

# Open Text- Based Assessment 2015-16



## Mathematics Class-IX

### Themes:

1. Childhood Obesity in India
2. Energy Consumption and Electricity Bill

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**Central Board of Secondary Education**

Shiksha Kendra, 2, Community Centre, Preet Vihar, Delhi-110301, India



# OPEN TEXT BASED ASSESSMENT

## MATHEMATICS CLASS-IX

### Theme-1: Childhood Obesity in India

#### Abstract

*The text given in this article will help teachers to sensitize the students about the importance of healthy food habits. They will be able to monitor and mentor the impact of the kind of food they intake. Now a day's being on diet is fad amongst adolescents. Sometimes to remain slim and trim they start following wrong practices. Using mathematical knowledge, they can analyse their diet programmes and the consequences. Youth today is also more inclined towards the junk food and electronic gadgets and is moving away from playing or taking regular exercises. This is resulting in growing childhood obesity and related health problems. All health professionals have a deep concern about the issue as the health of youth determines the health of a nation. Case study given below is based on use of linear equations. With the knowledge gained in class IX about linear equations, its graphical representation and its application; students can be made to understand the rising threat to children's health in the form of increasing childhood obesity cases in India.*

According to the Oxford Dictionary, 'Healthy' is defined as 'the state of being free from illness or injury'. Indian parents have a myth that the child who is chubby and cheeky is healthy. So they shower their love by over feeding the children. Child grows with understanding that over consumption is normal and it is a way of life.

Growing up years is the foundation of adult health. Children from age one onwards grows taller and heavier till they reach adolescence at a whopping rate of about 2-2.3 kg every year for weight and 2 to 3 inches for height.

During the growing up years the fat cells increase in number and size due to faulty eating practices. Once the extra fat cells have been formed, they stay. All efforts to reduce weight can only reduce the size of the fat cells but not the number. Overweight children generally grow as overweight adults.

**Rajat is studying in class IX. He feels hurt as well as confused when teased by his friends for being obese. He was admired as most cute and chubby guy of class. He decided to be on diet to control weight.**

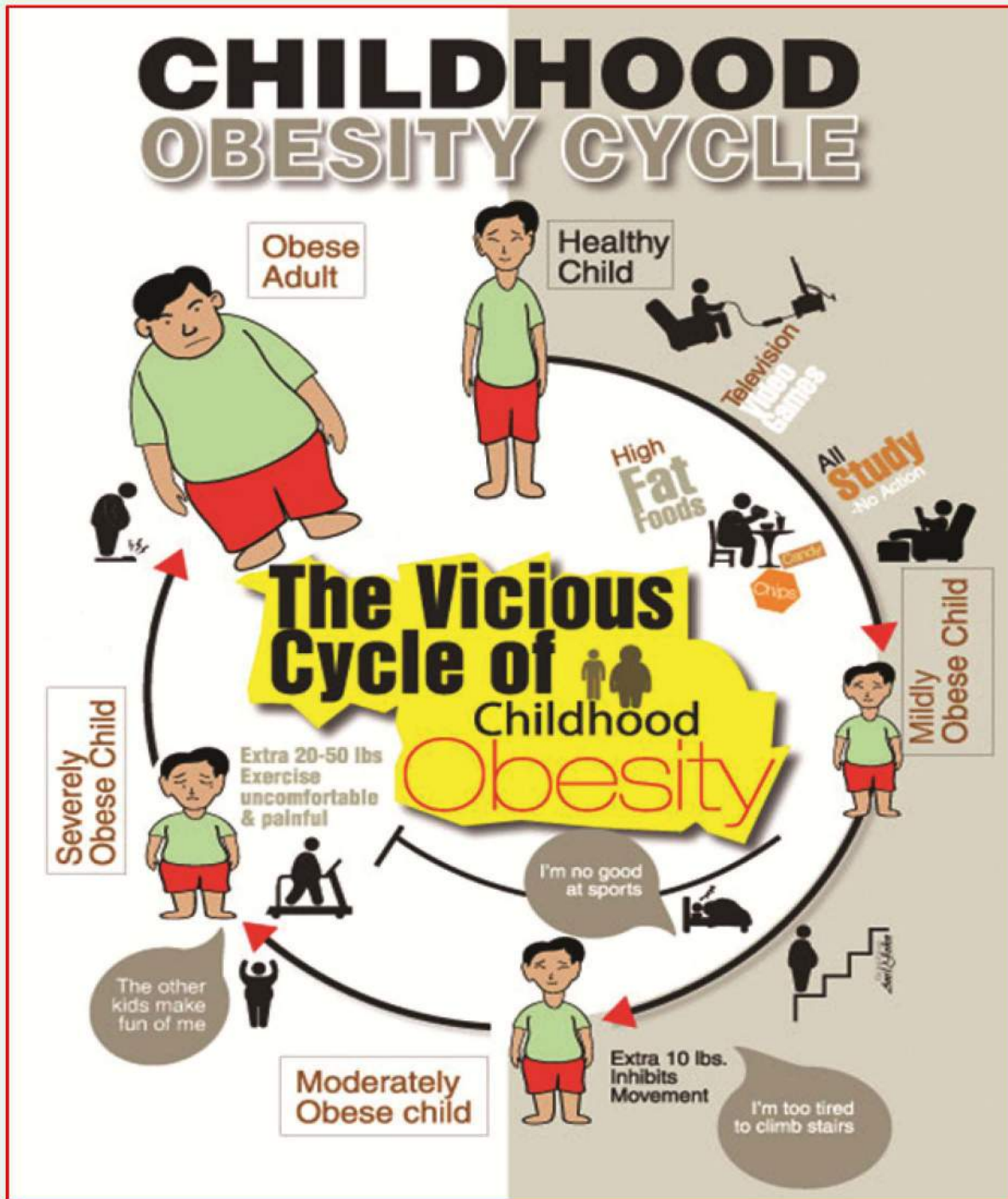
He started skipping meals and fasting. After some weeks he realized that instead of losing the weight he is running out of energy and is not able to focus on the studies. Rajat's parents discussed the issue with their family doctor. She calmed down them and told them that before starting any diet programme one must check his/her BMI in order to see the category in which the person falls – Normal or Overweight or Obese.

