Principal examiner reports for teachers

Principal examiner reports for teachers summarise what candidates did well and what candidates needed to improve for this examination series only.

This report is to be used in conjunction with the question paper and mark scheme.

For guidance on teaching and learning we provide resources for many of our syllabuses.

Resource	**Where to find it**
Grade descriptions – Grade descriptions describe the level of performance typically demonstrated by candidates achieving the different grades awarded for a qualification.	School support hub Select: Subject > Resource finder > Syllabus and specimen materials
Schemes of work – Schemes of work are designed to support you in your teaching and lesson planning.	School support hub Select: Subject > Resource finder > Teaching and learning
Lesson planning – Guidance on how to plan a lesson.	Lesson planning
Resource plus – There may be additional resources such as teaching packs containing lesson plans, resources and worksheets and videos for aspects of your syllabus.	School support hub Select: Subject > Resource finder > Teaching and learning
Teaching tools	Teaching Tools
Exemplar candidate responses	School support hub Select: Subject > Resource finder > Teaching and learning
Learner guide – A guide for students to help them understand what the course involves.	School support hub Select: Subject > Resource finder > Teaching and learning
Community forums – Do you have a question or something to share? Our online forums are great way to keep up to date with your subject and the global Cambridge community.	Community forum on the school support hub
Access to scripts for this series.	Access to scripts service
Results analysis is available for some syllabuses.	Results analysis
Test maker is available for some subjects.	Test maker

Other services from Cambridge International Education

- **Digital mocks service**
- **Insight assessments**
- **Professional development**
  - Focus on assessment
  - Online marking workshops

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ADDITIONAL MATHEMATICS

Paper 0606/12
Non-calculator

Key messages

What candidates did well

- Most candidates answered questions fully, showing that they had read questions carefully.
- The majority of candidates were able to analyse problems and identify a suitable strategy to solve them, including using combinations of processes where appropriate.
- Many candidates communicated their methods and results in a clear and logical form.
- Most candidates attempted to answer all questions.
- Some candidates checked their answers.

What candidates needed to improve

- Some candidates needed to refer to the List of formulas given on page 2 of the examination paper. This would have helped them to avoid incorrectly recalling formulas that are given to them.
- A few candidates needed to read each question more carefully to interpret all key statements and use all the information given.
- A few candidates needed to take more care with their arithmetic as some slips in accuracy were seen.
- Some candidates used sheets of additional paper headed Rough Work. Candidates should be aware that rough jottings, written in various orientations on the page with no question number indicated, generally cannot be considered as part of a solution. If work is written on additional sheets of paper, even if it is considered by the candidate to be rough work, it should be numbered and written neatly so that it can be marked as part of the solution if needed. Some responses could be improved by ensuring that working from rough notes is accurately transferred to the answer space.

Comments on specific questions

Question 1

(a) **Comprehensive responses**

- Most candidates successfully used the factor theorem, with $x = -2$, to answer this part of the question.

Limited responses

- A small number of candidates incorrectly used the factor theorem with $x = 2$.
- Few candidates used algebraic methods, and some responses could be improved by setting out the algebraic steps more clearly.

(b) **Comprehensive responses**

- Very many candidates offered fully correct solutions.
- A good number of candidates solved $x^2 = \frac{1}{4}$, which was fairly simple.

Limited responses

- A few candidates omitted to state $x = -2$ as a solution.
- A few candidates omitted $x = -0.5$ as they forgot to include the negative square root.
- Some of the candidates who factorised $4x^2 - 1$ stated factors of $(4x - 1)(4x + 1)$, for example.
- A small number of candidates misinterpreted the question and gave $(x + 2)(2x - 1)(2x + 1) = 0$ as their answer.

Question 2

(a) Comprehensive responses

- Most candidates attempted to draw a smooth curve that was clearly an attempt at the modulus of a quadratic function.
- Most candidates indicated the correct *y*-intercept.
- Candidates usually indicated the correct *x*-intercepts.

