



UNIT 10

Industrial Revolution



Learning Objectives

To acquaint oneself with

- The essential features of Industrial Revolution in 18th century England
- Favourable Conditions prevailing in England for the Industrial Revolution
- Inventions that facilitated revolution in textile production
- Steel industry quickening the processes of industrialisation in England
- Rise of working class movement and its consequences in England
- Second Industrial Revolution in France, Germany and America
- Great Rail Road Strike and Hay Market Massacre in the US
- Impact of Industrial Revolution in India



Introduction

In the latter half of the 18th Century major changes occurred in the method of production that changed the history of humankind. This profound transformation is described as the Industrial Revolution. Goods began to be produced not by hand but by machines. This increased the volume of goods produced exponentially. The changes were not only economic but made a profound impact on

society and politics. Society transformed from an agrarian and handicraft economy to one dominated by factory and machine-production. Starting in England first, it spread to other parts of the world. Although it was used earlier by French writers, but the term *Industrial Revolution* was popularized by the English economic historians to denote Britain's economic development from 1760 to 1840.





10.1 Attributes of Industrial Revolution

- Use of new basic materials: iron and steel
- Use of new energy sources: coal, electricity, petroleum
- Invention of new machines such as the spinning jenny and the power loom that increased the production with a minimum expending of human energy
- Emergence of a new organization known as the factory system, which entailed increased division of labour and specialisation of work
- Development in transportation and communication
- Increasing application of science to industry
- The use of new technology



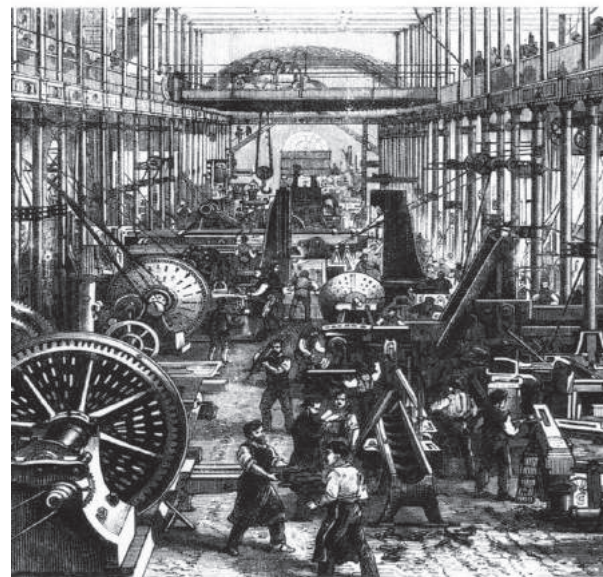
Beginnings

The Industrial Revolution began in England first because, it had certain external factors. They were:

- England had abundant resources and possessed colonies, with “India being the brightest jewel in the British Crown”
- Access to coal, iron and raw cotton from the colonies
- England possessed the required infrastructure for textiles, developed by immigrant artisans from the Netherlands
- England had a developed banking system, a growing entrepreneurial class, and potential investors
- Encouragement of the Royal Society of England for scientific discoveries and inventions
- Political stability of England to bestow its full attention to industrial growth

Invention of Steam Power

In the 18th Century, British mine-owners were faced with the problem of water seeping into the mines. Water had to be removed to extract coal. So they employed additional labourers to pump the water out. Employing human labour cost a lot of money. It was at that juncture the British engineer, Thomas Newcomen invented a contrive to pump the water out of mines. But the mechanism he developed consumed too much fuel. James Watt, a Scottish engineer, converted a stationary steam engine to a rotary engine which consumed less fuel.



