

EUROPEAN HISTORY

LO3 hijklm

The Industrial Revolution - 1750–1914



Year 10

Third Edition – 2023

for History SEC 2025



Curriculum Centre Annex

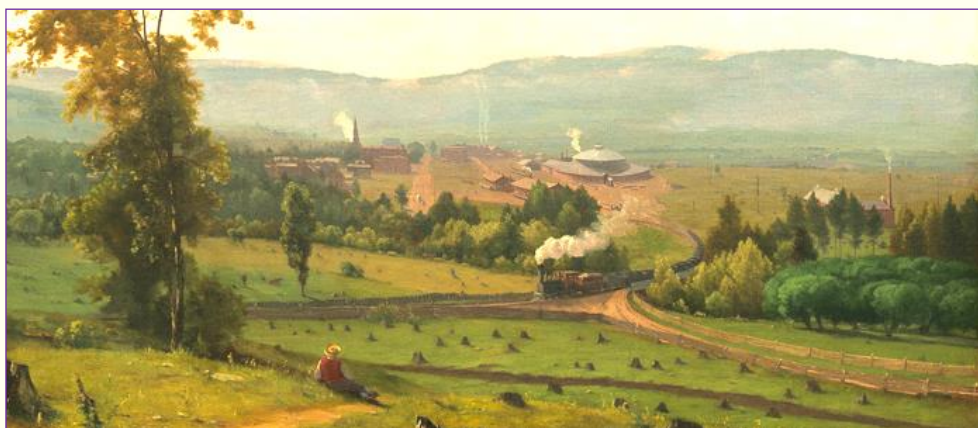
LO3 h - The Origins of the Industrial Revolution in Britain

Economic changes in 18th century Europe

Nineteenth-century Europe was shaped by two revolutions: The French Revolution sent ideas of liberty and equality across Europe while the Industrial Revolution transformed the social and economic pattern of everyday life. The Industrial Revolution was the processes by which hand craftsmanship in the home or the workshop gave place to machine-work in factories.

In the mid-1700s most of the common people in Europe were still peasants who earned a living by working the land. It was a time when Western Europe was beginning to recover from many decades of warfare, famine, disease and slow population growth. For the first time in its modern history, Europeans started enjoying frequent good harvests and a steady growth in population. By the end of the 18th century, Great Britain, more than any other place in Europe was transformed from an agricultural land to a nation of city dwellers. This pattern of change was repeated across Europe and the United States in the 19th century and in the rest of the world in the 20th century.

As a result of the Scientific Revolution of the late 17th century, and the Enlightenment in the 18th century, Europe became more open to new technologies and new ideas. During this period, the Dutch excelled in canal building, the Germans in mining and the French in military engineering. In Britain serfdom had been dead for centuries, while in most of Europe, feudalism still kept peasants tied to the land which they cultivated.

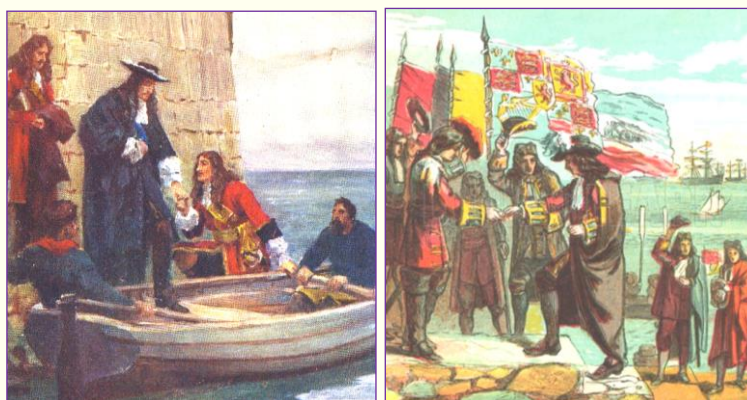


Source 1. Britain's changing landscape during the early phase of the Industrial Revolution.

During the 18th century, all the conditions necessary for industrialisation came together in one place – Great Britain. All the factors listed below helped to transform Great Britain from a modest country to the wealthiest and the most powerful Great Power with the largest overseas colonial empire in 19th-century Europe.

