30 ENERGY

30.1 INTRODUCTION

Heating, lighting, movement of men and materials all require energy. Can you think of a household without any means to heat. All cooking depends on heating. Similarly to overcome darkness we need lighting. These activities require energy. Energy may come from different sources and it may be used for different purposes. For instance, electricity may be used for lighting. It is also used for heating.

Factories, houses, offices, hospitals, farms, schools all depend upon different forms of energy and use it for different purposes. Factories use electricity for making machines work. It is impossible to think of life without the sources of energy. Even a man sitting in the sun to protect himself from cold is absorbing heat energy directly from the sun.

The use of energy is not new to human society. From the very beginning, human society has depended on energy. Energy not only fulfils various human needs directly, but also contributes significantly to production of goods and services. In this lesson you will read about the need of energy and various sources of energy.

30.2 OBJECTIVES

After going through this lesson , you will be able to :

- explain the need of energy for various sectors;
- list the various sources of energy in India;
- classify various sources of energy as renewable or non-renewable;
- explain the availability position of various sources of energy in India;
- explain the importance of energy in economic development of India;
- explain the major problems of the energy sector;
- state the steps required/being taken to solve the problems .

30.3 NEED OF ENERGY FOR VARIOUS SECTORS

Energy is one of the vital infrastructural facility which is used extensively by almost all the sectors of the economy including industry, agriculture, transport, household and service sectors.

1. Household

In household sector the energy is used directly to meet our daily needs .The main use of energy in this sector is for cooking . In rural areas the energy for cooking comes mainly through firewood and dung . The urban areas, however, are meeting their cooking needs through gas, electricity and kerosene oil. Besides cooking the household sector uses energy for lighting.

2. Agriculture

There was a time when all agricultural activities were performed manually. Animal power is still used for ploughing the fields. However, it is being gradually replaced by tractors . Tractors work by using the energy derived from diesel. The uncertainity with regard to monsoons have made it desirable to use reliable sources of irrigation like tube-wells, water pumps etc .These devices uses energy inherent in power or diesel. Use of such mechanical devices helps in increasing productivity i.e. higher output per hectare of land. The agricultural sector could not have used these devices without the help of energy.

3. Industry

Industry uses various types of machines for production of goods. These machines not only increase the production but also save a lot of time . Energy is used extensively in the form of power for running these machines in industry . Energy is also used in the form of fuel for various heating operations . You must have seen how a blacksmith works . He first heats up the iron before he finally shapes it. Industry uses various types of furnaces which heat up the materials with the help of coal , oil and power . Heating of materials is necessary if further operations like bending , rolling etc. are to be performed. Likewise, energy is also required for lighting.

4. Transport and Communication

Transport sector is one of the major consumer of energy. Road transport uses petrol and diesel. Though rail transport started with the invention of steam engine , in modern times rails run mainly by using the energy drawn from power and diesel. Means of communication like radio , television etc. are also dependent upon energy resources like power.

30.4 SOURCES OF ENERGY

Energy is generally defined as capacity to do work. There are many sources of energy. For

example , the energy inherent in animals (Animal Power) was widely utilised by earlier societies. Even today it is being used extensively in our villages . However, man has always concentrated on the development of newer sources of energy .The importance of coal in the industrial revolution in Europe is well known. Modern society uses various types of energy resources like :

- Coal
- Oil and Natural Gas
- Electricity- Nuclear, Thermal and Hydroelectric
- Firewood, Vegetable Wastes , Dried Dung and Bio-gas
- Solar Energy, Wind Energy, Tidal Energy etc.

30.5 CLASSIFICATION OF ENERGY SOURCES

Energy sources can be classified in different ways . One such way is to classify energy resources as renewable or non-renewable resources.

1. Renewable and Non-renewable Sources

(a) Renewable sources

This classification is based on whether the sources of energy are exhaustible or not. Renewable sources include hydro-electric power, dung cake , agricultural waste , solar energy, wind energy, tidal energy etc.

(b) Non-renewable sources

Coal, oil and natural gas come under the category of non-renewable sources as the reserves of these resources are limited. Non-renewable sources of energy cannot meet the long term requirements of energy of our country. On the other hand the potential of renewable sources is unlimited in our country.