A scene in an English factory

Development in Textiles

Before the Industrial Revolution, the spinning and weaving of cloth were undertaken for domestic and local consumption. It was done at home or in a small hired place. The production also took place on a cottage scale. The manually operated spinning wheel required four to eight spinners to supply yarn to one handloom weaver. In 1733 John Kay invented the ‘Flying Shuttle’ which, when operated by hand, increased the speed of the weaving of cloth. In 1764 James Hargreaves invented ‘the spinning jenny’. This machine spun eight threads at one and the same time. Two years later Richard Arkwright invented

the 'waterframe'. This spinning frame used water power in the place of manpower. The 'waterframe' was too big to be run at home. Thus was born the factory. In 1779 Samuel Crompton invented his 'spinning mule' which included a combination of both the 'spinning jenny' and the 'water frame'. It spun hundreds of threads simultaneously and produced eight fine and coarse threads. Eli Whitney invented the cotton gin in 1793, removing the seed from the cotton.



John Kay

James Hargreaves

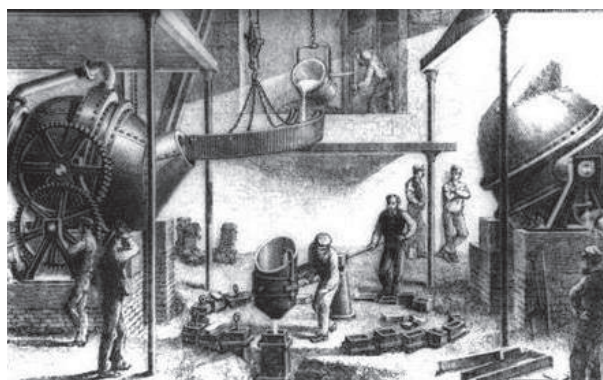
Textile manufacture was at the heart of the Industrial Revolution. Over a span of fifty years, the textile manufacturing industry in Britain witnessed a transformation in the method of production from handmade to machine-made goods. The newly invented machines enabled factories to produce textile goods in large quantities. Derbyshire, Lancashire, Cheshire, Staffordshire, Nottinghamshire, and Yorkshire became the major factory centres. The most notable was Manchester which had more than 50 mills in 1802. These factories involved in mass production were organized on the principle of division of labour.



Lancashire

Iron and Steel

The rolling mill (machine for rolling steel or any other metal into sheets) proved to be fifteen times faster than hammering wrought iron. Hot blast greatly increased fuel efficiency in iron production. In 1856, Henry Bessemer discovered a faster and cheaper method of producing steel. In course of time, iron and steel came to be used in making all machines and in all industries.



Iron and steel industry

Mining

The development of factories by Arkwright and the improvement of the steam engine by James Watt further increased demand for coal. As a result, coal mines became deeper and deeper, making it more and more dangerous. As miners used oil lamps in the mines the risk of explosion was high leading to the death of miners. This was reduced by the invention of a safety lamp by Sir Humphrey Davy in 1815.

The coal production in England increased from 4.7 million tonnes in 1750 to 250 million tonnes in 1900.



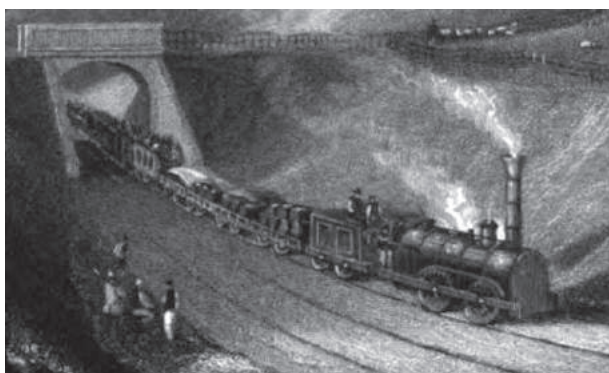
Coal mines

Transportation and Communication

Industrial Revolution was dependent on good transportation. As production increased raw materials had to be brought from afar to the factories. After the goods were produced they had to be transported to the markets. As a result new networks of canals, roads and railroads were built. Macadamised roads and George Stephenson's steam locomotive helped to improve road and railway transport system in the country.

John Loudon McAdam was a pioneering Scottish Engineer who single-handedly changed the way *roads* were built around the world. Macadamised road came to be adopted world over.

