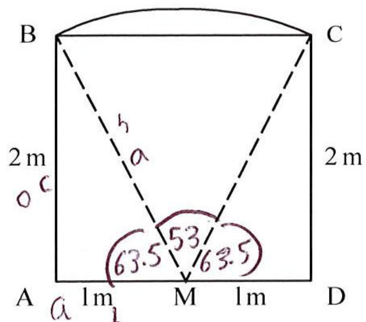


Fig. 2

(i) Find the length MB.

$a^2 = b^2 + c^2 - 2bc \cos A$

$1^2 + 2^2 - 2 \times 1 \times 2 \cos A = 3.215$ m ..... **[2]**

(ii) Show that the angle BMC is approximately 53°.

$180 - 53 = 127$

$127 \div 2 = 63.5$ ..... **[2]**

(iii) Hence find the length of the curved side, BC.

Or $53 \times \frac{\pi}{180} = 0.9250245036$

$0.9250245036 \times 2 = 1.850049007$ ..... **[2]**

$= 1.85$ (2.DP)

Commentary

The use of the cosine rule in (i) is not incorrect because the angle at A is 90º.This candidate writes down the cosine rule correctly; had cos90º been made 0 the correct answer would have been achieved and at least the first method mark would have been given. Instead, some other value has been written down with no explanation as to where it came from so there is no indication that all the correct values have been inserted into the cosine formula.

In (ii) there are a number of ways of showing the final answer. The angle at A is 90º and so Pythagoras' theorem should have been used. Candidates can start part (iii) with the correct angle even if not found here.

Candidates should not start with the answer given but should start with something known and progress to the result. A low level answer will show, as this one does, that the candidate has started with the final answer and tried to 'work backwards'. To have started with a right-angled triangle to find an angle would give at least the method mark.

In (iii) the formula required is in the formula book and a low level answer would ignore this. In many cases seen the formula for the area of a sector was used.

In this case the problem lay in rounding errors. It was necessary for candidates to enter into the correct formula for the arc length the results of the first two parts; given that the formula is given in the formula book, no reward was given for those who simply stated the formula without using it or using it with incorrect values. This candidate achieved full marks in (i) for the length MB but this value was not used in (iii). There is a general principle involving the accumulation of errors that, unless otherwise stated, candidates should assume that the 'appropriate degree of accuracy' is 3 significant figures but that if the value is to be used in later calculations the more accurate value should be used. This candidate did the opposite! In order to calculate the arc length the (correct) answer in (i) was rounded to 2 which resulted in a significant error.

Exemplar Candidate Work

Question 4(b)(i),(ii) and (iii) – high level answers

(b) A window has the shape of a square ABCD with a curved top BC as shown in Fig. 2.

The curved top BC is the arc of a circle with centre M.

M is the midpoint of the base AD. AB = DC = AD = 2 m.

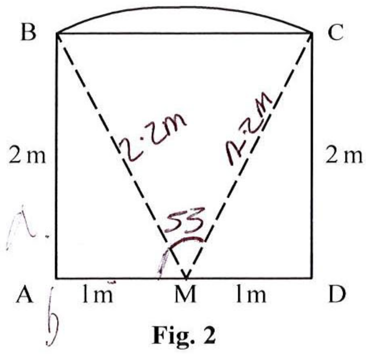
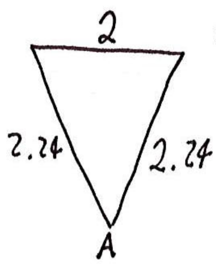


Fig. 2

(i) Find the length MB.

$2^2 + 1^2 = c^2 = 5 \quad \sqrt{5} = 2.2\text{m}$

[2]



(ii) Show that the angle BMC is approximately 53^0.

$A = \cos^{-1}\left(\frac{2.24^2 + 2.24^2 - 2^2}{2 \times 2.24 \times 2.24}\right)$

$= 53.03 \quad = 53°$

[2]

(iii) Hence find the length of the curved side, BC.

$\frac{53}{180} \times \pi \times 2.24 = 2.07\text{m}$

[2]

Commentary

A 'medium level answer' in the context of the 2 mark question in (i) would be to demonstrate the use of Pythagoras' theorem but get the calculator calculation incorrect. Some candidates took the answer to be 5 without taking the square root.

Writing down a process which will give one of the angles would give the method mark for (ii).

In (iii) two approximate values are to be multiplied (the radius and the angle) and the accumulation of these errors would result in a value outside the range allowed.