Being overweight means having more body weight than is considered normal or healthy for one's age or build. On the other hand, Obesity is the condition of being obese, i.e., excess amount of body



fat. While an overweight person will carry excess weight, he/she may or may not have excess accumulation of fat.

Doctor shared with them that child obesity is a major concern among all health professionals nowadays and appreciated the parent's concern about their child's sentiments and weight issues.



*"It is easier to build strong children than to repair broken man."*



But to fight against it, one should have the clear idea of factors controlling the weight and shall adopt just the right combination of physical activity and balanced diet.

Rajat asked the doctor to explain BMI in detail.

### What is BMI?

Body Mass Index (BMI) is a person's weight in kilograms divided by the square of height in meters. For children and adolescent, BMI is age- and sex-specific and is often referred to as BMI-for-age.

BMI	Health Status
18.5-25	Healthy
25-30	Overweight
30-35	Obese
Above 35	Severely Obese





After explaining BMI, doctor asked Rajat to calculate his BMI. Rajat quickly used the weighing machine and height chart at clinic and found that his weight is 60 kg and height is 150 cm. As per the chart shown above his BMI is 27, so he lies in overweight category.

Doctor took a sigh of relief and said. "Thank God. You are not in obese category." Rajat asked "Why obesity is such a serious issue."



### Child obesity: A major concern

Doctor replied, "The World Health Organization (WHO) has labelled childhood obesity as the most serious public health problem of the twenty first century as it contributes towards 44% of diabetes, 23% of heart disease and 7-41 % of certain cancers. WHO estimates that world wide 2.8 million people die each year as a result of being overweight and obese".

Risks of heart disease, stroke, type 2 diabetes and cancer increase steadily with increasing body mass index (BMI).

Obesity is defined as a 20% excess of calculated ideal weight for age, sex and height of a child. A child is said to be obese when there is an excess of accumulated fat in the subcutaneous tissue (below the skin) and other areas of the body.

Today, childhood obesity is on the rise and is considered as a major public health problem. Globally, in 2010 there were estimated to be over 42 million overweight children below the age of 5.

Studies show that in India, nearly 15% to 20% of children are overweight and 30% are in the risk of falling in this category. It is these statistics that ring major alarm bells in India.

## Prevalence of Childhood Obesity in India

- Do you know the number of children who are obese in India?
- **One in four** school children in Indian metros is overweight.
- **One in six in non-metro cities is overweight.**
- Around 20% of children show signs of obesity.





## Factors responsible for obesity

- Consumption of energy-dense, nutrient-poor foods and lack of physical activity contributes to an increase in calories as compared to the requirement. Calorie is a measure of the energy derived from a food source. The calories derived from fruits and vegetables are superior to the calories derived from fast foods and soda, even though the number of calories may be same in both foods.
- A diet low on nutrients and high in salt, sugar and fat is commonly referred to as junk food. It is dangerous for health, as it lacks nutrition and is loaded with only calories. Children eat nearly twice as many calories (770) at restaurants as they do during a meal at home (420).
- Watching television and consuming junk foods are associated with a higher prevalence of being overweight.
- Unavailability of open spaces leave the children not much of a choice but to be home and spend hours watching television or be with the gadgets. On an average a city child is spending 4-5 hours in front of media machines.

## Controlling Obesity

To control obesity in children it is essential to

- **Keep them physically active** in order to burn extra calories and to keep metabolism geared towards using food for energy instead of storing it for fat.

Nature of Physical Activity	Calorie Burnt (k. cal/min)
Home activities	3
Walking	4
Jogging	6
Running	8
Running up stairs	10

You can make linear equations to plan your workout schedule.

For example

You want to burn 150 kilo calories in a day and you can work out at the most for 30 minutes. Also you feel that walking and jogging are most convenient ways to carry out your plan.

From above table you can observe that walking burns 3 kilo calories per minute and jogging burns 6 kilo calories per minute.



Suppose you walk for  $x$  minutes and jog for  $y$  minutes.

To burn 150 kilo calories, fitness schedule can be followed according to linear equation

$$3x + 6y = 150$$

You can draw graph of this linear equation and identify suitable time to invest in walking and jogging.

- **Take balance food intake**

Recommended calorie intake for boys and girls per day is as follows:

For children, boys, girls	2200 calories
For active boys and girls	2800 calories

Recommended calorie intake from different nutrients is as given below:

Nutrient	Recommended Calorie intake from nutrients/Amount per day
Fat	15%-30%
Carbohydrate	55%-75%
Protein	10%-15%
Salt	5-6gm/day
Sugar	20-25gm/day

- During the growing up phase, children are able to burn calories due to their high metabolism and activity levels. However, the taste for salty and sugary food, once developed, continues well into adult life. The result is that these kids grow into obese adults.
- **Be cautious of deceiving labels**  
Sometimes the labels like cholesterol-free food, sugar free, multigrain, diet food etc. used as marketing tactics are very deceiving as such products may have low fat but excess salt and sugar which simply means intake of high calories. Decoding food labels is an essential exercise. For instance a bag of masala peanuts states that 100 gm of the product contain 610 calories. And the 50 gm fat in the packet of same product claims to provide 450 calories. Thus 450 calories out of 610 calories comes from fat, which is whopping 73%. Although the dietary recommendation is that only 30% of calories should come from fat.
- Avoid eating fast food as you can end up taking 47% more calories than traditional Indian food.