The railways date back to sixth century B.C. (BCE) in Corinth, Greece. They were man or animal driven. In the sixteenth century Germany had horse-powered rail transport. Modern rail transport commenced with the British development of the steam locomotives in the early 19th century. The first railway line in England was opened between Stockton and Darlington in 1825. In the next forty years 15000 miles of railway network was completed. Robert Fulton of the US invented the steamboat called Clermont in 1807 that sailed from New York to Albany, covering 150 miles. After a few years, steamboats carrying cargo shuttled on the rivers and coastlines. By 1830, the 40 miles between Manchester and Liverpool could be covered in an hour and a half.



The railways

10.2 Effects of Industrial Revolution in England

Industrial Revolution led to the expansion of trade, the production of more food, emergence of factory workers as a new class. The rise and growth of cities resulting in rapid urbanisation and organised working-class movements, seeking voting rights and regulation of their service conditions, brought about a new dynamics in politics.

Impact on Environment and Living Conditions

The use of chemicals and fossil fuels that replaced wind, water and firewood resulted in increased air and water pollution. The Industrial Revolution marked a major turning point in earth's ecology and humans' relationship with the environment.

The Industrial Revolution helped create opportunities for employment for all members of the family. However, the life for the labouring class was miserable. Children were employed in textile mills because they worked for lower wages. In 1842, the British Parliament published a report about the state of coal mining – the Mines Report .

Safety was very poor in early industrial factories and mines. The injuries from machinery would vary from mild burns, arm and leg injuries, to whole fingers to be cut off, or amputation of limbs and even death.

The housing was tiny, dirty, and sickly for the labouring class. Workers had no time to clean or change their own atmosphere even if they wished to, leading to the outbreak of typhoid, cholera, and smallpox.

Urbanisation

With the advent of the Industrial Revolution, England became the workshop of the world. There was however, a general decline in agriculture. This resulted in the flow of population from villages to industrial towns. Population growth, migration and urbanisation



were the major social changes taking place during this period. In pre-industrial society, over 80% of people lived in rural areas. As the migration from the countryside began to intensify, small towns became large cities. The city of London grew from a population of two million in 1840 to five million in forty years.

Manchester's cool climate was ideal for textile production. Further it was situated close to the port of Liverpool and the coalfields of Lancashire. Manchester became the textile capital of the world, drawing huge numbers of migrants to the city. In 1771, Manchester was a sleepy town of 22,000 people. Over the next fifty years, its population exploded and reached upto 180,000.

Socio-economic Consequences

While the peasants were pauperized and the working class suffered, the middle class became wealthy by investing capital in trade and industry. The governments of the day were influenced by them. All legislations safeguarded their interests. Labourers were not permitted to form trade unions. It was under these circumstances that Socialism as a new ideology was born in Europe. Karl Marx advocated scientific socialism for the protection of the working class from the exploitative policies of the capitalist class. By the latter half of the nineteenth century there were strong working class movements all over western Europe which demanded economic as well as political rights.

Labour Movement

The Reform Bill of 1832 granted voting rights only to the propertied middle class. Frustrated by this, the working class in a large gathering prepared a charter of demands and obtained signatures from millions of fellow workers. The charter was presented to the House of Commons (the English Lower house in the Parliament, England). Known as Chartism, this working class movement was active between 1836 and 1848. The Chartists called for voting rights to every man over twenty-one years of age, secret ballot (voting), abolition of property

qualification for members of the parliament, annual parliamentary elections and equal representation.

10.3 Spread of Industrial Revolution

Industrial Revolution in France

France did not possess as much natural resources as England. The political instability caused by the French Revolution and the prolonged Napoleonic Wars wrecked the country. Many of those French businessmen who had sought refuge in Britain during the Revolution, on their return to France after Napoleonic Wars, used British technology. This helped to accomplish industrial revolution in their country. The adoption of British-made spindles led to a two-fold increase in French textile production during 1830-1860.

