RAMAIAH UNIVERSITY OF APPLIED SCIENCES

ASSIGNMENT

Course Code	BSC105B
Course Name	Engineering Chemistry
Programme	Bachelor of CSE
Department	Chemistry
Faculty	FET

Name of the Student	ALOK KUMAR SINGH
Reg. No	17ETCS002020
Semester/Year	FIRST
Course Leader/s	Dr. T. Niranjana Prabhu, Dr. Jineesh A.G.

Declaration Sheet				
Student Name	ALOK KUMAR SINGH			
Reg. No	17ETCS002020			
Programme	Bachelor of CSE		Semester/Year	FIRST
Course Code	BSC105B			
Course Title	Engineering Chemistry			
Course Date		to		
Course Leader				

Declaration

The assignment submitted herewith is a result of my own investigations and that I have conformed to the guidelines against plagiarism as laid out in the Student Handbook. All sections of the text and results, which have been obtained from other sources, are fully referenced. I understand that cheating and plagiarism constitute a breach of University regulations and will be dealt with accordingly.

Signature of the Student		Date	
Submission date stamp (by Examination & Assessment Section)			

Signature of the Course Leader and date	Signature of the Reviewer and date

Contents

Question No. A

Solution to Question No. A:

"Decision of changing the emission standard BSIII to BSIV is good one, considering the vehicle densities in Indian cities".

Overview:

Bharat stage emission standards are emission standards instituted by the Government of India to regulate the output of air pollutants from internal combustion engine equipment, including motor vehicles. The standards and the timeline for implementation are set by the Central Pollution Control Board under the Ministry of Environment & Forests and climate change.

A1 Comparison of the petrol and diesel emission norms of BS IV and BSIII.

1. The norms of gasoline according to BS-IV is minimum research octane number about 91 percent, minimum motor octane number about 81 percent, and maximum content8 by percentage in volume is 21 and the maximum oxygen content percentage by mass is around 2.7. the norms for the regular grade gasoline in BS-III is same as BSIV in both maximum and minimum octane number and both maximum and minimum octane volume percentage.
2. BS-IV regulates for the pollution control. On April 2010 it was introduces in 13 metropolitan cities and the with supreme court banning the sale of BS-III vehicles starting from first of April 2017.

   Whereas BS-III was introduced in 2005 and was implemented in 15 cities and overall implementation was done by 2010.
3. The feasible pollution levels from a diesel vehicle in BS-III is 0.64g/km of carbon monoxide, 0.50g/km of Nitrogen Oxid, 0.56g/km of Nitrogen Oxid and hydrocarbon and 0.05g/km of Particulate Matter.
4. The feasible pollution levels from a diesel vehicle in BS-IV is 00.50 g/km of carbon monoxide, 0.25g/km of Nitrogen Oxid, 0.30 g/km of Nitrogen Oxid and hydrocarbon and 0.025g/km of Particulate Matter.
5. For the vehicles running on petrol

   For BS-IV is 1.00g/km for Carbon monoxide, 0.10 g/km for Hydrocarbon and 0.15g/km for Nitrogen Oxide. And for BS-III it is 2.30g/km of Carbon monoxide, 0.20 of Hydrocarbon and 0.08g/km of Nitrogen Oxide.

A2 purchase cost of vehicle affecting common people

The companies were manufacturing cars, but when the get to know that government has started to implement BS-IV, they stopped their manufacturing of BS-III standardized vehicles. As BS IV has been

actualized from April 1 2017 and the everyday citizens who are anticipating buy a vehicle should spend a higher sum than before to possess one and over that fuel costs likewise should be considered.
After the Budget triggered off a price increased in all models of automobiles, prospective buyers were in for another jolt, as the industry was set to jack it up again in April due to the implementation of the new emission norms—Bharat Stage IV.
After the government started to implement BS-IV, the companies started selling their vehicles at heavy discounted prices. This was only for a short time until the stocks were over and the BS-IV was officially implemented after which the prices obviously increased as the engine has to be that of better quality and the company has to compensate for the losses they incurred after selling their cars for cheap. This will happen again in the future when the BS-VI will get implemented by next four years.

