CM

A Level Maths Question Countdown

5 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.

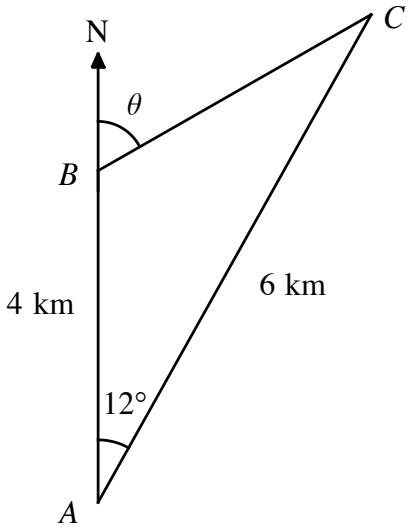
Notes to self

Pure questions – standard

1 The curve C has the equation $y = 4x^2 \ln x,\ x > 0$.

Find the exact coordinates of the stationary point on C **and** use further calculus to determine its nature. You should show all your working clearly.

2



The diagram above shows the positions of planes A, B and C at a particular instant in time, which are assumed to be in the same horizontal plane. Plane B is 4 km due north of plane A and plane C is 6 km from plane A on a bearing of 12°.

(a) Calculate the distance between plane B and plane C.
Give your answer to the nearest 0.5 km.

The bearing of plane C from plane B is $\theta°$, as shown in the figure.

(b) Find the value of θ to the nearest degree.

Pure questions – problems

3 A sequence of numbers $u_1, u_2, u_3, \ldots$ is defined such that

$$u_{n+1} = ku_n + 5, \quad u_1 = 1$$

Given that the sequence is a periodic sequence with order 2,

(a) find the possible values of k.

(b) Hence, find $\sum_{n=1}^{100} u_n$ for each of the values of k found in (a).

4 (a) On the same axes, sketch the graphs of

(i) $y = |2x - 3|$

(ii) $y = |5 - x|$

showing clearly the coordinates of any points where the graphs cross or meet the coordinate axes.

(b) Hence, or otherwise, find the possible values of x such that

$$|2x - 3| = |5 - x|$$

Pure questions – modelling

5 Erwin is completing a number of experiments using a chemical. In each experiment, he must increase the amount of chemical he uses. In the first experiment, he uses 7 g of the chemical and in the second experiment, he uses 8.2 g of the chemical.

Two models, A and B, are created for the amount of chemical used.

In model A, the amount of chemical used is assumed to form an arithmetic progression.

(a) Use model A to find the total amount of chemical Erwin uses in the first 25 experiments.

In model B, the amount of chemical used in assumed to form a geometric progression.

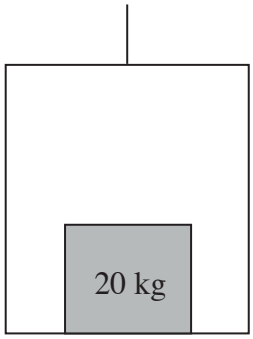
(b) Use model B to find the total amount of chemical Erwin uses in the first 25 experiments.

There is a total of 1800 g of the chemical available to Erwin.

(c) Showing your working clearly, determine the greatest number of experiments possible in each of the two models.

Applied questions – mechanics

6



A lift of mass 180 kg is being lowered by a light vertical cable attached to the top of the lift. A crate of mass 20 kg is on the floor inside the lift, as shown in the diagram. The lift descends vertically with constant acceleration of magnitude 1.8 m s^{-2}. There is a constant upwards resistance to motion of magnitude 135 N to the lift. The crate experiences a constant normal reaction of magnitude R N from the floor of the lift.

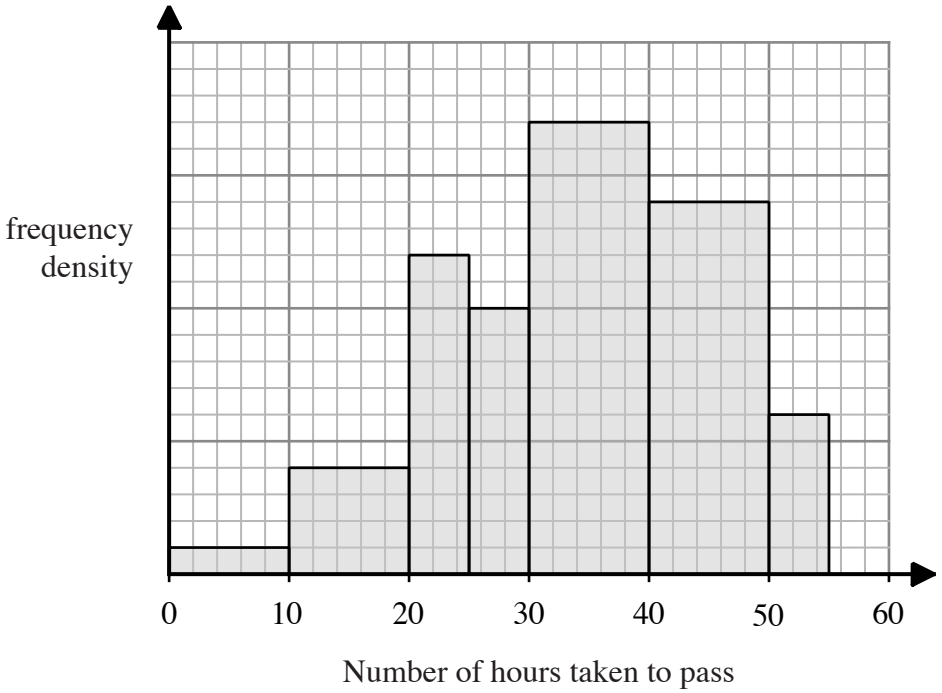
(a) Find the value of R.

(b) Find the tension in the string.

(c) Suggest why the answers to this problem may be different if this lift is operating deep underground.

Applied questions – statistics

7



Emma collects information on the number of hours it took individuals to pass their driving test. To collect her data, Emma uses an opportunity sample. She sampled 53 individuals and obtained 50 data points.

Opportunity sampling is a non-random method of sampling.

(a) State **one** advantage of using a non-random sampling method as opposed to a random sampling method.

(b) Suggest why Emma only obtained 50 data points despite sampling 53 individuals.

(c) Using the histogram, estimate the number of individuals in Emma's sample that took between 25 and 38 hours to pass their driving test.

(d) Calculate an estimate for the median of Emma's data.

Emma suggests that the time taken for individuals to pass their driving test is a normally distributed variable.

(e) Does Emma's data agree with her suggestion? Justify your answer.