The Francois de Wendel family brought British technology to Lorraine. The family introduced steam engine in coal mining and puddling kilns for iron smelting. By the 1860s the de Wendel family employed over 10,000 workers. By diversifying its business, it entered other heavy industries such as railroad construction and shipbuilding.

The town of Mulhouse in the province of Alsace rose to prominence for its dyes that brought many designers there. From this foundation, Mulhouse diversified into the growing heavy industry of the region and became prominent as a maker of machines. Saint-Chamond saw developments in iron production. In 1820, the British technology of refining cast iron began to be used in this town.

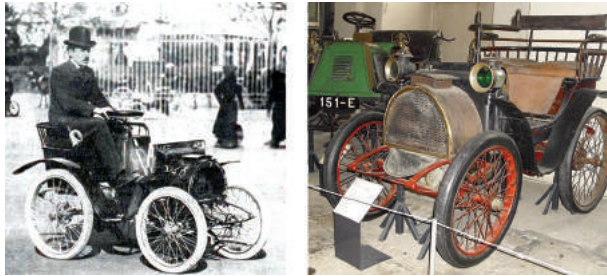


Francois de Wendel

In 1832, the first French railroad, St. Etienne–Andrezieux line was opened. Numerous railroad lines followed. By the end of the nineteenth



century France had become prominent for its automobiles. The two biggest automobile companies of today's France were started in 1891. Arman Peugeot produced his first batch of automobiles. In 1898, Louis Renault built the *quadricycle*, from which he began to produce in large quantities under his company, the *Societe Renault Freres* (Company Renault Brothers)



Old model Renault cars

In 1806, agriculture employed about 65.1% in France. It decreased to 42.5% in 1896. During the same period industries had grown in its share of employment from 20.4% in 1806 to 31.4% by 1896.

Industrial Revolution in Germany

Germany had the natural resources required for an industrial revolution. Large coal reserves were located in the areas of Saar, Ruhr, Upper Silesia, and Saxony. Iron was deposited in the areas of Erzgebirge, Harz Mountains, and Upper Silesia again.

Germany's main challenge was its feudal socio-political structure, perpetuating the practice of serfdom and their unhelpful licensure policies for establishing factories. In addition, only two major ports, Bremen and Hamburg, had clear and secure access to the North Sea. But the most significant challenge to Germany's industrial revolution was its political setup. Before 1871 Germany was made of numerous German states with Prussia being the biggest.

Cartel is an association of manufacturers or suppliers with the purpose of maintaining prices at a higher level and of restricting competition.

Railroads served Germany well in its industrial development as also in its Unification. The first railroad line opened on December 1835 and ran between Nuremberg and Furth. In 1842, the Prussian government created the Railway Fund in order to finance railroad construction project. In Prussia, Berlin became a centre of the railroad network. Railroads connected the members of the Zollverein and made trade and commerce more vibrant.

With the use of steam engines, the number of factories in Prussia grew from 419 in 1837 to 1,444 in 1849. The production of coal increased from one million ton in 1820 to over 6 million in thirty years. From 46,000 tons of iron produced in 1810, iron production rose to 529,000 tons by 1850. Railroads increased from 3,638 miles in 1850 to a distance of 11,600 miles in 1870.

In 1871, Prussia finally united Germany. Germany emerged as the most industrialised country by the end of the 19th century. Germany surpassed the home of the industrial revolution, Great Britain, and proved a competitor to the United States. In electrics, Germany offered companies like Siemens. In chemicals, Germany excelled in the production of potassium salt, dyes, pharmaceutical products, and synthetics. Companies like Bayer and Hoechst led the chemical industry of Germany. Germany became a leader in automobile industry. Daimler and Benz became the most popular brands of automobiles in Germany and the world.