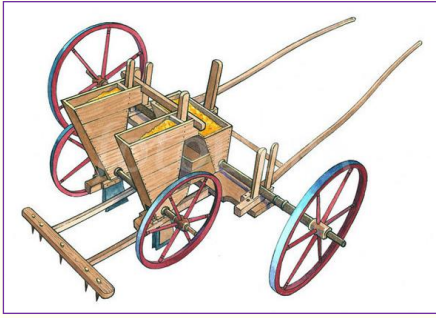
The Glorious Revolution

In 1688, an Act of Parliament deposed the Catholic King James II who tried to rule as an absolute monarch. James, like many other European monarchs sought to emulate the rule of Louis XIV of France. William III, his Protestant son-in-law was chosen as King in his place. This revolution established Britain as a constitutional monarchy where King and Parliament governed the country jointly. From this time onwards, Britain started enjoying a stable parliamentary government under which trade and commerce could flourish.



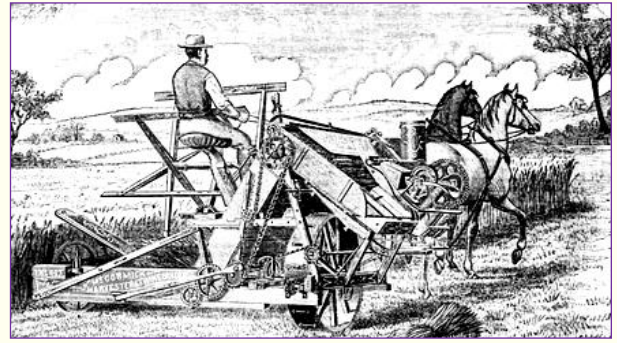
Source 2. Left: King James II escaping to France following his deposition.

Source 3. Right: William III on his arrival from the Netherlands as the new King of England and Scotland.



Source 4
Left: The seed drill of 1782.

Source 5
Right: the steam-powered reaper, invented in the US in 1841.



The Agrarian or Agricultural Revolution

Around 1760 British farmers started using more efficient farming methods when cultivating crops and when breeding farm animals. This change resulted in a sharp increase in production at a time when the population was growing steadily. This increase reduced the incidence of famine. During this period many rich landowners started buying small fields owned by the poorer peasants, turning them into enclosed fields and employing farm labourers. Thus, thousands of small farmers were left without land and unemployed. To avoid starvation, they started migrating to the cities in search of employment in industrial work in factory mills.

Britain's overseas trade and colonial empire



Source 6
A British Royal Navy ship-of-the-line is seen leading a French vessel into Portsmouth harbour captured during a naval battle in 1782.

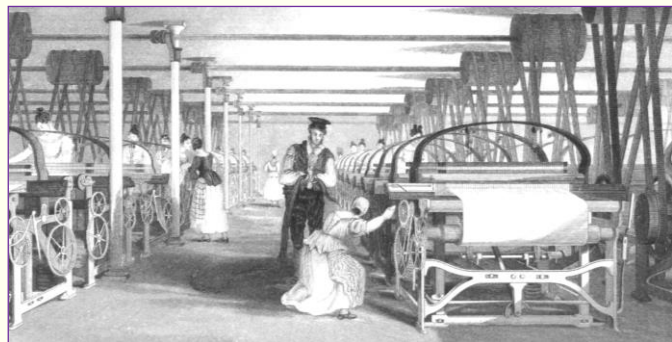
Painting by Dominic Serres

During this same period Britain's foreign policy aimed at enlarging her overseas colonial empire, opening-up new markets for her goods and acquired raw materials for the manufacturing industries that were developing at home. Britain had a large merchant navy and a powerful navy to protect her trade routes. She had also a well-developed system of banking and insurance. Britain did not have internal customs barriers that restricted trade. Unlike the European aristocracy, British nobles engaged in trade and commerce by opening mines or quarries to extract coal or iron ore. Others invested in turnpike roads, canals, aqueducts and bridges to provide cheap and efficient means of transporting goods across the country.

The cotton industry



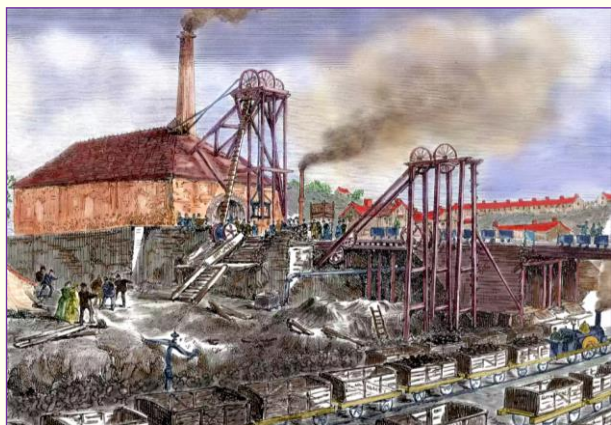
Source 7. Left: pre-industrial cotton spinning done in the home was a slow and laborious process.



Source 8. Right: Industrialization shifted cotton weaving and spinning to the factory mill using steam-powered machinery.