Limited responses

- Some candidates drew graphs that clearly had ruled sections.
- A few candidates stated incorrect *x*-intercepts.
- A few candidates omitted to state some or all of the intercepts.
- Some candidates drew their local maximum on the *y*-axis.
- Candidates who plotted and joined points needed to ensure that the shape of their graph accurately reflected the data points.

(b) Comprehensive responses

- Very many candidates offered a fully correct response.
- Candidates who were the most successful, inverted the function using a series of steps, each of which changed a single operation.

Limited responses

- Some candidates needed to set out each method step clearly to avoid sign or arithmetic slips in their solution and offered, for example, $y = 2 + \ln\frac{x-1}{4}$ or $y = -\frac{1}{2}\ln\frac{x+1}{4}$.
- A few candidates used either an incorrect order of operations or used a completely incorrect operation. For example, incorrect method steps seen were $4e^x \times \frac{1}{16} = y + 1$ and $\ln(x - 1) = 4(x - 2)$.
- A few candidates omitted to swop the variables and offered an expression in *y* rather than *x*.

Question 3

(a) Comprehensive responses

- Some candidates drew a completely correct, ruled line from (0, 0) to (4, 3).
- Many candidates showed working to derive the point (4, 3).

Limited responses

- The majority of candidates drew a straight line from (0, 0) to a point with an *x*-coordinate of 4. Many candidates drew their line from (0, 0) to (4, 6) misinterpreting the given displacement as the velocity. Many other candidates drew a line from (0, 0) to (4, 1.5), using $\text{velocity} = \frac{\text{displacement}}{\text{time}}$.
- A few candidates drew lines that were not ruled.
- Some candidates drew curves, not straight lines.

(b) Comprehensive responses

- Many candidates offered a correct solution for their linear velocity-time graph from part **(a)**.

Limited responses

- A few candidates who had drawn curves in part **(a)** were unable to offer a valid solution in this part as their graphs did not justify a constant acceleration.
- A few candidates attempted to use suvat equations and sometimes this was done incorrectly. Knowledge of suvat equations is not needed for this syllabus.
- Some candidates did not interpret the acceleration as the gradient of their line. For example, some candidates evaluated the area of the triangle with vertices (0, 0), (4, 0) and (4, their 3).

Question 4

Comprehensive responses

- Most candidates offered fully correct solutions, usually making use of the sum to n terms formula given on page 2 of the examination paper.

Limited responses

- Some candidates used an incorrect formula for the sum to n terms.
- A few candidates made arithmetic slips after forming $4a - 12 = 10a - 90$. For example, some candidates offered $a = \frac{-72}{-6} = 12$ or $-6a = 78$, $a = -13$.
- A few candidates needed to set out each step clearly when simplifying the equation. For example, $2(2a - 6) = 5(2a - 18)$ sometimes became $4a - 12 = 10a - 18$.

Question 5

Comprehensive responses

- Many candidates gave fully correct responses.
- Many candidates organised their response well, stating the general form of the quotient rule and then listing the four components they needed.
- A few candidates rewrote the function as a product and successfully used the product rule.
- Most candidates who had stated a correct derivative went on to form $-x^2 + 6x - 8 = 0$, or the negative version of this.

Limited responses

- Some candidates did not use the correct structure of the quotient rule. For example, candidates sometimes reversed the numerator or omitted to square the denominator.
- Candidates who attempted to rewrite the function as a product did not always do this correctly. For these candidates, this approach could be improved by setting out each step clearly to avoid slips in calculation.
- Some candidates needed to set out each step clearly when manipulating the equation after equating the derivative to 0. For example, a few candidates equated both the numerator and the denominator to 0 and solved both equations, leading to an extra, spurious point. A few other candidates attempted to solve $-x^2 + 6x - 8 = (3 - x)^2$ or similar.
- A small number of candidates went on to find an expression for the second derivative, equated that to 0 and attempted to solve.
- Some candidates made sign slips when finding the length of PQ such as $\sqrt{(4-2)^2 + (-8-4)^2}$.

Question 6

(a) **Comprehensive responses**

- Most candidates offered a fully correct response.
- Forming and solving two linear equations was quite common. This was usually successful. Forming and solving a quadratic equation was also seen. Some candidates used both approaches to check their solutions.

