Coursework reports 2014–2015

CO0001 Mathematics for business

Test 1

Question 1

This question involved using a given formula by substituting in values for its variables. It tested the ability of candidates to interpret the question and carry out the necessary operations on their calculator to arrive at the required solution. In part (a) this entailed finding $3^{1/18} - 1$. In (b) finding $(40{,}000/20{,}000)^{1/10} - 1$ and in (c) rearranging $1.04 = (A/5{,}000)^{1/20}$). Many candidates were able to carry out the first two of these calculations but struggled with the third. One way to proceed would be to raise both sides to the power of 20 and then multiply the left hand side by 5,000 to give A.

It is necessary to be as accurate as possible and to be familiar with the facilities of the calculator you are using. If giving a solution correct to, say, two decimal places the working should be carried out to at least three decimal places throughout, prior to correcting back to two decimal places at the final stage.

Question 2

In this question a demand function is given in terms of the variable q which represents the quantity of the item. Candidates were asked to sketch the graph of this function, showing the points where the graph meets the axis. This is easily done by setting first $q = 0$ to give $p = 120$, and then setting $p = 0$ and re-arranging the equation to give $q = 30$. The two points thus found are (0, 120) and (30, 0) if X is on the horizontal axis and C on the vertical axis. It is good practice to find another point as a check such as $q = 10$, $p = 80$. The line joining the two intercepts should pass through the extra point too, otherwise candidates need to check their calculations. Appropriate scales should be used on the axes.

In part (b) the corresponding supply function was given and candidates were asked to find the equilibrium price. This is a common question that candidates should be familiar with and be able to calculate using a method for solving simultaneous equations, as here we have two linear equations and their solution gives the value of p at equilibrium and also the value of q at equilibrium. Thus we have $q = 21$ and $p = 36$. It is good practice, having found the solution, to check it by substituting into one of the original equations which it should satisfy if correct. Many candidates had difficulty dealing with the fraction in the supply function. One way round this would be to multiply it through by 3 to give $3p = q + 57$ and then solve this with the demand equation. There were many errors in dealing with the subtraction of negative numbers in this process.

Part (c) asked whether a quantity of 12 brings a shortage or surplus to the market. If this is substituted in to the demand equation, it gives the result 72 and in the supply equation it gives 33. So it can be seen that this quantity means demand is greater than supply and that gives a shortage. Some justification for saying a shortage would result was required, such as substituting into the two equations and comparing the results.

Question 3

In the first part of this question candidates were asked to solve a quadratic equation and a hint was given that the formula would be needed by asking for the solutions to be given to two decimal places. This is standard bookwork and candidates should ensure they know the formula and how to apply it and use their calculators appropriately to produce the solutions.

In part (b) a related profit function was given where the variable was q rather than x. The solutions to (a) are the same as the roots of this function as its graph will pass through points that are solutions to $-2q^2 + 5q - 1 = 0$ which are also solutions to $2q^2 - 5q + 1 = 0$ and are the same as the solutions to (a). They are the break-even points of this profit function and the points where profit is zero. A sentence such as this last one would be an adequate answer to this part of the question.

In (c) the value of q which gives maximum profit occurs half way between the roots or break-even points found above. Alternatively, this may be found by differentiating the profit function with respect to q and setting this derivative to zero and solving for q. Both methods give $q = {}^5/_4$.

The maximum profit itself is found by substituting this value of q into the original profit equation.

Some candidates found q but lost a mark by neglecting to find the corresponding value of p.

Question 4

In part (a) the right hand side of the equation should be multiplied out first to give $5x = 3x + 12$. Subtracting $3x$ from both sides gives $x = 6$.

In part (b) both sides of the equation could be multiplied by x to give $1 = {}^3/_4\,x + 1.x$ which becomes $1 = {}^7/_4\,x$ and then multiplying both sides by ${}^4/_7$ gives $x = {}^4/_7$. Many candidates who proceeded this way did not multiply both terms on the right hand side by x.

Another way to proceed would be to add the numbers on the right hand side of the original equation to give ${}^1/_x = {}^7/_4$ and multiply both sides by x to give the solution.

In part (c) multiplying the brackets out gives a quadratic equation in x which can then be re-arranged to give $x^2 = 36$. This can be square-rooted giving the solutions $x = 6$, $x = -6$. Many candidates failed to give the negative root solution. Some could not multiply out the original two brackets to get $x^2 - 25 = 11$ and others, having done this, could not add 25 to both sides correctly.

Question 5

In (a) the point $p = 60$, $q = 60$ should satisfy all of the inequality constraints if it lies in the feasible region. It does satisfy the first constraint. However it does not satisfy the second as $p + q = 120$ which is not less than 110. Therefore, the point does not lie in the feasible region. Some such justification was required.