Have a look at the following chart showing the effort required to burn the specific amount of calorie obtained after eating junk food.

Junk food	Calorie value	How to burn it.
1 Slice pizza	250	Bicycling for 90 minutes
1 Cheese burger	330	Swimming for 60 minutes
1 Medium French fries	300	Jogging for 30 minutes
1 Pastry	500	Tennis for 90 minutes
1 Samosa	150	Dancing for 30 minutes
200 ml cola	110	Jumping rope for 15 minutes

### Why Fasting is not good for weight loss?

Fasting is popular because it can provide dramatic weight- loss but it is primarily water loss rather than fat. Lost water is regained quickly when eating is resumed.

After getting this information Rajat understood how to reduce the weight and he charted his diet plans with the help of his parents which of course was right blend of physical exercises, control over excess technology hours and vigilant intake of food with nutrients, salt and sugar in appropriate proportions.

You too can make one for yourself.

### REFERENCES

- <http://www.cseindia.org>

### SAMPLE QUESTIONS

Q1. It is stated that

“Children from age one onwards grows taller and heavier till they reach adolescence at a whopping rate of about 2 kg every year for weight and 3 inches for height.” 3 Marks

Assuming weight as variable ‘w’ and height as ‘h’, and ‘a’ as age in years, if weight at age 1 is 5 kg and height is 24 inch, establish a linear relationship between

- a) a and w
- b) a and h

Q2. Atul wants to burn 250 calories in a day by doing physical activity. He chooses walking and running stairs for the same and plans to spend ‘t’ hours in walking and ‘s’ hours in running stairs. Write a linear equation for the same and draw the graph. 4 Marks

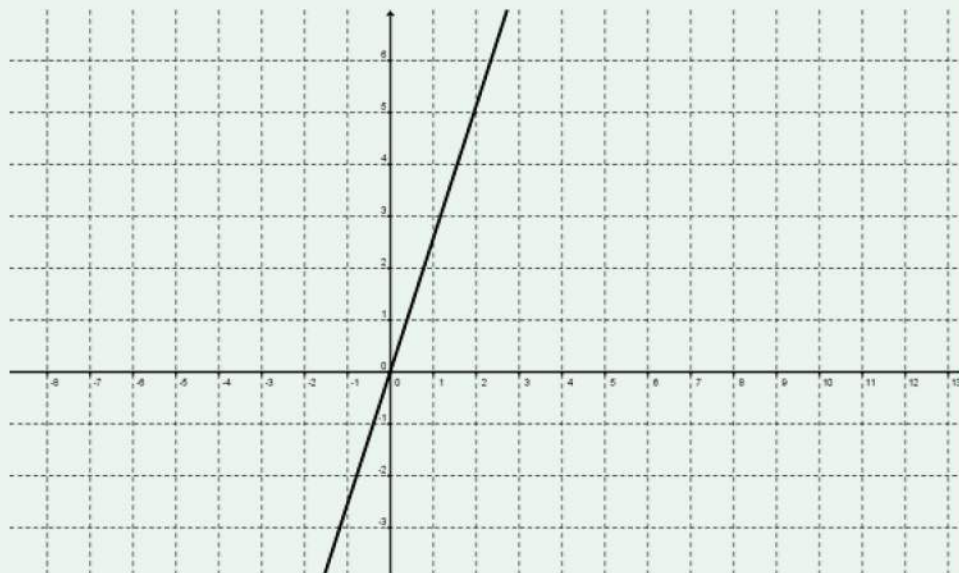




- Q3. Body mass Index (BMI) is a person's weight in kilograms divided by the square of height in meters. Taking the height as 160cm, form a linear equation in two variables taking BMI as  $x$  and weight as  $y$  kg. Draw its graph also. 3 Marks

### MARKING SCHEME

- Sol.1.** a)  $w = 5 + (a-1)2$  3  
 $\therefore w = 3 + 2a$
- b)  $h = 24 + (a-1)3$   
 $= 19 + 3a$
- Sol 2.**  $4t + 10s = 250$  & Graph 4
- Sol 3.**  $x = \frac{y}{1.6^2}$  3  
 $2.56x - y = 0$





# OPEN TEXT BASED ASSESSMENT

## MATHEMATICS CLASS-IX

### Theme-2: Energy Consumption and Electricity Bill

#### Abstract

*The text given in this article will help teachers to motivate the students to prepare a case study on consumption of electricity in their homes and schools and to identify the ways to reduce the electricity bills by knowing energy saving tips. This will also give an insight into the way the bills are calculated for all basic amenities like electricity, water and telephone. The article will also help the students to understand the difference between the energy factor and power factor and how they impact electricity bill.*

*It also intends to make the students good decision makers. This is the time of informed choices. If the students are well aware of all terms like kWh, power factor, star rating on electrical appliances etc. they can help as well as guide their parents to make wisest choices while purchasing electrical appliances. Children can learn to save energy, save money, awareness about consumer issues by assimilating the ideas given in the text.*

It was a monthly affair in Rohan's home that the moment the electricity bill is dropped at their place a cribbing discussion starts in family about wrong billing, wrong meter reading, raised rates etc. Rohan always wanted to know on what basis bills are generated? How electricity board manages to raise separate bill for each house?