Limited responses

- A few candidates stated two correct linear equations and made a slip when solving one of them.
- A few candidates formed one linear equation only.

(b) **Comprehensive responses**

- Many candidates stated a fully correct response.
- Squaring both sides of the inequality seemed to be the more popular approach.

Limited responses

- Some candidates needed to set out each step clearly when expanding brackets after squaring both sides of the inequality
- Some responses could be improved by showing all steps when forming two linear inequalities or equations.

- A few candidates found the correct critical values, 1 and 5, and then stated an incorrect final answer such as $1 > x > 5$ or $x > 1$, $x > 5$ or $1 < x < 5$.
- A few candidates formed one linear inequality or equation only.

Question 7

Comprehensive responses

- Many candidates offered a fully correct solution.
- Most candidates stated a correct derivative.
- Many candidates were able to recall and use a correct small changes relationship.

Limited responses

- Some candidates only successfully differentiated the term $3\sqrt{x}$. Some candidates needed to set out each step clearly when differentiating the second term were to rearrange it and forget to differentiate it or to omit to multiply by $-\frac{1}{2}$.
- Some candidates rewrote the given expression as a single algebraic fraction and attempted to use the quotient rule. This was not always successful.
- A few candidates omitted to use $x = 4$ and gave their answer as a product of h and an expression in x.
- A few candidates used $4 + h$ as the increase in x or as x itself.
- Some responses could be improved by showing all steps when evaluating the derivative at $x = 4$.

Question 8

(a) **Comprehensive responses**

- Very many candidates stated a fully correct derivative.

Limited responses

- Some responses could be improved by ensuring the use :wof product rule or to differentiate e^{2x+1} as $(2x + 1)e^{2x+1}$.

(b) **Comprehensive responses**

- Most candidates understood the link to part **(a)**, used their derivative to find the gradient of the tangent at $x = 4$ and then progressed to complete the solution.

Limited responses

- A few candidates found the x-intercept and y-intercept and did not state their answer as pairs of coordinates.
- Some candidates were unable to simplify terms in powers of e. For example, $e^2 + e^2$ was sometimes given as e^4 and $2e^2x = \frac{1}{2}e^2$ was either simplified as $x = 1$ or left in the form $\dfrac{\frac{1}{2}e^2}{2e^2}$.
- A few candidates used their derivative to find the gradient of the tangent at $x = 4$ and then found the perpendicular gradient and formed the equation of the normal.
- A few candidates used an incorrect approach and attempted to solve their $\frac{dy}{dx} = 0$.

(c) **Comprehensive responses**

- A good number of candidates offered fully correct responses. Most of these solutions were well presented, clear and made one single change in each step.
- Some candidates successfully started from $\int 2xe^{2x+1}dx + \int e^{2x+1}dx = xe^{2x+1} + c$. Other candidates started from $\int xe^{2x+1}dx = \frac{1}{2}\int\left(2xe^{2x+1} + e^{2x+1}\right)dx - \frac{1}{2}\int e^{2x+1}dx$ and were equally successful.

Limited responses

- Some candidates omitted to include a constant of integration in their final step. Without a constant of integration, the solution is considered to be incomplete.
- Candidates who carried out more than one change could improve by showing all steps clearly.
- A few candidates omitted to replace y with xe^{2x+1}.

- Some candidates were unable to integrate e^{2x+1} correctly.
- A few candidates made no attempt to use the answer to part **(a)**. These candidates offered answers such as $\int x\,dx \times \int e^{2x+1}dx = \frac{x^2}{2} \times \frac{1}{2}e^{2x+1}$.

Question 9

(a) (i) **Comprehensive responses**

- Many candidates offered a correct vector in *t*.

Limited responses

- A few candidates misinterpreted 'at time *t*' to mean when $t = 0$.
- Most candidates used a correct vector form. A few candidates used an incorrect form such as $\begin{pmatrix}(-3+4t)\mathbf{i}\\(4-2t)\mathbf{j}\end{pmatrix}$ or $\begin{pmatrix}4\\-2\end{pmatrix}t+\begin{pmatrix}-3\\4\end{pmatrix}$.
- A few candidates, perhaps, needed to read the question more carefully as the answer $\begin{pmatrix}-3\\4\end{pmatrix}t$ was sometimes offered.