A3 Justification of your stance

here I am taking stance against the topic. The vehicles aren't solely the explanation of pollution however conjointly the factories creating such pollution square measure to accountable. If we have a tendency to see the stats we discover that dynamical from baccalaureate IV to baccalaureate III has not created abundant distinction in pollution however created an excellent impact on money economy. The biggest drawback is handling the sharp and short deadlines declared by the Supreme Court of Republic of India, the most important issues sweet-faced by the automotive firms were to cope up with call was to get rid of all the baccalaureate III ranked automotive and convey the BS- IV cars within the market speech that by Gregorian calendar month first none of the car firms ought to be having any stock containing BS-III ranked cars. automotive firms spent an enormous quantity on the R&D team to make BS-IV ranked cars. once these cars came to the market these cars price a touch higher due to a modification. This reason light-emitting diode to recession in a number of the automotive firms. Even today fuels price are raising higher day by day. it might be higher if SC would have given AN order for reducing pollution and not by increasing the value.

Question No. B

Solution to Question No. B1:

B1.1 As an engineer discuss the factors responsible for corrosion:

At the time of winter, some countries suffer from the road block due to the snow fall, due to which there is no traction for cars and other vehicles to move on the roads, which leads to the road accident. To resolve this issue, road department cleans the road blockage, by adding salt and some mixtures of sand which decrease the water frizzing point. And due to this the ice, which blocks the road get melt even though the temperature of the environment remains same before the melting and after the melting of the ice i.e. temperature remains below frizzing point. Sand keeps the salt in the place and adds a bit of traction to the wet surface of road. It is very beneficial to clean blocked roads from the snow during the winter time. But it causes some damage to the body of vehicles like undercarriage damage to the vehicles by corrosion and rust. Parts of the cars include springs, exhaust system, frame and hydronic break system.

The corrosion in the lower part of the vehicles occurs due to the electrochemical reaction of iron and oxygen to form iron oxide. For the reaction, it need electrolyte. Since the mere pure water form ice, it doesn't function well as an electrolyte because it does not have as many as required for the reaction. but the salt provides all the ions to the electrolyte. Water needs for the reaction. the salt in used to clear the road from the ice is is not a common salt, sodium chloride but also calcium chloride and magnesium chloride which involve more ion distribution and thus increases the corrosion activity by devastating the metal. since the car runs on the melted ice which contain salt, it sprinkled on the wheelwalls the wheels by which the combined salt and the moisture trapping and cervices occurs.

The reaction involves for the rusting of the iron is: -

$$2Fe(s) + \frac{3}{2}O_2 + xH_2O \longrightarrow Fe_2O_3.xH_2O$$

Then once the rust starts, it works quickly. Iron oxide molecules take up more space than iron atoms, so they start to expand. Carbon dioxide in the water combines with the iron to create iron hydroxide, another form of rust that easily separates from the base metal. And after the winter the, warmer condition of summer comes which increases the rate of corrosion.

B1.2 Recommend the remedial measures to control corrosion:

Following are the measures can help to prevent corrosion due to ice water contain salt:

1. We can prevent corrosion on the car by washing it after 2-3 day of usage. By which the salts that are present on the surface of metal of car, get removed.
2. We can apply grease or oil on the undercarriage of the vehicles, by this coating will help to prevent the salt and water to sticking to the metal surface of vehicles.
3. We can apply wax to the surface of the metal of vehicle before the winter season. It makes very easy to remove the salt that stick on the surface of metal of the car.
4. We can avoid puddles which driving to prevent excess content of salty water wetting the car
5. Getting a pre-winter checkup with a mechanic to ensure a safe and sound car. Any indications of wear and tear should be addressed before the temperature drops.
6. We can wash our car after snow storm, which ensures cleaning of bottom body of vehicles
7. Before winter season we can check our car by mechanic for any type of scratch in the bottom of car. Because on the surface of the metal if any scratch present, then that scratch will act as anode and the remaining surface will act as cathode, and since the area of anode is very much less than the area of cathode, so the chances of rate of corrosion will be very high.

Question No. B

Solution to Question No. B2:

given reaction:

$$S_2O_8^{2-}(aq) + 3I^-(aq) \rightarrow 2SO_4^{2-}(aq) + I^{3-}(aq)$$

B2.1 Deduce the rate law for this reaction and determine the rate order w.r.t. each reactant using the data given in the table 1:

Consider the order of reaction above with respect to $[S_2O_8^{2-}]$ is 'm'

and the order of reaction above with respect to $[I^-]$ is 'n'

Rate : $[S_2O_8^{2-}]^m [I^-]^n$

Rate = $k[S_2O_8^{2-}]^m [I^-]^n$ where k is the rate constant.