Daimler Company

10.4 Second Industrial Revolution in United States of America

A shift from manual labour-based to more technical and machine-based manufacturing industry marked the Industrial Revolution in the United States. Samuel Slater, a citizen of England, having worked at a cotton mill from age 10, had gained enough experience to operate a mill. On learning that Americans were interested in the new techniques, Slater departed for New York in 1789 illegally. Slater offered his services to Moses Brown, a leading Rhode Island industrialist, who had earlier made an unsuccessful attempt to operate a mill. Brown agreed and in consequence the mill became operational in 1793, being the first water-powered roller spinning textile mill in the Americas. By 1800, Slater's mill had been duplicated by many other entrepreneurs as Slater grew wealthier and his techniques more and more popular. Andrew Jackson, the U.S. President hailed him as "Father of the American Industrial Revolution."



Samuel Slater



Andrew Jackson

The United States in the nineteenth century began to show technological innovation. Robert Fulton established the steamboat service on the Hudson River. Samuel F.B. Morse's invention of the telegraph and Elias Howe's invention of the sewing machine came before the Civil war (1860–1865).

In 1846, an American, Elias Howe invented the 'sewing machine' to stitch clothes. With the invention of new methods of bleaching, dyeing and printing, cloth with different colours could be produced during the early half of 19th century.

After the Civil War, industrialisation went on at a frantic pace. In 1869, the first transcontinental railroad was completed to transport people, raw materials and products. There was unprecedented urbanisation and territorial expansion in the US. As a result, between 1860 and 1900, fourteen million immigrants came to the country, providing workers for a variety of industries. The invention of electric bulb by Thomas Alva Edison (1879) and telephone by Alexander Graham Bell (1876) changed the world beyond recognition.

Andrew Carnegie established the first steel mills in the U.S for mass production. He acquired business interests in the mines that produced the raw materials for steel, the mills and

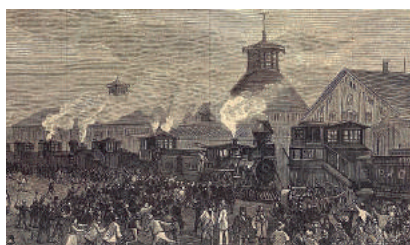


John D. Rockefeller ovens that created the final product and the railroad and shipping lines that transported goods, thus controlling every aspect of the steelmaking process. John D. Rockefeller merged the operation of many large companies to form a trust. His Standard Oil Trust came to monopolise 90% of the industry and reduced competition. These monopolies affected the smaller companies and even threatened them. The U.S. government supported the industrial growth by providing land for construction of railroads and protected the American industry from foreign competition.

The Industrial Revolution quickened the process of the transition of the United States from a rural to an urban society. Young people raised on farms saw greater opportunities in the cities and moved there, as did millions of immigrants from Europe. Providing housing for all the new residents of cities was a problem, and many workers found themselves living in urban slums; open sewers ran alongside the streets, and the water supply was often contaminated, causing disease.

10.5 Working Class Strikes

The difficult working conditions in the factories, long hours of work, low wages,



Railroad Strike of 1877

exploitation of women and children contributed to the growth of labour unions. After the Civil War, workers organized strikes. One major strike was the Great Railroad Strike of 1877. Wage cuts in the railroad industry, in the context of a prolonged economic depression, led to the strike, which began in West Virginia and spread to three additional states over a period of 45 days before being crushed



by a combination of vigilantes, National Guardsmen, and Federal Army.

Haymarket Massacre

A labour protest took place on 4 May 1886, at Haymarket Square in Chicago. What began as a peaceful rally in support of workers striking for an eight-hour day resulted in the killing of several workers by the police. To commemorate the Haymarket Affair 1 May 1887 is observed as the Labour Day or May Day or International Worker's Day.