So for instance, the answer 2.2 was allowed in (i) but would result in a penalty in (iii), given that an approximate value for π would not achieve the accuracy required.

Although there was no assertion that Pythagoras' theorem was being used in (i), it is clear that it has been by the workings shown. At this stage it would have been appropriate either to leave the answer as a surd (which is perfectly acceptable as no approximation was stated - $\sqrt{5}$ is therefore exact while any other answer is only approximate!) or to write a decimal approximation. If candidates do not know in any particular question what 'a degree of accuracy appropriate to the context' actually means then they should give 3 significant figures. In this case it is possible that the use of the value 2.2 could cause an accumulation of errors later in the question but was accepted for full marks here.

In (ii) a high level answer would result in an angle BMC that was more accurate than the 'approximately 53º' of the question. In this case the use of the cosine formula in triangle BMC is correct and a more accurate answer for the angle given.

In (iii) full marks would have been given for the answer only, but a high level response would demonstrate how the answer was achieved. Had the arithmetic been incorrect then this candidate would at least have been awarded the method mark while an answer of, 2.2 with no working shown would have been given 0.

Question 5

5 (a) A metal plate OADBC has three straight edges OA, OC and CB, and one curved edge ADB.

Fig. 3 shows the shape of the plate overlaid onto a Cartesian coordinate system (x, y), where corner O is located at the origin.

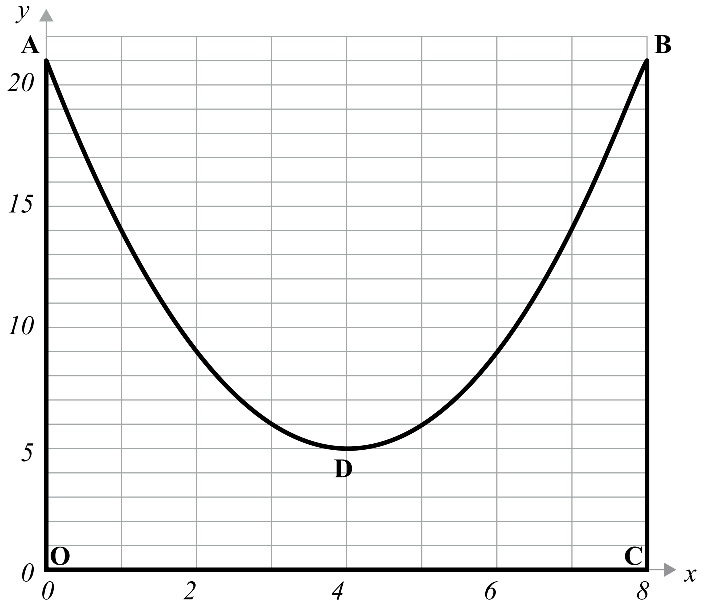


Fig.3

On a coordinate system the points O, A, B and C have coordinates (0,0), (0, 21), (8, 21) and (8, 0) respectively.

The curved side ADB has equation $y = x^2 - 8x + 21$. Units are centimetres.

(i) Use integration to find the area of the metal plate.

$$\text{Area} = \int_0^8 \left(x^2 - 8x + 21\right)\mathrm{d}x = \left[\frac{x^3}{3} - 4x^2 + 21x\right]_0^8$$

$$= \left(\frac{512}{3} - 256 + 168\right) - (0) = \frac{248}{3}$$

.... **[4]**

(ii) The point D is the turning point of the curve.

Using differentiation, show that the coordinates of D are (4, 5).

$$\frac{dy}{dx} = 2x - 8$$

$= 0$ when $x = 4$

$\Rightarrow y = 5$

Coordinates of D are (4, 5)

... **[4]**

over

Mark scheme guidance

Question 5(i):

Evidence of integration (all powers increased by 1 but beware multiplication by x).

All three terms (ignore limits).

Limits applied correctly.

Accept 82.6 or anything that rounds to 82.7.

isw (i.e. taking 82.7 from 21×8).

Question 5(ii):

Diffn

Set = 0

x

y

Examiners comments

There were many correct answers here, though calculus is a topic that is not understood well by some candidates. In part (i) an answer with no working got no credit and without differentiation and appreciation that the turning point of the curve occurred where the tangent had zero gradient, part (ii) received few marks also. Some did gain a mark by correct differentiation but did not know what to do next.

