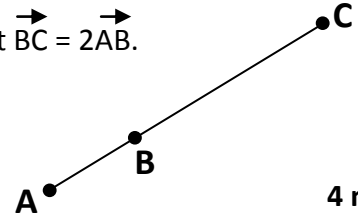


Unit 3 – Homework 3

1. Relative to a suitable coordinate system A and B are the points $(-2, 1, -1)$ and $(1, 3, 2)$ respectively.

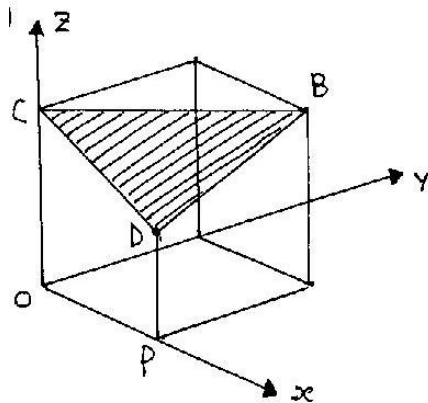
A, B and C are collinear points and C is positioned such that $\vec{BC} = 2\vec{AB}$.

Find the coordinates of C.



4 marks

2. The diagram shows a cube of side 4 units.



- a) Find the components of the vectors \vec{CD} and \vec{CB} where D is the midpoint of the edge of the cube drawn from P. **2 marks**

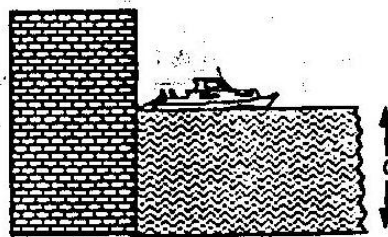
- b) Find the size of angle DCB. **3 marks**

- c) Find the area of triangle DCB. **2 marks**

3. If $g(x) = \frac{1}{(x^2 - 2x)} + \cos 2x$, find $g'(x)$. **5 marks**

4. Evaluate $\int_0^2 \sqrt{4x+1} dx$ **5 marks**

5. The depth of the water in a harbour on 1 July 1986, was given by the equation:
 $d(t) = 25 + 6\cos 30t^\circ - 8\sin 30t^\circ$
 where t is the number of hours from midnight on 30 June and d is the depth in metres.



- a) Write $6\cos 30t^\circ - 8\sin 30t^\circ$ in the form $R\cos(30t - \alpha)^\circ$ **4 marks**

- b) Write down the depth of the water in the harbour at high tide. **1 mark**

- c) A ship requires a depth of at least 30 metres of water to be able to safely leave the harbour. Between which 2 times, on 1 July, must it avoid leaving the harbour? **5 marks**

6. A lake is polluted by a cleaning agent from a dye-works. Every day, the pollutant is broken down by natural processes, (rain, the fish in the lake etc.)

The formula for the **percentage** of the pollutant is:

$$P(d) = 100e^{-0.02d}$$

where $P(d)$ = the percentage of pollutant after d days.

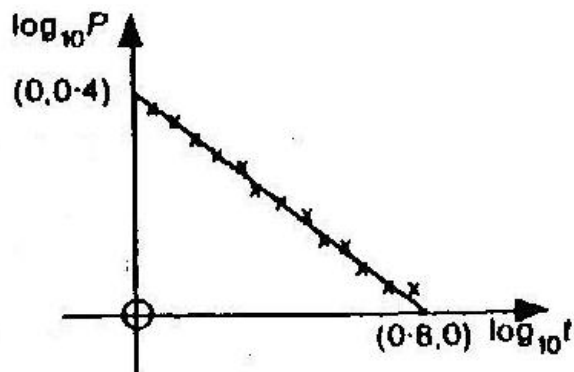
a) What percentage of the pollutant will remain in the lake after 10 days? **2 marks**

b) How long will it take for half the pollutant to be removed from the lake? **4 marks**

7. When the results of an experiment involving two variables, P and t are recorded and a graph of $\log_{10} P$ is plotted against $\log_{10} t$, a straight line is produced.

Derive a formula connecting P and t of the form

$$P = kt^n.$$



5 marks

Total = 43 marks