The overall scarcity of coal, oil , natural gas etc. in our country has given rise to urgent need to develop and exploit renewable sources of energy. Another problem with regard to exhaustible sources like coal, oil and natural gas is that the availability of these resources is not widespread, which results in higher transportation costs besides safety.You must have seen large oil or gas tankers moving on the roads. These tankers carry oil and gas from refineries to the places of consumption.

(c) Arguments in favour of renewable sources

There are three arguments in favour of renewable sources of energy. First, considering the vast distances and the costs of transportation of energy, locally available renewable sources like solar, wind, bio-gas energy become attractive. Second, these resources are non-exhaustible. Three, uses of these resources cause little pollution.

The Government of India is fully aware of the importance of renewable/non-exhaustible sources of energy and is encouraging the development and use of these sources of energy. The Indian Renewable Energy Development Agency Ltd. (IREDA) was established in March 1987, as a public sector enterprise for the promotion, development and financing of new and renewable sources of energy (NRSE) technologies.

(d) Conventional vs. non-conventional sources

Apart from this classification the sources of energy are also classified as conventional or non-conventional. Coal, electricity, oil, gas, firewood, dried dung, etc. has been in use for quite some time and are therefore called conventional. Solar energy, wind and tidal energy are called non-conventional sources of energy because their use has started only recently.

POINTS TO REMEMBER

- All sectors of the economy need energy.
- Energy is defined as the capacity to do work.
- Sources of energy can be classified into two - Renewable and Non-Renewable.
- Coal, oil and gas are examples of non-renewable sources of energy.
- Solar, wind and tidal energy are examples of renewable sources of energy.

INTEXT QUESTIONS 30.1

State whether the following statements are true or false :

(i) Energy is used only in the household sector and not in industry and agriculture.
(ii) Coal , oil and gas are renewable energy sources .
(iii) Solar , wind and tidal energy are non-conventional sources of energy.
(iv) Government is discouraging the use of solar energy as it is not adequately available in India.

30.6 AVAILABILITY OF VARIOUS SOURCES OF ENERGY IN INDIA

(A) COAL

Coal is one of the most common form of fuel used for cooking and heating. This is the best source of power as well as fuel. Coal is an exhaustible source of energy . Coal, however, has played and is expected to play an important role in the economic development of our country. Coal industry was in the private sector till it was nationalised in 1970's with the creation of Coal India Ltd. (CIL). This was done to curb malpractices of coal mine owners. However, due to shortage of funds and to promote competitiveness, private sector investment has been encouraged in the coal industry through the Coal Mines Act of 1990s.

The power sector is so far the largest consumer of coal. The other major consumers are: steel, cement, railways, fertilisers and the household. Besides states like Bihar, Madhya

Pardesh and West Bengal who are the largest producers of coal , states like Orissa , Assam, Maharashtra also contribute significantly in meeting our coal requirements.

Coal Resources

The coal reserves in our country at the beginning of 1992 stood at 196 billion tonnes. However, out of 196.02 billion tonnes, only 144 billion tonnes are mineable because of various technical problems. Further, only 70 billion tonnes of coal can be extracted economically i.e. at reasonable costs , based on present day technology.

Problems of coal industry

1. Production not sufficient

The total production of coal which was 3 crore 23 lakhs tonnes in 1950-51 has increased to 27 crore 1 lakh tonnes in 1995-96. The demand for coal, however, has increased at a faster rate, necessitating imports at times. The demand and production of coal by the end of the eighth plan was fixed at 31 crore 1 lakh tonnes and 30 crore and 8 lakh tonnes respectively. So the production was not sufficient.

2. Poor quality

The quality of Indian coal is also generally poor. Indian coal has high ash (waste material) content and low calorific value (amount of energy).The ash content varies from 25 to 40% and sometimes exceeds 40%. It also results in low efficiency of coal based thermal plants and adds to air pollution. In order to meet the quality requirements, the steel industry has to import large quantities of coal causing burden on foreign exchange resources of our country.

3. Low productivity

The coal industry in India has been suffering due to low productivity levels as compared to the levels in developed countries. The coal industry employs nearly 7 lakh people. The productivity levels have been especially low in case of underground mines. The underground mines employ 80% of the manpower, but contribute only 30% of total output.

(B) OIL AND NATURAL GAS

Industrial development during the 18th and 19th centuries was based on coal, which was the leading source of energy. Towards the end of 19th century, however, mineral oil replaced coal as the leading source of energy. After Independence ,India also imported large quantities of oil to accelerate economic development.