All that was needed to set off the Industrial Revolution in Britain was to find a way how to increase the rate of production. This breakthrough came **in** cotton clothing. Two new machines (the **flying shuttle** and the **spinning jenny**) were invented to turn cotton into cloth more quickly. In 1769 a new machine, one powered by water and another one powered by steam meant that the cotton industry had to be located near a river or lake. This led to the concentration of cotton paid labourers working in factory mills, such as the one Cromford Mill **in 1780** which employed 300 workers. Factory mills sprang up everywhere, especially in Lancashire and Liverpool. By the 1820s 50% of Britain's exports consisted of cotton fabric. By the turn of the century in 1800, Britain was ready for the next stage of the Industrial Revolution: that of iron, coal and steam.

The coal and iron industries

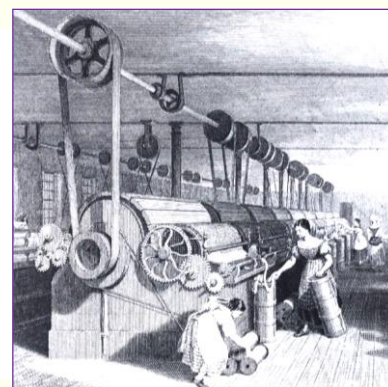
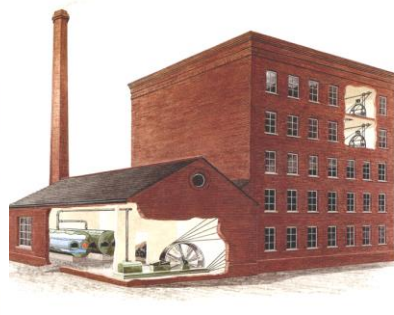
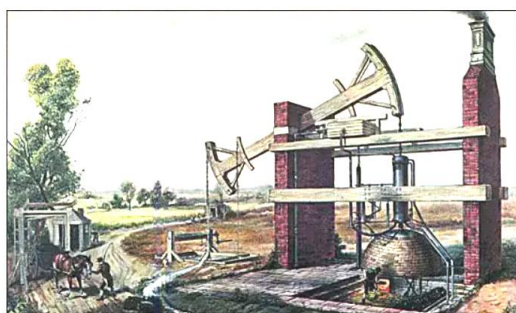


Source 8. Left: A coal mine of the early industrial period.

Source 9. Right: Iron bridges, one of the visible features that changed Britain's landscape during the Industrial Revolution.

In the iron industry in Britain started flourishing in 1709 when a method for smelting iron ore using coke was discovered. The demand for more coal led to an increase in coal mining. As a result, iron output rose rapidly in Britain. The two industries (coal and iron) stimulated each other. Cast iron was used for making cannon and to construct iron bridges. In 1784 wrought iron was invented which is more flexible and tougher than cast iron. Iron was used to construct steam engines and coal was used to provide them with steam power.

The invention of steam power



Source 10. Left: A Newcomen steam pump of 1780.

Source 11. Centre: Artistic impression of a steam-powered factory mill.

Source 12. Right: By the late 1700s, the British cotton industry was the first to adapt to steam power.

One technical problem faced by engineers in the 18th century was how to pump out water as the coal mine was dug deeper in the rocks. Eventually, a steam pump employing a steam engine was invented to overcome this hurdle. The invention of the steam engine was a major turning point in the Industrial Revolution for it replaced the 'up and down' motion with the faster 'rotary motion'. Soon steam replaced water or muscle power to drive the machines. The development of steam further increased iron output and production because only machines made of iron could stand up to the strains and heat generated by steam power. The more primitive wooden machines soon became obsolete. One other development was that factories using steam power could now be open-up all over Britain because the need for water from rivers or lakes was no longer necessary.

The invention of the railway



Source 13

The Stockton-Darlington line was the world's first public passenger and small goods railway to use a steam locomotive. It was operated between 1825 and 1863. It used a primitive steam-powered engine similar to Robert Stephenson's 'Rocket' and it travelled at a speed of around 20 km/hr.