To find the corners of the feasible region in part (b) the points where the lines $3p + 2q = 300$ and $p + q = 110$ cut the axes must be found and sketched. Also the point where these two lines intersect needs to be calculated and this may be done by solving the two equations simultaneously to give $p = 80$ and $q = 30$. The fourth corner is thus (80, 30).

In (c) the value of the profit function should be calculated at each of the four corners, i.e. (0, 0), (0, 110), (80, 30) and (100, 0). Substituting these points into the profit function gives maximum profit of 410 at (80, 30).

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Test 2

Question 1

Part (a) of this question involved finding various composite functions of *f(x)* and *g(x)*. Candidates were not required to simplify the resulting functions so it was not a test of algebraic manipulation but rather of understanding how functions operate and how they can be combined. Some candidates confused *g(f(x)),* where *f* is applied first to give an input of 3*x* into the function *g* which results in the correct solution, $\sqrt{3x}$, with *f(g(x))* where *g* is applied first and then input into the function *f.*

In part (b) of this question candidates were asked to calculate the derivative of *y* with respect to *x* for three functions. The first requires knowledge of the product rule or can be done by multiplying out the brackets and then differentiating, the second knowledge of the chain rule and the third may be most simply evaluated by applying laws of indices to give $y = 1/x^{1/2}$ which becomes $y = x^{-1/2}$. This has a derivative with respect to *x* of $-\frac{1}{2}x^{-3/2}$ with no need to simplify further. There is no need to use the quotient rule here, though if correctly applied it results in an equivalent answer.

Question 2

The dimensions of *A* are 3×2 and of *B,* 1×3 and of *C,* 3×2.

Thus in part (a) only *BA* and C^tA are valid matrices since the number of columns of the first matrix is equal to the number of columns of the second matrix.

In part (b) these two products were to be computed.

It was notable that a considerable number of candidates could not carry out a matrix multiplication correctly and had not learnt the method for doing so. Some knew what to do in principle but encountered difficulties dealing with multiplication of negative numbers.

Question 3

The first part of this question asked candidates to write the two given series using Sigma notation, a general term and appropriate upper and lower limits. Thus they needed to work out the number of terms in the series and whether it was a GP or another type of series. In (a) i, we have an Arithmetic Progression where the constant 4 is added to one term to obtain the next, the first term is $a = 2$, the second is $2 + 4$, the third is $2 + 4 + 4$. If we call the last term the *n*th, it can be seen as $2 + (n - 1)\,4 = 130$. We may find *n,* the number of terms, by solving this equation to give $n = 33$. So we have a general term of $2 + (k - 1)4$ and lower limit of $k = 1$ and upper limit of $k = 33$.

In (a) ii, which is a GP, the first term is $a = 2$ and the common ratio $r = 4$. Here *n* may be found by solving the equation $2.4^{n-1} = 2(19683)$. Dividing both sides by 2 and taking logs we get $n = 10$. So this series has general term 2.4^{k-1} and lower limit $k = 1$ and upper limit $k = 10$.

For part (b) the sum of the second of these series can be found by substituting the relevant values of a, r and n into the formula for the sum of a geometric progression.

Question 4

The cubic equation with these roots has the linear factors $(x - 2)$, $(x + 3)$, (x).

In part (a) these are multiplied together to give $x^3 + x^2 - 6x$ and thus the required equation is $y = x^3 + x^2 - 6x$.

In (b) the graph of this equation is a cubic curve. Candidates should be aware of the general shape of a cubic curve and also know the difference between this type of curve and a quadratic curve. Some confused the two.

Clearly the curve cuts the x axis at $x = -2$, $x = 3$ and $x = 0$. It cuts the y axis at $y = 0$. The curve lies above the x axis between $x = -3$ and 0 and lies below the x axis between $x = 0$ and $x = 2$. Candidates may plot a few extra points to check the value of y, maybe where $x = -1$ and $x = 1$. However, unless these checks are correct they may confuse the issue.

In (c) the area is calculated in two stages, since the area below the axes is found by integration giving a negative result which is then corrected to give a positive area. Here we integrate the function between the limits $x = 0$ and $x = 2$ which gives $-6\,^2/_3$. The positive number $6\,^2/_3$ is then added to the other area found between $x = -3$ and $x = 0$ to give the solution $12\,^{11}/_{12}$ square units.

Question 5

In (a), the indefinite integral with respect to x is $3x + {}^{x^2}/_2$. Then the upper and lower limits are calculated and the second result subtracted from the first. Candidates should be aware of the integral notation and the use of square brackets and the placing of the limits after them.

In (b) the indefinite integral using the chain rule is $^1/_8\,(1 + 2x)^4$ and again the limits should be substituted appropriately to evaluate the solution. It is also possible to carry out the integration by expanding the cubed bracket, combining relevant terms and integrating term by term. However, this is a much longer method prone to more errors.

In part (c) the indefinite integral is $^1/_5\,e^{5x}$ and upper and lower limits should be calculated to give the final solution of 4375.61 correct to two decimal places.