Production

Bombay High, Mahanadi Delta, Assam, Ankleshwar and Cambay in Gujarat, Arunachal Pradesh, Tripura etc. have known reserves of oil and natural gas. India's crude output, which averaged less than 2.5 lakh tonnes in early 1950s , shot up to over 10 lakh tonnes in 1962 after the development of Ankleswar field in Gujarat and increase in production in

Assam. The discovery and subsequent development of the Bombay field in western offshore in 1974 led to a pick-up in production to 100 lakh tonnes in 1977.With addition of Bombay High and other fields in western offshore area, India's crude output touched a peak of 341 lakh tonnes in 1989-90. However after 1989-90 , the growth in production of crude has remained slow. In 1995-96, production was 351 lakh tonnes.

The long term availability position with regard to oil and natural gas is not satisfactory in India. The low availability of oil and natural gas in India, has always been a major area of concern for Indian planners.

Oil and Natural Gas Corporation Ltd.(ONGC) contributed 90% of the total crude oil produced in the country in 1995-96 while the rest was produced by Oil India Ltd.(OIL) and joint ventures. Though traditionally the production, refining and marketing of Oil and Gas is primarily the responsibility of Public Sector Undertakings, like ONGC, OIL, HPCL, GAIL etc. In order to boost up availability of oil and petroleum products , the Government of India has thrown open major segments like oil exploration, development of oil and gas fields, refining, marketing etc. for private investment.

Though the production of crude oil has increased from 2.5 lakh tonnes in 1950-51 to 351 lakh tonnes in 1995-96 , the increase is not sufficient when one compares it with increasing demand. During 1995-96 the consumption of petroleum products was 747 lakh tonnes.

Due to demand-supply gap in case of oil, India has to spend large amount of foreign exchange to import oil and oil products. At the same time the prices of oil and oil products are continuously increasing in the international market. This has raised our import bill considerably.

A large number of measures have been taken to reduce the oil consumption. Still the consumption of oil has shown an increasing trend. In 1995-96, of the total imports the share of oil, petroleum and lubricants alone was very high at 21%. Rise in the prices of crude oil and the trend of increasing consumption have together contributed to the rise in the value of imports of POL (Petroleum, Oil and Lubricants). The trend is likely to continue in the future in wake of the increasing demand for oil products and slow growth in domestic production.

The domestic prices of petroleum products are fixed by the Government. In order to protect the weaker sections of society large subsidies are provided on items of daily use like kerosene oil, liquified petroleum gas (LPG) etc.

(C) POWER

At present electricity is an important source of energy. This source of energy is generated with the help of many natural resources such as coal, diesel, oil, water etc. It is called the secondary source of energy.

The demand for electricity in India is large and is growing steadily. In absolute terms consumption of electricity is increasing day by day in almost all the sectors of the economy. However, it is the agricultural sector which has shown the highest increase in percentage use of electricity power (see table 29.1). With programmes of rural electrification, demand for lift irrigation and energisation of pump sets has increased during the recent years.

Table 29.1
Sector-wise consumption of electricity
(percentage distribution)

Sector	1950-51	1970-71	1993-94
Industry	63	68	40
Agriculture	04	10	30
Railway Traction	07	03	02
Public Lighting	13	10	10
Domestic Use	13	09	18
Total	100	100	100

Electricity generated through various sources can be classified in various heads which are the following:

1. Thermal electricity

In the production of thermal power, coal and other raw materials found in collieries and mines are used. That is why thermal power plants are constructed near the coal mines. Thermal electricity is also produced from diesel oil. Coal and diesel oil cannot be renewed, so it is difficult to rely upon them over a long period of time. There are certain places in India where the water is scarce. And whatever water supply is available is used for irrigation. So the water cannot be used for generating electricity. In these areas thermal power is very useful.

In the northern India the share of thermal electricity and hydro-electricity in total power production are equal. In eastern and western India, a large share of total power production is contributed by thermal power. Coal is used on a large scale in the generation of thermal power. This is the reason why big aluminium and steel plants have set up their own thermal power plants for availability of power. About 55% of the total power generation is contribut ¹ by thermal power.

2. Hydro-electricity

Among the various sources of generating electricity, water is the non-exhaustible natural resource. Dams are constructed and the river water is made to run huge turbines. Electricity so produced from water is known as hydro-electricity.

The construction of these plants requires a lot of time and heavy expenditure is incurred. In spite of this it is the cheapest of all the sources of power.