(ii) **Comprehensive responses**

- A good proportion of candidates offered correct solutions.
- Most of these candidates equated the position vectors of *A* and *B* at time *t* and showed there to be an inconsistency either in time or position.
- A few of these candidates correctly showed that it was not possible for the distance between *A* and *B* to be 0.

Limited responses

- A few candidates made arithmetic slips when solving equations they had formed.
- Some candidates equated the position vectors of *A* and *B* at time *t* and then formed and solved one equation only. These candidates usually stated that the particles collided as a positive value of *t* existed. Other candidates formed, and correctly solved, a pair of equations then stated that the particles collided twice.
- Some candidates attempted to argue that the particles collided based on an approach which only checked whether the particles could be the same distance from the origin at the same time. These solutions made no attempt to consider the direction of the particles.

(b) **Comprehensive responses**

- Candidates used a variety of successful approaches to solve this part of the question.
  For example, some candidates used an efficient approach, such as finding $\overrightarrow{RS} = \pm\frac{1}{2}\overrightarrow{QR}$ either from the ratio of the lengths of $\overrightarrow{RS}$ and $\overrightarrow{QR}$ or using $\overrightarrow{RS} = k\overrightarrow{QR}$ and $16k^2 + 4k^2 = 5$.
  Some candidates were successful with methods that involved forming two equations in *a* and *b* and solving these simultaneously.
  Some candidates formed one equation in *a* and *b* and then found expressions in terms of a third variable, *k*, which they used to eliminate both *a* and *b*.
- Many candidates made good use of a helpful sketch.

Limited responses

- Many candidates attempting a method based on $\overrightarrow{RS} = k\overrightarrow{QR}$ omitted one of the possible values of *k* and stated one value for each of *a* and *b*.
- Some candidates who found $\pm(-2\mathbf{i}+\mathbf{j})$ stated answers of $a = \pm 2$ and $b = \pm 1$. Some of these candidates had stated $\overrightarrow{RS} = \pm(-2\mathbf{i}+\mathbf{j})$. These candidates, perhaps, did not interpret the position vector of *S* correctly.
- Some candidates were able to form one correct relationship between *a* and *b* ad made no real progress beyond this step in their solution.
- Several candidates stated a correct, useful vector, such as $\overrightarrow{QR}$, $\overrightarrow{RS}$ or $\overrightarrow{QS}$, and made no real progress after this statement.

- Working was not always well-presented. Candidates who were attempting several different approaches often offered solutions that were disorganised.

Question 10

(a) **Comprehensive responses**

- Many candidates offered fully correct solutions to this part of the question.
- Most candidates changed the base of the third term in the equation, so that all logarithms had base 5.
- Candidates who stated and made a substitution such as $y = \log_5 x$ leading to $y - \frac{3}{y} = 2$, before they rearranged their equation, were usually successful.

Limited responses

- Candidates who found $\log_5 x = -1$ and $\log_5 x = 3$ sometimes incorrectly discarded $\log_5 x = -1$.
- Candidates who found $x = \frac{1}{5}$ and $x = 125$ sometimes incorrectly rejected $x = \frac{1}{5}$.
- Some candidates needed to set out each step clearly when rearranging the equation after they had changed the base. For example, candidates who omitted the brackets in $(\log_5 x)^2$, and instead wrote $\log_5 x^2$.

(b) **Comprehensive responses**

- Candidates used a variety of exponential functions to solve this part of the question. Some candidates formed and solved a quadratic equation in 2^{3x}. A few candidates solved quadratics in 8^x, 2^{3x+2}, 2^{3x+4} or 2^{3x+1}.
- Many candidates rejected the negative solution from their equation.