Are bills always correct? If not, how to check? He discussed these questions with his friends and found that all of them are puzzled over these questions. They went to their Mathematics teacher to understand the complexity of billing process.

On hearing them the Mathematics teacher announced in the class that everyone shall paste the last three electricity bills in their notebooks and they will do comparative study of the bills.

All students very enthusiastically participated in the activity and pasted the bills in their notebooks and found that all of them were getting bills of different amount. They asked their teacher the reason of getting bills of different amount. Teacher discussed with them the significance of knowing all the terms and units written on the bill. She explained the meaning of the following terms:

1. Electricity Bill
2. Electrical energy consumption and its unit
3. Power and its unit



### Electricity bill

An **electricity bill** is a **bill** for the consumption of **electric** energy

### Electrical Energy

It refers to the actual consumption of electricity. On all electricity bills the consumption of electricity is shown in kWh or kilowatt hours.

Usage of 1000 Watts or 1 Kilo watt of power for 1 hour implies consumption of 1 unit or 1 Kilowatt-Hour (kWh) of electricity. When a 100-Watt bulb is kept on for 10 hours it consumes:

$100 \times 10 = 1000 \text{ Watt-Hour} = 1 \text{ Kilo watt-Hour (kWh)} = 1 \text{ unit (on your meter)}$ .

**Rohan:** Madam we have purchased an Air Conditioner of three and half tons yesterday. On its box 6.5 kW is printed. What it means?

**Teacher:** It refers to the rate at which electricity is used by it.

$$\text{So, Power} = \frac{\text{Energy}}{\text{Time}}$$

Power is represented in watt (W) or kilowatt (kW). A thousand (1000) watts make one kilowatt. So if any appliance is rated as 6.5 kW then it means that it consumes electricity at a rate of 6500 W.

To estimate the units consumed by any appliance daily; units and monthly units consumed can be calculated using the following equation:

$$\text{Daily Units} = (\text{Wattage} \times \text{Usage hours per day}) \div 1000$$

$$\text{Monthly Units} = \text{Daily Units} \times \text{no. of days in a month}$$

Once you know the units consumed in a day or in a month you need to know the tariff plan applicable in your state.

Tariff is slab wise rate per unit of electrical consumption.

**For example: If tariff plan of some state is as follows**

Slab of Units	Rate per unit
First 150 units	Rs 2.20
Next 250 units	Rs. 4.20
Above 400 units	Rs.4.40



For example, electricity bill for consumption of 800 units for a month can be calculated as follows:

Slab of Units	Rate per unit	Total
First 150 units	Rs 2.20	150 units x 2.20 = Rs. 445
Next 250 units	Rs. 4.20	250 units x 4.20 = Rs. 1050
Above 400 units	Rs.4.40	400 units x 4.40= Rs. 1760
<b>TOTAL</b>		<b>Rs. 3255</b>

After this explanation, teacher asked the students to verify the following actual bills and to observe the difference between them:

Meter Reading Status : DI  
Billing Period : JAN-15  
Bill Date : 24-01-2015

Tariff Category : Domestic      Cycle No. : 11

**Customer Care Centre No. (ग्राहक सेवा केंद्र का नंबर) 39 99 97 07**

Meter No. (मीटर नं.)	Unit (यूनिट)	Billed Consumption (Current)		Billed Consumption (Previous)		Multiplication Factor (गुणक)	Current Consumption (वर्तमान अवधि का मूल्य)	Unit (यूनिट)
		Date of Meter Reading (बीज दिनांक की तिथि)	Reading (पढ़ाई)	Date of Meter Reading (बीज दिनांक की तिथि)	Reading (पढ़ाई)			
22068661	KWH	19-01-2015	89179.00	19-12-2014	88696.00	1.00	31	483.00
22068661	KW	19-01-2015	5.58	19-12-2014	-	1.00		5.58

**Billing Details (बिल का विवरण)**  
Current Period Charges (वर्तमान अवधि का मूल्य) (20-12-2014 to 19-01-2015)

Fixed Charge "A" (₹)	Consumption Measured During (कुल मापी गई)	Energy Units Consumed / Billed (इकाई इकाई में / बिल में)	Slabwise Energy Charge (नियत स्लैब में बिजली का मूल्य)	Slabwise Power Purchase Adjustment Charge (इकाई इकाई पर अंतर का मूल्य)	Time of Day (TOD) Charge (दिन के 1 (तिथि) मूल्य)	Surcharge @ 1% on Energy Charge - Fixed Charge - Rebate = "C"	Electricity Tax @ 1% on Energy Charge, Surcharge on Energy Charge, PPA amount & TOD Surcharge/ Rebate amount = "D"	Total Amount (A + B + C + D) (कुल मूल्य)
225.00	1.00 MP(स)	200.00	4.00	800.00		225.67	3196.75	
		200.00	5.95	1190.00				
		83.00	7.30	605.90				
Total Units = 483		Total (B) = 2595.90		Total (C) =		Total (D) =		

**Past Dues / Refunds / Subsidy (पिछला बकाया / कूपरी / राशिवाप)**

Arrears / Refunds (बकाया / कूपरी)	Late Payment Surcharge (LPSC)	Other Charges, if any	Total Charges Payable (कुल देय मूल्य)	Rebate / Subsidy (₹/-)	Net Amount Payable (कुल देय राशि)
Amount (₹)	₹	₹	₹	₹	₹
		4.55	3191.30		3191.30

Amount not immediately payable, if any. (राशि जो तुरंत देय नहीं है, यदि हो तो)      ₹      Reasons (कारण)

Security Deposit with DISCOM (अंशों के पास जमा सुरक्षा राशि)      ₹4500.00

Interest accrued for FY 2013-14, already adjusted in bill No. 10220804093 (generated for the period 20-01-2014 to 15-04-2014)      ₹(270.00)

Interest for FY 2014-15 will be adjusted in your first bill to be generated in FY 2015-16.