Most of the hydro-electricity is produced in southern India because of the low level surface. There are plenty of water deposits in north eastern Himalayan regions but they have not been properly utilised. Hydro-electric power is utilised in western Himalayas specially in the upper parts of Punjab.

Various river valley projects were started in India after Independence. The main objective of these projects was electricity generation. The electricity generation can be increased manifold by utilising the water from canal, rivers and lakes.

3. Atomic electricity

It is the latest source and gradually becoming a major source of power. It is generated from uranium and thorium. In India the known reserves of uranium are approximately 2000 tons which are very limited. But we have the largest deposits of thorium in the world i.e. 5,00,000 tons. The quantum of power generated from atomic minerals can be much more than what is from any other source. This you can observe from the fact that electricity generated from 10 to 11 thousand tons of coal can be generated from only 1 ton of uranium. Besides, the heavy expenditure incurred in the generation of thermal power can be reduced by generating electricity through atomic minerals.

Tarapur, Kota, Kalpakkam are examples of atomic power plants.

Presently, the contribution of nuclear plants in total power generation is very marginal. The country is likely to have installed capacity of 2225 MW only at the beginning of Ninth Five Year Plan.

Though the availability of uranium in our country is limited, the country is endowed with good potential of generating nuclear power specially if thorium can be used in fast breeder reactors.

It is no denying the fact that demand for energy is increasing faster than its supply. In the case of electric power itself, the requirement of all industry, agriculture, households is increasing at a very fast rate.

Increasing generation of electricity is difficult because of the shortage of available resources. That is why the generation of electricity which was done in the public sector earlier, is

being thrown open to the private sector comprising both Indian and foreign companies.

D. SUN, WIND AND THE TIDES

Solar and wind energy are non-conventional sources. Efforts are now being made to tap these resources. The non-conventional sources are now preferred because conventional sources are limited and polluting. Non-conventional sources are non-exhaustible and non-polluting.

1. Solar Energy

While the availability of solar energy is abundant , the need is to find cost-effective technologies to tap the solar energy. Some examples of the use of solar energy are solar cookers, street lighting systems,domestic lighting systems and small power plants. During the year 1995-96 , 680 street lighting systems , 7470 domestic lighting systems , 44938 solar lanterns and power plants of an aggregate capacity of 89 Kwp were installed.The use of solar energy devices is being encouraged through subsidies.

2. Wind Energy

Wind energy is also available in abundance in coastal and hilly areas. Subject to techno-economic feasibility of converting it into useful energy , the wind energy potential has been estimated to be more than 10,000 MW. India has achieved considerable progress in the exploitation of wind energy during the last few years. A total capacity of 732 MW has been installed by the end of year 1995-96 of which 684 MW has been installed in the private sector. It was expected to reach 1000 MW by the end of the eighth five year plan and that would place India in the second position in wind energy after USA.

3. Tidal Energy

Tidal energy , too, can become a major source of energy, because of large coastal area. The main problem with tidal power plants is that they are economical only if the installed capacities are high ; besides investments required are considerable. In fact this has been a major inhibiting factor. France has already demonstrated the use of tidal power.

(E) BIO-MASS

Fuel wood, animal dung and crop residues are biological sources of energy and are collectively referred as Bio-Mass. Fuel wood is an important source of energy for the rural and, to some extent, urban households. The growth in demand for wood for industry, house construction , domestic use etc. has led to decline in the numbers of trees in the jungle. This has an adverse effect on environment. Fuel wood is supplemented by dung and crop residues in meeting domestic energy needs in the rural areas. The annual availability of wet dung has been estimated to be around 100 crore tonnes. The net annual availability of crop residues, which can be used as fuel was estimated to around 5 crore tonnes.

Large scale afforestation at the village and regional levels can meet the local biomas requirements. Work is in progress on 70 fast growing fuel wood tree species for raisin

yield and acreage in the country. Further, appropriate technologies are required to convert the biomass into energy in an efficient manner.

(F) BIO-GAS

A typical bio-gas plant converts animal and human excreta into organic manure, extracting methane in the process, which can be used extensively for both cooking and lighting purpose. It can also be used to carry out simple agricultural operations. The oil energy crisis in 1970's generated a lot of interest in bio-gas plants. The Government announced a series of subsidies and bank loans for the construction of bio-gas plants in rural areas.