Haymarket Massacre

10.6 Important Inventions of the Industrial Revolution Era

Inventions	Inventor	Year
Blast Furnace (Iron & Steel)	Abraham Darby	1709
Steam Engine	Thomas Newcomer	1712
Flying Shuttle (Textiles)	John Kay	1733
Improved Darby Process (Iron & Steel)	John Smeaton	1760
Spinning Jenny (Textiles)	James Hargreaves	1764
Spinning Frame (Waterframe) (Textiles)	Richard Arkwright	1769
Newcomen's Steam Engine Redesigned	James Watt	1769
Spinning Mule (Textiles)	Samuel Crompton	1779
Power Loom (Textiles)	Edmund Cartwright	1785
Cotton Gin (Textiles)	Eli Whitney	1793
Puffing Devil (the first steam powered locomotive)	Richard Trevithick	1801
Air Pump (in Mines)	John Bundle	1807
The Butcher (Locomotive)	George Stephenson	1814
Safety Lamp (for Mining)	Humphrey Davy	1815



Telegraph; Morse Code (Communication)	Samuel Morse	1844
Sewing Machine (Textiles)	Elias Howe	1846
Cheaper method of Making Steel (Iron & Steel)	Henry Bessemer	1856
Telephone	Alexander Graham Bell	1876
Incandescent Electric Bulb	Thomas Alva Edison	1879
Wireless Signals (Communication)	Marconi	1899

10.7 Impact of Industrial Revolution in India

Until the middle of eighteenth century, England was an agricultural country and India was known for its excellence in manufactures as well as in agriculture. In the first quarter of eighteenth century, in the context of Indian cotton manufactures flooding in England, a law was enacted prohibiting the use of Indian calicoes and silks. The invention of flying shuttle by John Kay and the inventions of Hargreaves, Arkwright and Crompton within thirty years accelerated the process of spinning and weaving. When the British established their foothold in Bengal as a territorial power, the loot from Bengal and the Carnatic provided the required capital and helped accomplish Industrial Revolution in England. The weavers of Bengal suffered at the hands of the Company's officials and their agents, who first insisted on payment of a transit duty for the commodities they carried from one place to another and later for cultivation of commercial crops required for British industries in England. Because of loss of market for hand-woven cotton goods, India lost her old industrial position and became an exporter of raw material.

By the first quarter of nineteenth century the export of Dacca muslin to England stopped. Even the export of raw cotton from India had steadily dwindled owing to the competition from USA. Weavers who were eking out an independent livelihood were thrown out of employment because of

flooding of British factory-made cheap cotton fabrics in Indian markets.

The Collector of Madurai reported that families of about 5000 weavers did not have the means to take more than one meal of rice a day. The Collector of Tirunelveli observed that the weaving population has 'outrun its means of subsistence and trammels of caste prevent them from taking to other work.' Millions died of starvation in famines. To escape starvation deaths, peasants and artisans had to move out of the country opting to working on plantations in British Empire colonies as indentured (penal contract) labourers under wretched service and living conditions.

Recap

- The main attributes of Industrial Revolution are presented
- Reasons for Industrial Revolution taking place first in England are explained
- Inventions leading to development in textiles are discussed
- Use of iron and steel leading to mechanisation of all industries and the rapid changes in transport and communication are detailed
- Impact of Industrial Revolution on environment and living conditions are highlighted
- Spread of Industrial Revolution in France, Germany and America are dwelt at length



- Labour movement and the repressive measures of the state in the US are particularly focused to demonstrate that the rights of working class were obtained after struggles and sacrifices



EXERCISE



I. Choose the correct answer

1. Who established the first steam boat service?
 - a. Arkwright
 - b. Samuel Crompton
 - c. Robert Fulton
 - d. James Watt
2. Why was Manchester considered ideal for textile production?
 - a. availability of land
 - b. rich human resources
 - c. better living condition
 - d. cool climate
3. Who invented the sewing machine?
 - a. Elias Howe
 - b. Eli-Whitney
 - c. Samuel Crompton
 - d. Humphrey Davy
4. Which family introduced steam engine in France?
 - a. de Wendel
 - b. de Hindal
 - c. de Arman
 - d. de Renault
5. Who called Slater, the father of American Industrial Revolution?
 - a. F.D. Roosevelt
 - b. Andrew Jackson
 - c. Winston Churchill
 - d. Woodrow Wilson
6. Which of the following is observed to commemorate the Hay Market Massacre?
 - a. Independence Day
 - b. Farmers Day
 - c. Labour Day
 - d. Martyrs Day
7. Where was Zollverein Customs Union formed?
 - a. England
 - b. Germany
 - c. France
 - d. America
8. Who produced the first batch of automobiles in France?
 - a. Louis Renault
 - b. Armand Peugeot
 - c. Thomas Alva Edison
 - d. McAdam
9. What was the invention that removed seeds from cotton?
 - a. Rolling Mill
 - b. Cotton Gin
 - c. Spinning Mule
 - d. Spinning Jenny
10. Which of the following was used as fuel in olden days to smelt iron?
 - a. Coke
 - b. Charcoal
 - c. Firewood
 - d. Paper