Limited responses

- Only a few candidates incorrectly stated a value from the negative solution. These candidates usually stated $x = \frac{\log_2(-1)}{3}$, or similar.
- Some candidates needed to set out each step clearly when factorising their quadratic equation.
- Some candidates were unsuccessful in writing the equation in a solvable quadratic form.
- Some candidates used laws of indices in an invalid way. For example, $2^{6x+4} - 3 \times 2^{3x+4} = 64$ sometimes became $2^{\frac{6x+4}{3x+4}} - 3 = 64$ or similar.
- A few candidates used logarithms in an invalid way. For example, $\log(2 \times 8^{2x+1}) - \log(3 \times 2^{3x+4}) - \log 64 = 0$.

Question 11

Comprehensive responses

- Some candidates were able to find the correct x-intercepts and use these as the limits of their integral. Many of these candidates factorised, some used the quadratic formula.
- Most of the candidates who had made a valid attempt to find the limits of the integral integrated the expression of the curve correctly.

Limited responses

- Some candidates made algebraic or arithmetic slips in the final steps of their solution when simplifying and solving the equation in a that they had derived.
- Some slips were made when substituting the limits into the integral.
- A few candidates attempted to integrate $x^2 - 3ax + 2a^2$.
- Occasionally, candidates made sign slips when finding the x-intercepts of the curve.
- Many candidates were unable to identify a suitable strategy to find the limits they needed.
- Working was not always well-presented.

Question 12

Comprehensive responses

- Success in this question depended on candidates identifying a correct process to find a simple relationship between x and y that could be used to eliminate one of the unknowns.
- Some candidates subtracted the equations of the circles to find the correct equation of the common chord. This was an efficient approach.
- Some other candidates rewrote the given equations as $(x + 1)^2 + (y – 2)^2 = 25$ and $(x – 6)^2 + (y – 3)^2 = 25$ and then rearranged to make either y or x the subject. This approach resulted in more-complicated algebra involving square roots.

Limited responses

- Some candidates who subtracted the equations of the circles to find the correct equation of the common chord could improve by setting out each step clearly. For example, the relationship $y = –7x$ was stated by candidates who equated the two equations and incorrectly cancelled the –20 on one side with the +20 on the other.
- Some candidates attempted to rewrite the given equations as $(x + 1)^2 + (y – 2)^2 = 25$ and $(x – 6)^2 + (y – 3)^2 = 25$ and made a slip when doing so.
- Some candidates who rewrote the given equations as $(x + 1)^2 + (y – 2)^2 = 25$ and $(x – 6)^2 + (y – 3)^2 = 25$ and then rearranged to make either y or x the subject omitted to take the negative square root. This resulted in one of their points of intersection being incorrect. Some candidates who rewrote the given equations as $(x + 1)^2 + (y – 2)^2 = 25$ and $(x – 6)^2 + (y – 3)^2 = 25$ then stated $(x + 1)^2 + (y – 2)^2 = (x – 6)^2 + (y – 3)^2$. These candidates often treated this as an identity and went on to solve $(x + 1)^2 = (x – 6)^2$ and $(y – 2)^2 = (y – 3)^2$.
- Some candidates were unable to find an expression with x or y as the subject.
- Working was not always well-presented. Candidates who were attempting several different approaches often offered solutions that were disorganised.

ADDITIONAL MATHEMATICS

Paper 0606/22
Calculator

Key messages

What candidates did well

- Many candidates produced well thought out and clearly presented solutions.
- Candidates demonstrated a clear knowledge of the syllabus and were able to apply appropriate mathematical techniques.

What candidates needed to improve

- Candidates need to work to a sufficient degree of accuracy so that non-exact answers can be given correct to three significant figures for non-exact answers and angles in radians, with angles in degrees being given to one decimal place.
- Candidates should ensure they are meeting the demands of the question, as in **Question 3**, where the solutions need to come from a graph and not a calculator.
- Candidates should make more use of diagrams to help understand a situation.

Comments on specific questions

Question 1

(a) **Comprehensive responses**

- Most candidates were able to write the given expression in the correct form.

Limited responses

- Where errors were made, they occurred in the calculation of *b* and *c*.

(b) **Comprehensive responses**

- Many candidates identified the range from using their answer to part **(a)**.

Limited responses

- Some candidates made sign errors, notation errors or assumed the range was the set of real numbers.