National project on biogas development was taken up in public sector during 1981-82 on a country-wide basis. Against the potential of 120 lakh numbers of family type biogas plants the installation has reached 23.59 lakh by 1995-96. Besides family size biogas plants, the ministry of Non-Conventional Energy Sources is also promoting the setting up of community and institutional biogas plants in the country.

INTEXT QUESTIONS 30.2

State whether the following statements are true or false:

(i) The quality of Indian coal is generally good as Indian coal has low ash content.
(ii) Coal reserves are mostly concentrated in states like Punjab, Haryana and J&K.
(iii) Steel industry is the largest consumer of coal.
(iv) The availability of oil and natural gas is not satisfactory in India.
(v) The prices of petroleum products in India are determined by the market.
(vi) The share of thermal plants in total electricity generation is highest.
(vii) India has low reserves of thorium, but it has large reserves of uranium.
(viii) We cannot produce power from solar energy.
(ix) Bio-gas plants produce both the manure as well as gas.

30.7 IMPORTANCE OF ENERGY IN ECONOMIC DEVELOPMENT OF INDIA

Energy resources like coal , oil , natural gas, water etc., have always provided tremendous motive power for economic development of any country. The industrial revolution of the West would not have been possible without the use of various sources of energy. In the context of India also a lot of credit must be given to various sources of energy for the progress made by India since Independence. Indian Planners were fully aware of the importance of energy in economic development , and therefore accorded high priority to this sector. The share of energy sector in total plan outlay has increased from 19.7% in the first five year plan to 28.2% during the seventh five year plan.

The major areas where energy has contributed in a significant manner are outlined below:

1. Improvement in Quality of Life

Energy has substantially improved the quality of human life. Application of energy for lighting , cooking, transport, heating, cooling, mechanisation etc. has made the life more comfortable. Energy is the main base of the high living standards of developed countries. Energy is not only essential to improve the physical quality of life but is also required for socio-economic development of the rural people of the country. For example, the low status of the rural women has also been raised by freeing them from certain types of jobs and reducing the burden of domestic work through the installation of water-pumps, provision of cooking fuels etc.

2. Increasing Productivity Levels in Various Sectors

The role of energy in development of agriculture sector is well known. The use of energy-run devices like tractors, tube-wells, threshers etc. in agricultural has enabled the higher production of cereals , cash crops , vegetables, fruit and other agricultural products. The use of energy therefore helps to raise the income levels of the people through higher productivity.

Consumption of energy is a good indicator of level of economic activity of any country. In fact there is high degree of corelation between the large per capita consumption of energy and the high per capita income in these countries. The per capita consumption of energy in India is very low as compared to developed countries like Japan, USA, UK etc. However with the growth in our economy , the energy consumption in India has been steadily going up. To meet the growing requirement of energy , our country produced approximately 27.1 crore tonnes of coal in 1995-96 as compared to 3.23 crore tonnes in 1950-51. Similarly, the electricity generation in 1995-96 was 415.2 billion KWH as compared to only 6.6 billion KWH in 1950-51. The production of other sources of energy like crude oil, petroleum products, natural gas etc. also shows an upward trend.

The present day industries largely depend on use of energy for production of goods. Nearly half of the commercial energy is used in industrial sector. However, non-availability of energy resources is considered as one of the major constraints in rapid development of industrial sector in our country . Since energy is an important input for any industry, non-availability of the same results in lower utilisation of existing facilities . It is therefore necessary to increase the availability of energy.

3. Generation of Employment

The use of energy has also increased employment opportunities through higher economic activity. Further, the energy sector itself provides immense employment opportunities. Coal industry alone provides employment to nearly 7 lakh people. In addition to this , there are many Government agencies/public undertakings which are engaged in the development and production of energy sources. These organisations provide employment to millions of people. With the onset of liberalisation process and encouragement to private sector for development of energy resources , it is expected that more and more employment opportunities will also be created in the private sector also.

30.8 MAJOR PROBLEMS OF ENERGY SECTOR

1. Inadequate production

India's energy problem is not one of imbalance between demand and production in oil only. In fact demand-supply imbalance is widening rapidly in all commercial fuels. Though the production of all commercial fuels has been rising but not to an adequate requirement. The growth in generation of power and the increase in crude oil production are much below the targets.

2. Lack of financial resources

Massive investments are required for development of energy resources. It is not possible to finance such massive investments with only budgetary support.