**Bill Amount Payable (बिल देय राशि)**

**₹ 3190.00**

**Due Date of Payment (सुझाव देय तिथि) 11-02-2015**

If payment is made after the due date, LPSC for the delay, shall be charged in the next bill. (निश्चित तिथि के बाद भुगतान करने पर इस बिल में देय अवधि के बाद एलपीएससी जोड़ दिया जाएगा)

Last payment ₹ 2819.00 received on 09-01-2015. Payment accounted upto 21-01-2015. The connection shall be liable for disconnection on non-payment of all dues (including arrears of previous bill(s)) by due date, after notice as per Section 56(1) of the Electricity Act, 2003

LCC 26609982      65982 077C



**Customer Care Centre No. (सहक सेव केंद्र का नं०) 39 99 97 07**

Meter No. (मीटर नं.)	Unit (इकाई)	Billed Consumption (Current)		Billed Consumption (Previous)		Multiplication Factor (गुणक)	Current Consumption (धारागत)	
		Date of Meter Reading (मीटर पढ़ने का तिथि)	Reading (पढ़ने)	Date of Meter Reading (मीटर पढ़ने का तिथि)	Reading (पढ़ने)		Days (दिने)	Unit (इकाई)
22068661	KWH	23-03-2015	90116.00	19-02-2015	89663.00	1.00	32	453.00
22068661	KW	23-03-2015	5.28	19-02-2015		1.00		5.28

**Billing Details (बिल का विवरण)**  
Current Period Charges (वर्तमान अवधि का शुल्क) (20-02-2015 to 23-03-2015)

Fixed Charge "A" ₹ (स्थायी शुल्क)	Consumption Measured During (मात्रा मापने का काल)	Energy Units Consumed / Billed (इकाई / बिल के अंतर्गत इकाई)	Slabwise Energy Charge (स्लाब आधारित शुल्क)		PPAC % on B (अथवा 3% प्रति इकाई)	PPAC Amount = "C" ₹ (प्रति इकाई)	Taxes of Day (TOD) Charge (दिने के शुल्क)		Surcharge @ 8% on Energy Charge + Fixed Charge - Rebate = "D" ₹ (अथवा 8% प्रति इकाई)	Electricity Tax @ 5% on Energy Charge, PPAC amount & TOD Surcharge - Rebate amount = "E" ₹ (अथवा 5% प्रति इकाई)	Total Amount (A+B+C+D+E+F) ₹ (कुल राशि)
			Units Rate ₹ (इकाई दर)	Amount = "B" ₹ (कुल)			TOD % (अथवा 0.5% प्रति इकाई)	TOD Surcharge on "B" - Rebate Amount = "D" ₹ (अथवा 0.5% प्रति इकाई)			
239.28 (1.06 MWh)		213.00	4.00	852.00					204.56	125.16	2890.78
		212.00	5.95	1261.40							
		26.00	7.30	204.40							
PPAC on Fixed Charge = "C" ₹ (अथवा 3% प्रति इकाई)											
0.00											
Total Units = 453		Total (B) = 2317.80		Total (C) =		Total (D) =					

**Past Dues / Refunds / Subsidy (पिछला बकाया / वापसी / सहायता)**

Arrears / Refunds (अर्ब / वापसी)	Late Payment Surcharge (LPSC) (दिले से शुद्ध कर अर्ब)	Other Charges, if any* (अन्य शुल्क, यदि हो तो)	Total Charges Payable (कुल देय शुल्क)	Rebate / Subsidy (अथवा सहायता)	Net Amount Payable (कुल देय राशि)
Amount (राशि)	Amount (राशि)	Amount (राशि)	2890.52		2890.52

Amount not immediately payable, if any. (यदि जो शुद्ध देय नहीं है, यदि हो तो) ₹ \_\_\_\_\_ Reasons (कारण) \_\_\_\_\_

Security Deposit with DISCOM (अपने बैंक पर जमा शुद्ध राशि) ₹ 4500.00

Interest accrued for FY 2013-14, already adjusted in bill No. 102220904093 (generated for the period 20-03-2014 to 15-04-2014) ₹ (270.00)

Interest for FY 2014-15 will be adjusted in your first bill to be generated in FY 2015-16

Bill Amount Payable (बिल देय राशि) **₹ 2890.00**

Due Date of Payment (सुपान देय तिथि) **13-04-2015**

If payment is made after the due date, LPSC for the delay, shall be charged in the next bill (यदि भुगतान तिथि के बाद सुपान करने पर अगले बिल में अर्ब के लिए अर्ब का शुल्क चार्ज किया जाएगा)

IMPORTANT MESSAGE (महत्वपूर्ण सूचना)

**Rahul:** Madam, how is slab based tariff structure designed?

**Teacher:** In all states the tariff structures for residential consumers are designed in such a way that per unit charge is less, if your consumption is less and more if your consumption is more. In fact it increases significantly as you increase your electricity consumption. For example in a city the tariff is as below:

First 100 units	Rs 2.96/unit
Next 200 units (from 101 to 300)	Rs 5.56/unit
Next 200 units (from 301 to 500)	Rs 9.16/unit
Any units after that (above 500)	Rs 10.61/unit

You will pay higher amounts per unit as your consumption increases.