II. Fill in the Blanks

1. _____ called for voting rights to men in England.
2. _____ changed the way roads were built around the world.
3. _____ discovered a faster and cheaper method of production of steel.
4. _____ advocated scientific socialism.
5. The first railroad line started in Germany was in the year _____.



III. Find out the correct statement

1. i) British mine-owners were faced with the problem of water seeping into their mines
ii) Employing human labour was cheap for this work
iii) Newton invented a steam engine to pump water out of mines
iv) Water had to be removed to get coal in mines
a. (i) is correct
b. (ii) and (iii) are correct
c. (i) and (iv) are correct
d. iii) is correct

2. i) Trade Unions were formed by labourers to get their rights
ii) Germany's political setup was the most significant challenge for the industrial revolution
iii) To protect capitalists Karl Marx advocated socialism
iv) There were no natural resources in Germany
a. (i) is correct
b. (ii) and (iii) are correct
c. (i) and (iv) are correct
d. iii) is correct

3. **Assertion (A):** Workers had rights to get holidays.

Reason (R): There were laws to protect the workers.

- a) A is correct R is wrong
b) Both A & R are wrong
c) Both A and R are correct
d) A is correct R is not correct explanation of A

4. **Assertion (A):** Slater was called the Father of the American Industrial Revolution.

Reason (R): His spinning textile mill was duplicated and his techniques became popular.

- a) A is correct and R is the correct explanation of A
b) A is wrong and R is the correct explanation of A
c) Both A and R are wrong
d) Both A and R are correct

IV. Match the following

- | | |
|--------------------------|-----------------|
| 1. Benz | – U.S.A |
| 2. Safety Lamp | – Louis Renault |
| 3. Quadricycle | – Humphrey Davy |
| 4. Great Railroad Strike | – Lancashire |
| 5. Coalfield | – Germany |

V. Answer the following questions briefly

1. What was the condition of labourers' houses during Industrial Revolution?
2. Account for urbanisation in England
3. Attempt a note on Haymarket Massacre
4. What do you know of Louis Renault?
5. Highlight any two important results of Industrial Revolution.

VI. Answer in Detail

1. Enumerate the causes for the Second Industrialization in the USA.
2. What were the effects of Industrial Revolution of England on India?



FUN WITH HISTORY

Student Activities

Organize a debate on the positive and negative aspects of Industrial Revolution. Prepare a list of fabrics and designs and the places of production in India.

Assignment with teacher's guidance

Collect the pictures of the inventions made at the time of Industrial Revolution. Write an assignment on the modern plastic road being made by used- plastics.



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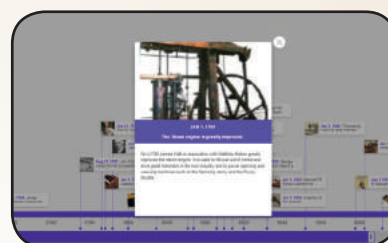
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ICT CORNER

INDUSTRIAL REVOLUTION

Through this activity you will know about the world historic events through interactive timeline.



Procedure

Step – 1 Open the Browser and type the given URL (or) Scan the QR Code.

Step – 2 Click Search option and enter any Timeline (Ex. Industrial Revolution)

Step-3 Click on full screen mode

Step-4 Explore the Timeline events with pictorial descriptions.

URL:

<https://www.timetoast.com/categories> (or) scan the QR Code

Pictures are as indicators only