Exemplar Candidate Work

Question 5(i) – low level answer

5 **(a)** A metal plate OADBC has three straight edges OA, OC and CB, and one curved edge ADB.

Fig. 3 shows the shape of the plate overlaid onto a Cartesian coordinate system (x, y), where corner O is located at the origin.

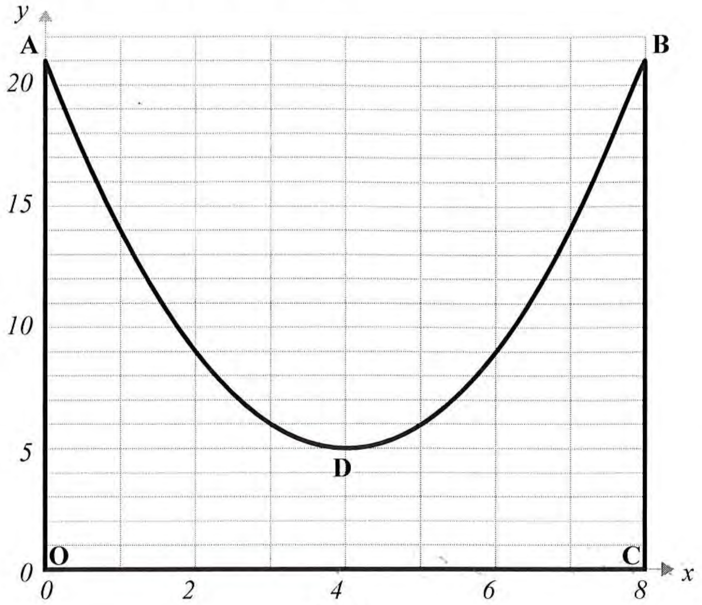


Fig.3

On a coordinate system the points O, A, B and C have coordinates (0,0), (0, 21), (8, 21) and (8, 0) respectively.

The curved side ADB has equation $y = x^2 - 8x + 21$. Units are centimetres.

(i) Use integration to find the area of the metal plate.

$y = x^3 - 8x^2 + 21x$

$\rightarrow y = x^3 - 4x^2 + 21x + C$

[4]

Commentary

There are some calculators which will give the answer to a definite integral. This question was designed to test the ability to integrate and so integration must be seen. In this answer it is clear that the candidate has integrated as two terms out of the three are correct. So although the correct mathematical notation has not been used some credit can be given for the attempt to integrate. It seems, however, that the candidate does not understand why integration is necessary or what result it will achieve. A deeper understanding of the fact that a definite integral will enable an area to be found would have led to an awareness of the limits and the calculation of the area.

Exemplar Candidate Work

Question 5(i) – high level answer

5 (a) A metal plate OADBC has three straight edges OA, OC and CB, and one curved edge ADB.

Fig. 3 shows the shape of the plate overlaid onto a Cartesian coordinate system (x, y), where corner O is located at the origin.

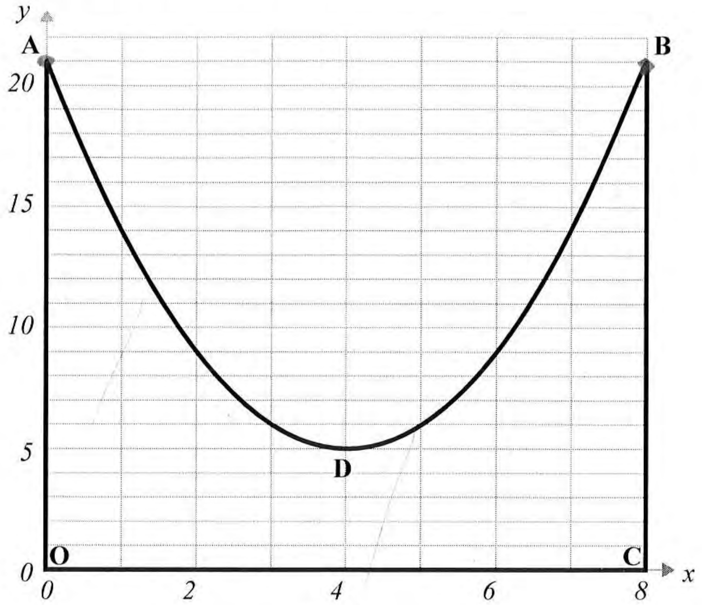


Fig.3

On a coordinate system the points O, A, B and C have coordinates (0,0), (0, 21), (8, 21) and (8, 0) respectively.