According to the given data,

$1.5 \times 10^{-5} = k[0.038]^m [0.060]^n$ ----------(1)

$2.8 \times 10^{-5} = k[0.076]^m [0.060]^n$ ----------(2)

$2.9 \times 10^{-5} = k[0.038]^m [0.120]^n$----------(3)

Dividing equation (1) and (2):-

$$\frac{1.5}{2.8} = \frac{(0.038)^m(0.060)^n}{(0.076)^m(0.060)^n}$$

$$\Rightarrow \left(\frac{1}{2}\right)^1 = \left(\frac{1}{2}\right)^m$$

So, m=1

Dividing equation (1) and (3):-

$$\frac{1.5}{2.9} = \frac{(0.038)^m(0.060)^n}{(0.038)^m(0.120)^n}$$

$$\Rightarrow \left(\frac{1}{2}\right)^1 = \left(\frac{1}{2}\right)^n$$

So , n=1

The order of the reaction is: m+n=1+1=2

Since, Order of reaction above with respect to $[S_2O_8^{2-}]$ is 1.

And Order of reaction above with respect to $[I^-]$ is 1.

Hence the, Total order of the reaction is 2.

B2.2 Calculate the rate constant and the reaction rate when the concentration of both reactants is 0.050 mol/L.:

Putting the value of 'm' and 'n' on equation (1)

$1.5 \times 10^{-5}=k[0.038]^m [0.060]^n$

$\Rightarrow 1.5 \times 10^{-5}=k[0.038] \times [0.060]$

$$k = \frac{1.5 \times 10^{-5}}{(0.038)(0.060)}$$

$k=6.5789 \times 10^{-3}\ s^{-1}$

now, we have:

$[S_2O_8^{2-}]=0.050 mol/L$

$[I^-]=0.050 mol/L$

Reaction rate $=k[S_2O_8^{2-}]^1[I^-]^1$

$=1.6447 \times 10^{-5}$ mol/Ls

Hence, the rate of reaction is 1.6447×10^{-5} mol/Ls and the rate constant is $6.5789 \times 10^{-3}\ s^{-1}$

Question No. B

Solution to Question No. B3:

B3.1 The specific rate constant for the second order neutralization of nitropropane by a base is given by

$$\boldsymbol{logk = 11.899 - \frac{3169}{T}}$$

here concentration is in moles litre-1 and time in minutes. k is rate constant and T is temperature in Kelvin. Initial concentration of both reactant is 0.01M. Calculate activation energy and half-life at 25 °C:

since, $k=Ae^{-Ea/RT}$,

Where R is gas constant and A is the Arrhenius factor, Ea is the Activation energy required by the reaction.

- ⇨ ln k= ln A – Ea/ET
- ⇨ $logk = logA - 2.303\frac{E_a}{RT}$ --------(1)

Consider, [M] as Concentration of nitropropane

We have the equation $\log k = 11.899 - \frac{3169}{T}$

Or, $logk = logA - \frac{3169}{T}$, where log A = 11.899

Relating the given equation with equation (1) we get

$$3169 = 2.303\frac{E_a}{R}$$

- ⇨ $\frac{3169 \times \mathrm{R}}{2.303} = E_a$
- ⇨ Ea=11440.324 J/mol

Now, Given Temperature T=25°C=273+25 = 298 K

And we have, $logk = 11.899 - \frac{3169}{T}$

Substituting T on the given equation:

$$logk = 11.899 - \frac{3169}{298}$$

- ⇨ $logk = 1.2647$
- ⇨ $k = 18.398\, min^{-1}$

Given, [M]=0.01M (concentration of nitropropane)

Therefore, Half-life of second order reaction:

$$t_{1/2} = \frac{1}{k[M]}$$

⇨ $t_{1/2} = \frac{1}{18.398 \times 0.01}$

⇨ $t_{1/2} = 5.4354\ min$

B3.2 At 400 °C, the half-life period for the first order thermal decomposition of propylene oxide is 320 min and the energy of activation of the reaction is 217570 J/mole. From these data estimate the time required for propylene oxide to be 75% decomposed at 500 °C:

We have:

Order of reaction is 1

T_1=400 °C= 673K

T_2=500 °C= 773K

Ea is activation energy which is equal to 217570 J/mol

R=8.314 J $K^{-1}mol^{-1}$ is gas constant

$t_{1/2}$=320min=Half-life of reaction at 673K

formula/equation for half-life in first order reaction is:

$$t_{1/2} = \frac{0.693}{k_1}$$

⇨ $k_1 = \frac{0.693}{320}$

⇨ $k_1 = 2.166\ \times 10^{-3} min^{-1}$

We have equation:

$$ln\left(\frac{k_2}{k_1}\right) = E_a\left(\frac{T_2 - T_1}{RT_1T_2}\right)$$

⇨ $ln\left(\frac{k_2}{2.163 \times 10^{-3}}\right) = 217570\ \times \left(\frac{773-673}{8.314(773)(673)}\right)$

⇨ $ln\left(\frac{k_2}{2.163 \times 10^{-3}}\right) = 217570\ \times \left(\frac{100}{520229}\right)$

⇨ $ln\left(\frac{k_2}{2.163 \times 10^{-3}}\right) = 5.0303$

Taking anti log both side:

⇨ $\frac{k_2}{2.16\times10^{-3}} = 152.98$

⇨ k_2=0.331 min^{-1}

Using $k=t^{-1}ln(a/a-x)$ relation we will find time 't' required for propylene oxide to be 75% decomposed.

For a=100 and x=75, a-x is 25. (Using given percentage relation)

$k_2=t^{-1}\ln(100/25)$

$t=\ln(4)/k_2$

$t=2\ln(2)/0.33120=4.18478\text{min}$

Time required for propylene oxide to be decomposed by 75% of initial value is 4.18378min

Question No. B

Solution to Question No. B4:

B4.1 Give plating bath composition for chromium plating with anodic and cathodic reactions and identify any six reasons for the formation of blisters on the surface of the gear parts

The chromium plating is composed of 250 g of chromic acid + 2.5 g of 100:1 sulphuric acid per liter.
Anode is made up of an insoluble anode of Pb-Sb and Pb-Sn, which is coated with lead dioxide. The reaction takes place at anode.
The cathode is an object which is plated with chromium, The reaction takes place at cathode

The reactions at anode and cathode are as follows: -
At anode: -

$$H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$$

At cathode-

$$Cr^{3+} + 3e^- \longrightarrow Cr$$

Reasons for the formation of blisters on the surface of the gear parts are the following: -

1. voltage- if the supplied voltage is higher than the required voltage, then the current density will increase and if current density is more than the required density value of 1455 A/ft^2 to 430 A/ft^2, then it will lead to the formation of blisters.
2. If the surface of the material to be plated is not free from moisture, then the presence of moisture would lead to formation of blisters
3. It can happen if the temperature is higher than the optimum range i.e. between 45^{o}C to 60^{o}C
4. When chromium metal reacts with acid it liberates hydrogen gas and when these gasses taken place on the surface of the planted chromium, then the formation of blisters occurs.
5. If the thickness of the plating is more than the required thickness then also the formation of blisters occurs.
6. if the process of plating is conducted in an environment which has debris in the air which can rest on the surface of the material to be plated and cause blistering

B4.2 Discuss health hazards associated with chrome plating and suggest any two alternatives of chrome plating

since chromium is a harm full metal and hence inhaling of these metals can cause respiratory problems. Because the procedure uses a process of acid bath. In chemical bath, the object is placed in chemicals that includes hydrochloric, nitric-hydrofluoric and sulfuric acids. Because of theses chemical contain an extremely high acid base, which lead to the skin problem and damage of eyes can occur. These chemicals can also release vapors that can cause Sevier burns and damage to the throat and other internal organs. The NIH reported that the chemicals in use in the process can causes lungs cancer. If the amount of chromium in the body increases, it can lead to severe diseases like damage of kidney and liver weakening of immune system and in some severe cases can lead to cancer and may also lead to change in the DNA structure of the organism.

This above problem can be resolved by the use of alternatives to chromium like nickel tin cobalt etc. we can also use water instead of insoluble chromium as this will reduce the risk of people getting contaminated water containing chromium and leading to deadly diseases like cancer or damage of the kidney and liver.