(c) **Comprehensive responses**

- Fewer candidates identified the value of *k* using their answer from part **(a)**.

Limited responses

- Errors included the incorrect use of *x* or *k*, or not making use of the answer to part **(a)**.

(d) **Comprehensive responses**

- Most candidates used the correct order of operations to obtain an unsimplified expression.
- Most candidates continued to correctly simplify their correct unsimplified expression to obtain an acceptable form of the answer.

Limited responses

- Some candidates did not simplify $(e^{3x})^2$ correctly.
- Some candidates used the incorrect order of operations.

Question 2

(a) **Comprehensive responses**

- Most candidates found the midpoint of line *AB* and the gradient of a line perpendicular to *AB*. Many then found the equation of the perpendicular bisector and substituted $x = 2$ to find the correct value of *a*.

Limited responses

- The main error was the use of the coordinates of the points A or B, rather than the midpoint to find the equation of the perpendicular bisector.
- Other errors were usually arithmetic, for example, an incorrect midpoint coordinate or gradient.

(b) **Comprehensive responses**

- Many candidates drew a diagram and used displacement vectors to obtain the correct coordinates of the reflection.
- Other methods were acceptable but tended to be less successful.

Limited responses

- Some candidates assumed that the coordinates of the point of reflection were obtained by changing the sign of each of the original coordinates.

Question 3

Comprehensive responses

- Most candidates drew in the line y = 7 on the given graph.
- Many candidates obtained some of the critical values to the required level of accuracy and used them to obtain a correct acceptable range.

Limited responses

- Candidates made use of their calculators to solve the given inequality. The inequality needed to be solved using the graph not a calculator, as in the demand of the question.
- Some candidates drew in an incorrect line on their graph.
- Some candidates used incorrect signs.
- Some candidates used over accurate values which cannot be read off the graph.

Question 4

(a) (i) **Comprehensive responses**

- Most candidates obtained the correct answer.

Limited responses

- A few candidates used combinations instead of permutations.

(ii) **Comprehensive responses**

- Many candidates obtained the correct answer.

Limited responses

- Some candidates obtained 6720. This needed to be multiplied by 6 in order to get the total number of 6-digit numbers.

(b) **Comprehensive responses**

- Many candidates obtained a fully correct solution.
- Many candidates showed the method of approach that they were using. There were two possible methods. The first and more concise method involved considering 3 separate situations, for example, 2 girls and 4 boys, 3 girts and 3 boys, and 4 girls and 2 boys. The second method involved a lengthier subtraction method.

Limited responses

- Some candidates using the subtraction method did not consider all the appropriate cases.

Question 5

(a) **Comprehensive responses**

- Most responses were given in terms of radians.

Limited responses

- Very few incorrect answers were seen.

(b) **Comprehensive responses**

- Many candidates showed a clear and correct method to find the area of the shape.
- Many candidates were able to find the area of a relevant sector, relevant triangle and then a relevant segment.

Limited responses

- Most errors were due to an incorrect plan. There were several acceptable methods. Some candidates omitted relevant errors or added extra areas,

Question 6

(a) (i) **Comprehensive responses**

- Most candidates realised that *x* was measured in degrees so a correct answer in degrees was the only acceptable answer.

Limited responses

- Some candidates gave their answers in radians.

(ii) **Comprehensive responses**

- Many candidates gave a correct answer in terms of degrees.

Limited responses

- Some candidates gave their answer in radians.
- Some candidates did not know w.

(b) **Comprehensive responses**

- Many candidates sketched completely correct curves.

Limited responses

- Some candidates did not indicate the curve tending towards a maximum point at the endpoints.
- Some candidates used an incorrect period.
- Some candidates used an incorrect amplitude.

Question 7

(a) **Comprehensive responses**

- Many fully correct solutions were seen.

Limited responses

- Some candidates did not show that the value of v gave a minimum point.
- Some candidates made errors in differentiation of C with respect to v.
- Some candidate rounded their answer to as 11.5 rather than 11.4.
- Some candidates did not show enough reasoning when showing the value of C to be a minimum.