**The motive behind such structure is to motivate people to consume less electricity.**

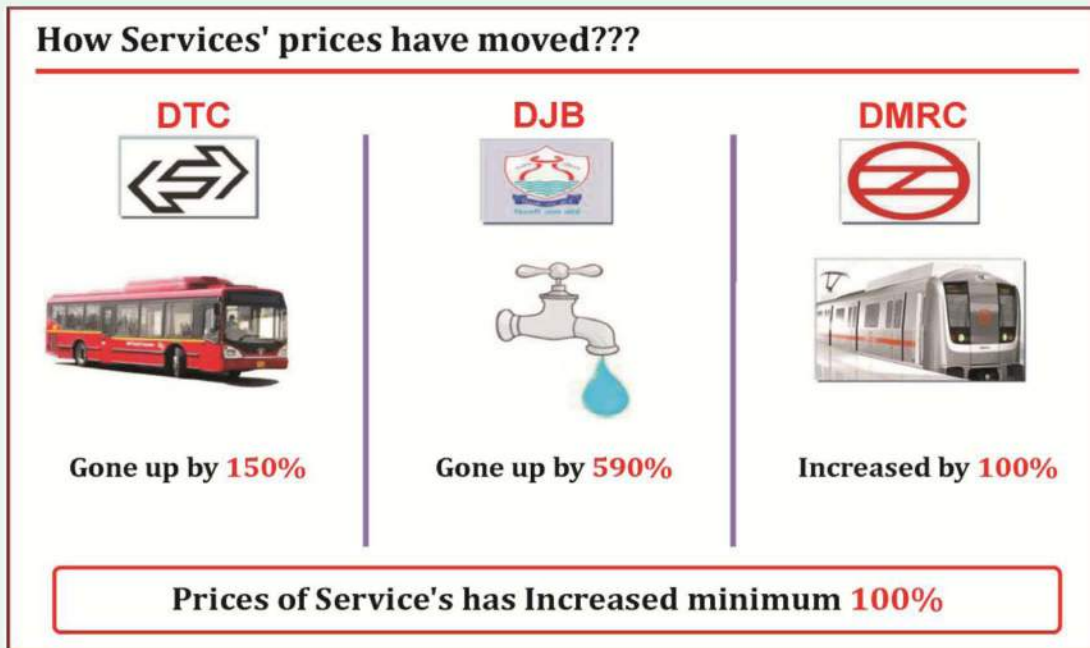
**Soham:** Madam, apart from the tariff slab, bill is showing some other charges.

**Teacher:** Soham you have sharp eye. Apart from the tariff slabs there is a fixed charge and 8% surcharge on total amount of fixed charge and electrical charge. Then there is electricity tax at the rate of 5% over the total electricity bill.

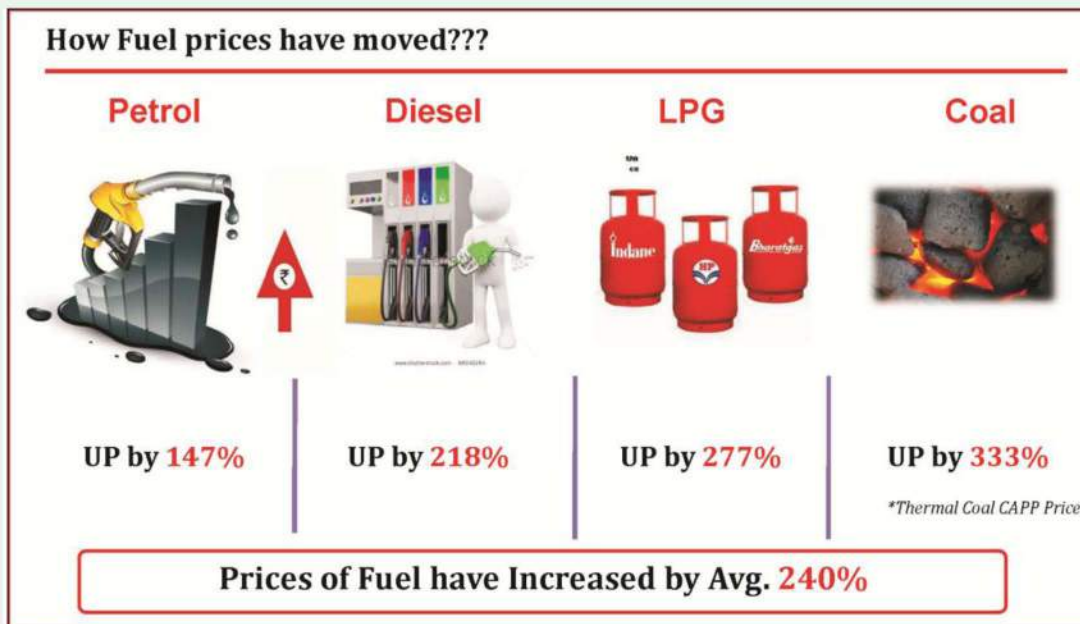


**Tina:** Madam, why there is surcharge when already the electricity consumption charges are taken?

**Teacher:** Very interesting question. As an aware citizen you must acquire the knowledge of these kinds of issues. In past few years fuel cost is raised by 240% due to which power generation cost is increased by 80% .However the electricity charges were not raised continuously for 6 years i.e. from year 2005-2011 which has caused heavy losses to electricity regulatory bodies. An interesting comparison chart is given in BSES report as follows:



Source: <http://www.bsesdelhi.com>



Source: <http://www.bsesdelhi.com>



To overcome the losses to the power generation and distribution companies due to hike in fuel prices and transportation costs surcharge is imposed for the first time by Government of India for temporary period.



