Entrance exam example 2018/ Engineering
The following are some examples of the type of questions asked in the entrance exam. The answers are given on page 2.

Mathematics

1. $\frac{5}{x}+\frac{1}{x}=2x$
2. $\frac{1}{x}-4x=0$
3. $\sqrt{x^2-9}=9$
4. Solve a and b if $10=2a+1b$ and $0=-5a+4b$
5. There is a square that touches the inside of a circle. The radius of the circle is $R=1$. Draw that this setup. A) Calculate the length of the squares sides. b) Calculate the ratio of the area of the square to the area of the circle
6. Find the zeros of the function $y=2x^2+3x-9$, indicate the position of this minimum/maximum and create a sketch for the function from $-4\leq x\leq +4$.
7. Find the intersections of a circle and a line if $R^2=x^2+y^2=1$ and a line is $y=3x$.

Logic

1. There are trees in the forest, on average one tree per $10\ m^2$. Each tree is 20 meters high and the equivalent shape of the tree trunk is a cylinder with a constant diameter of $25\ cm$. Calculate the timber volume per hectare.
2. There is a fence of length L. Calculate the ratio of the areas if the fenced geometry is either a square or a circle?
3. What is the total density of a mixture from 30% of A with density of $\rho_A=1000\frac{kg}{m^3}$ and 70% of B with a density of $\rho_B=5000\frac{kg}{m^3}$?

Physics

1. A satellite orbits earth in a geostationary orbit. This means the satellite is permanently above the same position at the equator. The satellite orbit is $36000\ km$ above earth surface, earth radius is 6400km. What is the approximate orbital velocity of the satellite?
2. The wave velocity in a solid is $v=\sqrt{\frac{E}{\rho}}$. Assume a material with a Young's modulus of $E=1000\ \cdot 10^6\ Pa$ and density of $\rho=1000\frac{kg}{m^3}$. How long time does an acoustic wave with before velocity need to travel along a rail line of $1000\ km$.

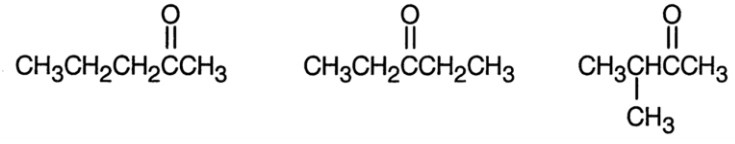
Chemistry

1. Balance the following equation.

   $C_4H_{10}(l) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$

   2 $C_4H_{10}(l) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$

2. There are 3 ketone isomers with the formula $C_5H_{10}O$. Draw their structures.



Mathematics

1. answer: $x = \pm\sqrt{3}$
2. answer: $x = \pm\frac{1}{2}$
3. answer: $x = \pm 10$
4. answer: $a = \frac{40}{13}$ and $b = \frac{50}{13}$
5. answer A) $\sqrt{2}R = \sqrt{2}$ B) $\frac{A_{square}}{A_{circle}} = \frac{(\sqrt{2}\,1)^2}{\pi\,1^2} = \frac{2}{\pi}$
6. answer: $x_1 = -3$ and $x_2 = +1.5$
7. answer: $x_{1/2} = \pm\sqrt{\frac{1}{10}}$

Logic

1. answer: $V_i = \pi R^2 h = \pi\, 0.125^2 20\ m^3$, $N = \frac{10000}{10}\frac{m^2}{m^2} = 1000\ trees.\ V_{tot} = N\,V_i = 1000\,\pi\, 0.125^2 20\ m^3$
2. answer: $a_{square} = \frac{L}{4}$ and $R = \frac{L}{2\pi}$ leaves $\frac{A_{square}}{A_{circle}} = \left(\frac{L}{4}\right)^2 \frac{(2\pi)^2}{\pi L^2} = \frac{\pi}{4}$
3. answer: $\rho_{tot} = 0.3\,\rho_A + 0.7\,\rho_B = 300\frac{kg}{m^3} + 3500\frac{kg}{m^3} = 3800\frac{kg}{m^3}$

Physics

1. answer: $|\vec{v}| = \frac{s}{t} = \frac{2\pi R}{t} = 2\pi\frac{R_{earth}+R_{orbit}}{t} = 2\pi\frac{42400}{24}\left[\frac{km}{h}\right]$
2. answer: $v = \sqrt{\frac{E}{\rho}} = \sqrt{\frac{1000}{1000}\,10^6\,\frac{N\,m^3}{m^2\,kg}} = 1000\frac{m}{s}$. Time of flight $t = \frac{s}{v} = \frac{1000}{1000}\frac{km}{m/s} = 1000\ s$

For further information related to the questions and answers below, please contact rene@arcada.fi