(b) **Comprehensive responses**

- Many candidates calculated the cost per hour, using their value of v and the number of hours that the journey would take. There was a range of acceptable answers due to the different possible places where the candidates could have approximated their answers.

Limited responses

- Some candidates did not use 150 km in the correct context.

- Some candidates calculated the cost per hour of the journey.

Question 8

Comprehensive responses
- Many candidates produced a completely correct, well set out solution. The final answer was acceptable in either exact or decimal form.

Limited responses
- A few candidates obtained an incorrect equation for the circle, with either sign errors or incorrectly equating their equation to 5 rather than 25.
- Some arithmetic or algebraic slips were made when simplifying work to obtain a quadratic equation in terms of x and k.
- Some candidates made arithmetic or algebraic slips when using the discriminant of their quadratic equation.
- Some candidates, having obtained an incorrect 3-term quadratic equation in terms of k, made use of their calculator to solve this incorrect quadratic equation. Candidates are recommended to use either a factorisation method or the quadratic formula to solve quadratic equations and then use their calculator as a check.

Question 9

(a) **Comprehensive responses**
- Most candidates produced a completely correct solution, showing sufficient detail.

Limited responses
- Candidates who did not write the expression in terms of sin x and cos x initially were less successful with simplification.
- 1/cosx needs to be typeset as a proper fraction (i.e. like the 1/2 in responses to (b)).

(b) **Comprehensive responses**
- Many candidates understood the meaning of the word 'Hence' in the stem of the question and used part **(a)** to obtain the equation $\sin 2x = \frac{1}{2}$.
- Most candidates were able to obtain at least 2 of the acceptable solutions for the equation.

Limited responses
- Some candidates did not use a double angle and solved $\sin x = \frac{1}{2}$.
- Some candidates did not give all the relevant solutions,
- Some candidates gave too many solutions which included incorrect solutions.

(c) **Comprehensive responses**
- Most candidates used a correct trigonometric identity to obtain a correct equation in terms of either $\cos(x – 1)$ or $\sec(x – 1)$.
- Many candidates were able to obtain the correct solution of 2.23 radians.

Limited responses
- Candidates who used a quadratic equation in terms of cosine obtained incorrect solutions from considering $\cos(x – 1) = 0$. These solutions were not checked in the original equation. This would have shown that these solutions were impossible.
- Many candidates obtained an answer of – 0.23 radians rather than – 0.231 radians. Angles in radians should be given correct to 3 significant figures.

Question 10

(a) **Comprehensive responses**
- Many correct solutions were seen.
- Most candidates integrated the acceleration function correctly and found the correct value of the constant of integration.

- Correct solution of the resulting expression for the velocity equated to zero was obtained by most candidates.

Limited responses
- A few candidates omitted the arbitrary constant when integrating.

(b) (i) **Comprehensive responses**
- Many correct solutions were seen.
- Most candidates integrated the velocity function correctly and found the correct value of the constant of integration.

Limited responses
- Some candidates made arithmetic errors.

(ii) **Comprehensive responses**

- This question part was quite demanding and fewer completely correct solutions were seen.
- More successful candidates often drew a sketch and realised they needed to consider the displacements at times when t = 0. 3 and 6.

Limited responses
- Many candidates did not use a correct method, with many making a substitution of t = 6 into their response to part **(b)** and not considering any other displacements.
- Some candidates, having considered the correct times, did not change a displacement of – 4.5 to 4.5 in their final calculation.

Question 11

(a) **Comprehensive responses**
- Most candidates were able to give each of the first three terms in descending powers of x and simplify them correctly.

Limited responses
- Some candidates gave the first three terms in ascending powers of x.
- Some candidates made arithmetic errors when simplifying the terms.

(b) **Comprehensive responses**
- Only candidates who made use of the general term made any real progress unless a fully reasoned explanation was given.
- Many candidates were able to obtain either n = 3r or n = 1.5r depending upon which method had been used.
- Few candidates stated that r had to be an integer, or equivalent, with completely correct working.

Limited responses
- Candidates who made a purely numerical approach were unable to progress with the solution which required an algebraic approach.