The curved side ADB has equation $y = x^2 - 8x + 21$. Units are centimetres.

(i) Use integration to find the area of the metal plate.

$\int = \frac{x^3}{3} - \frac{8 \times x^2}{2} + 21x + c$

$\int_0^8 = \frac{x^3}{3} - 4x^2 + 21x + c$

$\left[\frac{8^3}{3} - 4 \times 8^2 + 21 \times 8\right]_0^8 - [0]$ **[4]**

$= 82.7 \text{ unit}^2$

Commentary

This candidate understands that the area can be found using integration and the use of the correct limits. All working is shown including the fact that the substitution of the lower limit gives 0. The mathematical notation is not secure; the arbitrary constant of integration is introduced and the standard notation for a definite integral is not used. Nonetheless the process of finding the answer is worked through and the correct result is obtained.

Questions 6(a)

6 **(a)** A bag contains 50 small discs which are painted either red or blue. 40% of the discs are blue.

(i) John takes a disc at random from the bag, notes its colour then returns it to the bag before drawing a second disc at random.

What is the probability that both discs are red?

P(red) = 0.6 or (30/50)

P(both red) = $(0.6)^2 = 0.36$ (or $\frac{9}{25}$)

[2]

(ii) If instead, John does not return the first disc before drawing the second, what is the probability that they are both red?

P(both red) = $\frac{30}{50} \times$ *anything*

2nd fraction = $\frac{29}{49}$

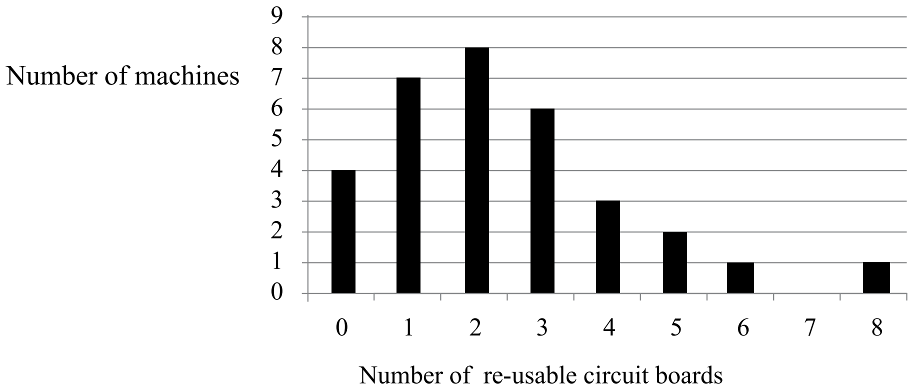
P(both red) = $\frac{30}{50} \times \frac{29}{49} = \frac{87}{245} \approx 0.355$

[3]

Questions 6(b)

(b) 32 electrical machines are to be scrapped. Each machine has a number of circuit boards that could be re-used. An electrical engineer removes the circuit boards from each machine to find out how many re-usable circuit boards there are in each one.

The bar chart below shows the findings.



(i) Find the median number of re-usable circuit boards in a machine.

Median is 16th value (or 16.5th value)
= 2

[2]

(ii) Find the modal number of re-usable circuit boards in a machine.

Mode = 2

[1]

(iii) Describe the skew of this distribution and explain what this means.

Positive skew, or skewed to the right
Explanation

[2]

Mark scheme guidance

Question 6(a)(i):

S.C. P(both blue) = 0.16 oe.

Question 6(a)(ii):

Treat P(both blue) as MR.

S.C. $\frac{29}{49}$ seen anywhere B1.

Question 6(b)(i):

Accept 2 www for 2 marks.

Question 6(b)(iii):

Accept "left skew" (only award if there is a description).

e.g. more data to the left longer tail to the right most machines have a small number of reusable boards data loaded towards zero.

Curves down in the positive direction.

Examiners comments

Those candidates who understood the difference in the two probabilistic situations in part (a), where replacement did and did not occur, scored well. Many candidates however did not understand the process of multiplying probabilities and so the difference in the two parts caused confusion.

In part (b) (i) and (ii) many candidates seemed to be unaware of the different averages used in different circumstances.

In part (iii) a wide range of answers were seen including left skew, right skew, negative skew, positive skew, skewed to the left, skewed to the right and several others. Candidates should have used the correct wording (positive skew), though in this instance other answers were accepted if they meant the same thing. It seemed as if candidates had an understanding of skew and its statistical implications but were unable to express themselves well.

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