3. Serious imbalances

First, country has low reserves of oil and gas , however consumption pattern shows bias in favour of more and more usage of oil and gas.
Second, urban areas use around 80% of commercial energy though their share in population is much less.
Third, little progress in development of renewable commercial sources of energy like solar and wind power.

4. Inefficiencies

The energy scene in India is marked by some serious inefficiencies , some of which are mentioned below :

First, use of equipment and appliances which are not energy efficient.
Second, considerable transmission and distribution losses especially in case of power.
Third, inefficiencies of power plants, coal mines and oil drilling.

30.9 STEPS REQUIRED/BEING TAKEN TO SOLVE THE PROBLEMS

Generally, the primary responsibility for providing infrastructural facilities including energy was considered that of government . However, it was increasingly felt that the massive investment needed in the energy sector cannot be met within the financial resources of the government without affecting other priority social and economic programmes . The current thinking, therefore, is to promote private sector participation in the development of energy sector. The government for this purpose, is providing various incentives in taxes and for raising financial resources . Further, to improve energy position following measures are being taken :

1. Thrust on oil exploration and stepping up indigenous crude oil production.
2. Promotion of fuel efficient devices.
3. Steps to check the distribution losses in power.
4. Research and Developmental efforts for substitution of petroleum fuels.
5. Development and utilisation of renewable energy resources.
6. Education of people with regard to energy conservation and efficiency.
7. Finance and subsidies for development and use of non-renewable sources of energy.
8. Greater use of unconventional sources of energy.
9. Allowing entry of private and foreign sector in the generation of electricity.

INTEXT QUESTIONS 30.3

Fill in the blanks with suitable words out of those given in the brackets:

(i) The countries having high per capita income have generally———level of energy consumption. (high , low ,zero)

(ii) The consumption of electricity, oil and coal has steadily————over the years.(increased, decreased, remained same)

(iii) The urban India uses ———— percentage of commercial energy than rural India. (less, more, same)

(iv) Industry uses roughly ———— percent of total commercial energy. (50%,20%,75%)

(v) The plan allocation for energy sector as percentage of total plan outlay has ———————— from the level of first plan. (increased , decreased, remained same)

POINTS TO REMEMBER

- Energy is used in the economy for cooking, running of machinery, lighting, water pumps, heating, cooling, for movement of goods etc.
- Various forms of energy can be classified in following broad categories: (a) renewable/non-renewable (b) commercial/non-commercial (c) conventional/ non–conventional.
- The reserves of coal, oil and natural gas are limited in our country.
- Government is encouraging the use of renewable sources of energy.
- Electricity is broadly of three types i.e. thermal, hydro and nuclear.
- Generation of hydro-power should be encouraged as it is renewable source of energy.
- Transmission and distribution losses of electricity are very high in India.
- There exists a large potential of solar,wind and tidal energy.
- Fuel wood, crop waste and animal dung are generally used in rural areas as sources of energy.

- The development of energy resources is of utmost importance, if rapid economic growth is to be achieved.
- The energy sector in India has the problems of demand-supply gap, lack of financial resources, imbalances in pattern of energy consumption and various inefficiencies.
- Steps taken to solve the problems are encouragement to private sector, thrust on oil exploration and substitution, use of fuel efficient devices, thrust on use and development of non-conventional sources, checking the distribution losses etc.

TERMINAL EXERCISE

1. List the various sources of energy. By giving examples, explain how the various sources of energy can be classified.

2. Discuss the advantages of using the renewable sources of energy.

3. Explain the availability position of coal and oil in India.

4. Explain the availability position of electric power in India . Outline the major problems of power sector.

5. Explain the role of energy in economic development of India.

6. Explain the availability of various sources of energy being used in rural India.

7. List the various problems of energy sector of India. What steps have been taken to solve these problems?

ANSWERS

Intext Questions 30.1

(i) False (ii) False (iii) True (iv) False

Intext Questions 30.2

(i) False (ii) False (iii) False (iv) True (v) False
(vi) True (vii) False (viii) False (ix) True

Intext Questions 30.3

(i) high (ii) increased (iii) more (iv) 50% (v) increased.

Terminal Exercise

1. Read section 30.4 & 30.5
2. Read section 30.5(c)
3. Read section 30.6 A & B
4. Read section 30.6 C
5. Read section 30.7
6. Read section 30.6
7. Read section 30.8 & 30.9