**Diya:** Madam, why there is separate electricity tax?

**Teacher:** Cost of supplying electricity to all, costs more to govt. But in our country in order to make electricity affordable for all traditions of providing electricity to common man at lesser rate is adopted after independence. To compensate the expenses of government required to maintain the huge infrastructure some electricity tax is imposed by the government.

**Mahima:** Madam, I have observed that when less units are consumed, the bill amount is also less. Is it possible for us to reduce the consumption of electricity and hence the bills?

**Teacher:** Yes, if you know the power of all appliances you can definitely calculate the electricity consumed in a day. Also you can keep a check on wastage and reduce the time for which an electrical appliance is used. Here is a suggestive table of load and consumption time in order to keep the consumed units below 400 units in summer and winter:

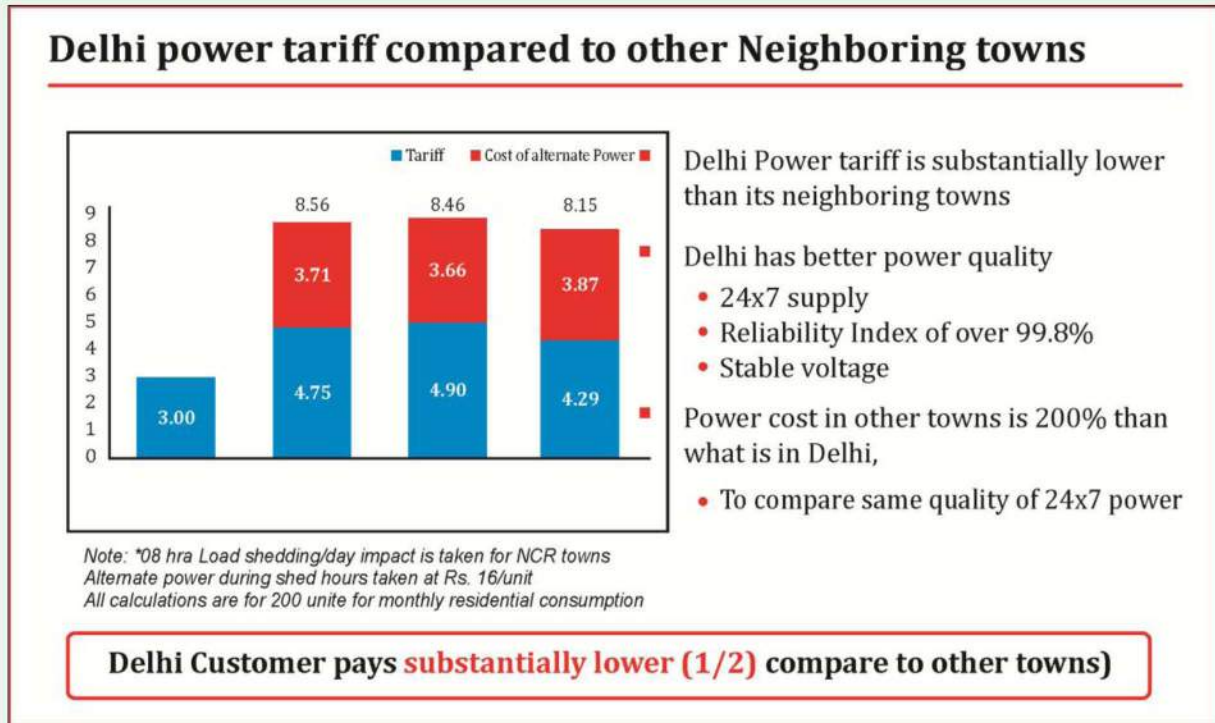
Approximate power consumption by consumers

APPROXIMATE POWER CONSUMPTION BY CONSUMERS							
 <h2>SUMMER</h2> <h3>WHAT YOU CAN RUN ON 400 UNITS AND LESS</h3>				 <h2>WINTER</h2> <h3>WHAT YOU CAN RUN ON 400 UNITS AND LESS</h3>			
APPLIANCES	APPROXIMATE LOAD (WATTS)	AVERAGE HOURS/DAY	APPROXIMATE UNITS/mth	APPLIANCES	APPROXIMATE LOAD (WATTS)	AVERAGE HOURS/DAY	APPROXIMATE UNITS/mth
Tube Lights (2)	40	7	17	Tube Lights (2)	40	7	17
Lamp (1)	100	5	15	Lamp (1)	100	5	15
Electric Iron (1)	600-1000	1	30	Electric Iron (1)	600-1000	1	30
Refrigerator (1)	200	24	144	Refrigerator (1)	200	24	144
Desert Cooler (1)	200	7	42	TV (1)	200	4	24
Ceiling Fan (2)	60-100	10	48	Computer (1)	200	1	6
TV (1)	200	4	24	Pump Motor (1)	740	1	22
Computer (1)	200	1	6	Geyser	1000-2000	1	60
Pump Motor (1)	740	1	22	Washing Machine (1)	700	1	10
Washing Machine (1)	700	1	10	Mixer Grinder (1)	200	1	6
Exhaust Fan (1)	200	1	6	Exhaust Fan (1)	150	1	5
Exhaust Fan (1)	150	1	5	Toaster (1)	750	1	22
Toaster (1)	750	1	22				
<b>A TOTAL OF 391 UNITS/MONTH CONSUMED.</b> HOWEVER IF THE AIR COOLER (42 UNITS/MONTH), IS REPLACED BY AN AIR CONDITIONER (1.5 TON) FOR A DURATION OF 7 HOURS/DAY THAT UNITS WOULD GO UP BY 37 & UNITS/MONTHS.				<b>A TOTAL OF 361 UNITS/MONTH CONSUMED.</b>			



