CM

A Level Maths Question Countdown

3 days until the 1st exam

Information

- Each of the ten sheets will contain five pure questions and two applied questions.

Pure questions

- Two of the pure questions will be 'standard'.
- Two of the pure questions will be 'problems'.
- The last pure question will involve modelling.

Applied questions

- One of the questions will focus on statistics.
- One of the questions will focus on mechanics.
- On alternate days, the statistics question will look at the large data set. Note that these questions may be brief as opposed to full length exam questions.

Notes to self

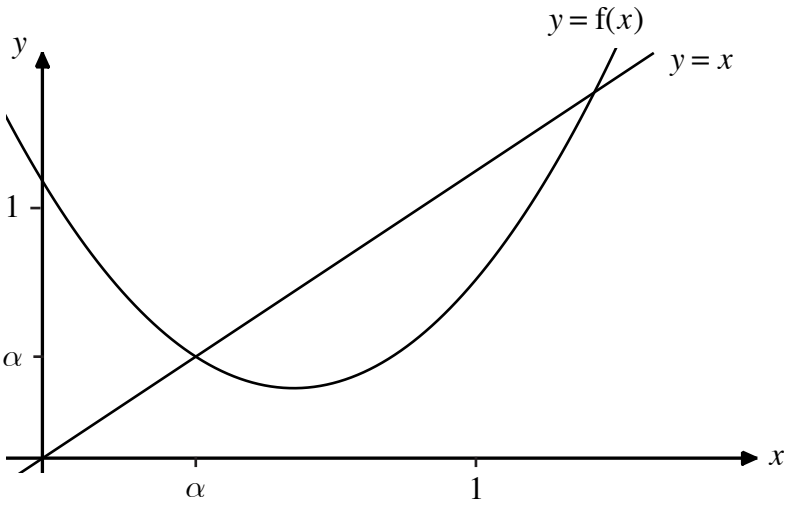
Pure questions – standard

1 Giving your answers as exact values where appropriate, solve the equations

(a) $3e^{2x} - 8e^{-2x} = 10$

(b) $\log_4(3-x) - 2\log_4 x = 1, \quad 0 < x < 3$

2



A student wants to use the iteration formula $x_{n+1} = f(x_n)$ to find an approximation for the root α of an equation.

The diagram above shows a sketch of the graph of $y = x$ and the graph of $y = f(x)$.

Using the graph and starting with $x_0 = 1$, determine whether the iteration formula can be used to find an approxiation for the root α of the equation.

Pure questions – problems

3 The position vectors of points A and B are $4\mathbf{i} + \mathbf{j} - \mathbf{k}$ and $2\mathbf{i} + 5\mathbf{j} - \mathbf{k}$ respectively relative to a fixed origin O.

The point C has position vector $8\mathbf{i} + p\mathbf{j} - \mathbf{k}$ relative to O.

Given that $\overrightarrow{OC} = q\overrightarrow{OA} + r\overrightarrow{OB}$,

(a) find the value of the constants p, q and r.

The point D is such that $ABCD$ is a parallelogram.

(b) Find the position vector of the point D.

4 A curve is described by

$$x^2 + 3xy + y^2 + 15 = 0$$

(a) Find $\frac{dy}{dx}$, giving y in terms of x.

A point P lies on the curve.

Given that the tangent to the curve at P is parallel to the x axis,

(b) find the possible exact and simplified coordinates of P.
(Solutions based entirely on graphical or numerical methods are not acceptable.)

Pure questions – modelling

5 (a) Express $\frac{1}{P(P-1)}$ in partial fractions.

The population of a particular species is modelled as

$$\frac{dP}{dt} = \frac{1}{4}P(P-1)\cos 3t, \quad t \geqslant 0$$

where P is the size of the population in thousands and t is the time measured in years since the start of the study.

Given that $P = 4$ when $t = 0$,

(b) solve this differential equation to show that

$$P = \frac{4}{4 - 3e^{\frac{1}{12}\sin 3t}}$$

(c) Find the time taken for the population to reach a size of 4300 for the first time.
Give your answer in years to three significant figures.

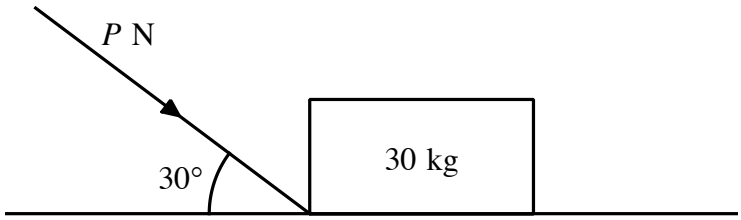
The model predicts the population oscillates between a maximum and minimum value.

(d) Find this maximum and this minimum value.

[NB: part (d) in this case would only be worth 3 marks. Use this to guide you in choosing an appropriate method.]

Applied questions – mechanics

6



A box of mass 30 kg is being pushed along a rough horizontal surface under the action of force of magnitude P newtons. The force acts at an angle of 30° to the horizontal, as shown in the diagram. The box moves at constant speed in a straight line along the surface and the coefficient of friction between the table and the box is 0.3.

By modelling the box as a particle, calculate the value of P.

Applied questions – statistics

7 The price of a computer, P pounds, is measured at various times, t years, after the computer was released. The table below shows the data collected.

Time (t)	1	2	3	6	7
Price (P)	1085	900	860	670	560
log(P)					

The data are coded according to the change of variables $x = t$ and $y = \log(P)$.

(a) Complete the table above.
Give all your values to two decimal places.

(b) (i) State what is measured by the product moment correlation coefficient.

(ii) Calculate the product moment correlation coefficient for the coded data.

(iii) Test, at the 1% level of significance, whether there is evidence of a correlation between the data. State your hypotheses clearly.

The equation of the regression line for y on x is $y = -0.043x + 3.063$.

(c) Express P in terms of t. Give your answer in the form $P = pq^t$, where the constants p and q should be determined to three significant figures.