**Chanchal:** Madam, I have shifted to Delhi recently. Are electricity tariffs same in all states or living in capital costly for electricity consumers?

**Teacher:** (Smiling) surprisingly this is not true. Look at the comparative rates of all states in the year 2013.



*Source: <http://www.bsesdelhi.com>*

Following are the tariff slabs of electricity charges applicable in different states in the Year 2013 in various categories like domestic, commercial, industrial etc.

TARIFF COMPARISON ACROSS DIFFERENT STATE UTILITIES NEAR DELHI NCR						
CATEGORY	Units	Delhi (TPDDL)	Haryana (DHBVNL)	Uttar Pradesh (NPCL)	Rajasthan	Punjab
		Rs. / Unit	Rs. / Unit	Rs. / Unit	Rs. / Unit	Rs. / Unit
Domestic - 2 kW	200	2.15	5.40	4.38	5.16	5.29
Domestic - 2 kW	400	2.53	5.41	4.44	5.17	5.76
Non Domestic- 10 kW	1500	8.57	6.22	7.73	7.13	6.57
LT Industrial - 10 kW	1500	8.13	7.08	7.50	6.78	5.74
HT Industrial - 100kW/108 KVA	15000	7.50	6.38	7.70	6.51	6.33
Power Outage During Summer(Avg.)**	Hours/day	0	4-6	2-4	2-2.5	2-2.5





TARIFF COMPARISON ACROSS DIFFERENT UTILITIES OF METRO CITIES IN INDIA					
CATEGORY		Delhi (TPDDL)	Mumbai (R-infra)	Kolkata (CESC)	Chennai (TNEB)
	Units	Rs./Unit	Rs./Unit	Rs./Unit	Rs./Unit
Domestic - 2 kW	200	2.15	3.88	5.69	2.98
Domestic - 2 kW	400	2.53	4.83	6.44	4.46
Non Domestic - 10 kW	1500	8.57	6.47	7.80	7.31
LT Industrial - 10 kW	1500	8.13	6.95	6.20	5.70
HT Industrial - 100kW/108KVA	15000	7.50	8.81	7.95	9.16

Sources: <http://www.ndpl.com>

**Teacher:** I hope you all will review your electricity bills and will be able to help your parents understand the bill.

**Students:** Yes, we have also got an idea about how to reduce power consumption and save electricity and to save money.

### SAMPLE QUESTIONS

**Note:** Attempt all questions given below without taking into account surcharge and electricity tax.

Q2. Form a linear equation if the total bill of a house in Delhi is above Rs. 3000 for a month assuming that the consumption is of  $x$  units as per Delhi tariff slabs shown in actual bill.

3 Marks

Q3. Form linear equations to calculate bill for consumption of electricity units between 200 units and 400 units for all states and metro cities given in last table.

4 Marks

Q5. Amit has three bedrooms flat. He installed four fans and two air conditioners of 1 ton in the house. He observed that his total consumption for light and other electrical appliances excluding fan and air conditioner is 200 units in a month. He wishes that his monthly consumption of electricity should be 550 units in a month. Establish a linear equation for the same assuming that he is using all fans for  $m$  number of hours and air conditioner for  $p$  number of hours. AC of 1 ton take load of 1900W.

3 Marks



## MARKING SCHEME

- Sol. 2** Given total consumption =x units 3  
As per given tariff slab rates of first 200 units and next 200 units are fixed.  
Consumption of electricity above 400 units.  
= x – 400  
Hence linear equation is  
 $200 \times 4.00 + 200 \times 5.95 + (x-400) \times 7.30$  [Without any fixed charges]
- Sol. 3** Let x be the consumption of electricity between 200 units and 400 units and y be the total electrical charges in respective states. Then as per the tariff slab given in last table linear equations will be as follows: 4  
For Delhi  
 $Y = 2.15 \times 200 + 2.53x$   
For Haryana  
 $Y = 5.40 \times 200 + 5.41x$   
For UP  
 $Y = 4.35 \times 200 + 4.44x$   
For Rajasthan  
 $Y = 5.16 \times 200 + 5.17x$   
For Punjab  
 $Y = 5.29 \times 200 + 5.76x$   
For Mumbai  
 $Y = 3.88 \times 200 + 4.83x$   
For Kolkata  
 $Y = 5.69 \times 200 + 6.44x$   
For Chennai  
 $Y = 2.98 \times 200 + 4.46x$
- Sol. 5**  $80(4m)/1000 + \frac{1900}{1000} 1n = 550$  3  
Given average load of fan in table in text is 60-100 W so 80 is taken as average load for fan. It is multiplied by 4m because 4 fans will run for m hours. The total energy consumed by fans are divided by 1000 because 1000 watt consumption shows for 1 hour 1 unit on meter.



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