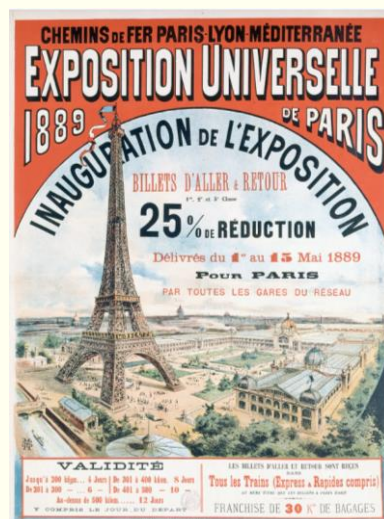
The manufacturing of heavy machines made from iron resulted in the need to develop a transportation system capable to carry them from one place to another. This resulted in the invention of the first steam locomotive, which ushered the 'Age of the Railway'. In 1804 a steam engine was made in Wales that moved on rails using steam power. In 1825 the first railway line for goods and passengers was inaugurated between Stockton and Darlington. Soon, Britain embarked on a large programme of railway building. Other industries profited from the metal-working techniques required to build railways, such as: iron bridges started replacing older wooden or stone one; digging tunnels; iron steamships and armaments. Moreover, the railway industry provided employment for many unemployed peasants.

The Great London Exhibition of 1851



Source 14. Left: The Crystal Palace from a contemporary print.

Source 15. Right: A poster issued during the Great Exposition in Paris in 1889.



The 'Great Exhibition of the Works of Industry of All Nations', also known as the 'Crystal Palace Exhibition' was an international exhibition that took place in Hyde Park, London, from May to October 1851. It was the first in a series of world fairs, exhibitions of culture and industry that became popular in the 19th century. The event was organised by Prince Albert, husband of Queen Victoria. The exhibition was held at the Crystal Palace, built for this occasion and the first building constructed using steel beams and huge glass panes.

Famous people of the time attended the Great Exhibition, including Charles Darwin, Karl Marx, Michael Faraday (who was one of the judges of the exhibits), Samuel Colt, the writers Charlotte Brontë and Charles Dickens. The world's first soft drink, Schweppes, was the official sponsor of the event. The exhibition was intended to serve as a showcase of British inventions of the time. By this time, Britain had become the model industrialized country which other European countries sought to imitate. A similar exhibition, the Universal Exposition of 1889 was held in Paris in 1889 to commemorate the 100 years of the French Revolution. For that occasion, the 300-metres high iron-made Eiffel Tower was constructed and inaugurated.

LO3 h - The Origins of the Industrial Revolution in Britain

1. Identify **three** objects in the landscape in source 1 related to the early Industrial Revolution in Britain.

_____ (3)

2. Briefly explain how the following contributed to the onset of the Industrial Revolution in Britain:

(a) The Glorious Revolution: _____

(b) The Agrarian Revolution: _____

(c) Britain's overseas colonial empire: _____

(d) Coal and iron mineral deposits: _____

_____ (8)

3. Use sources 7 and 8 to help you identify **two** changes in the cotton industry before and during the Industrial Revolution.

_____ (2)

4. Why were coal and steam very important during the early Industrial Revolution?

_____ (2)

5. Use source 13 to help you explain how people reacted when they saw the first railway locomotive in 1825.

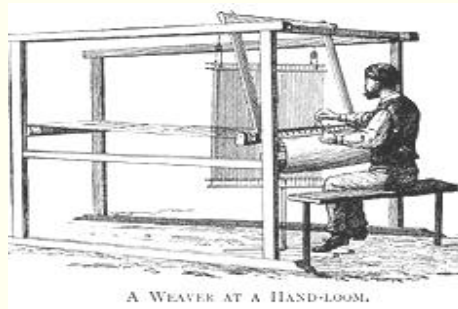
_____ (2)

6. Observe sources 13 and 14 and then mention **three** motives behind the London exhibition of 1851 and the Paris exhibition of 1889.

_____ (3)

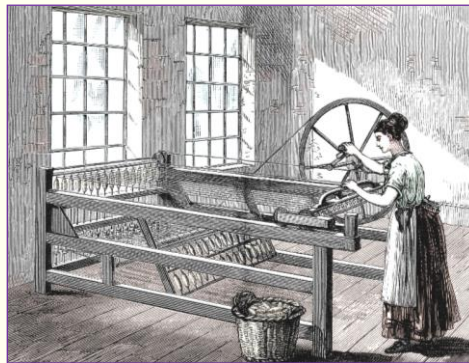
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LO3 i – The great inventions of the early Industrial Revolution



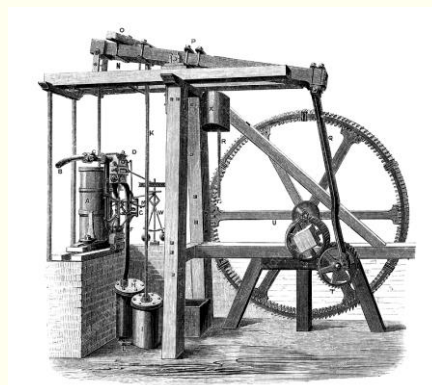
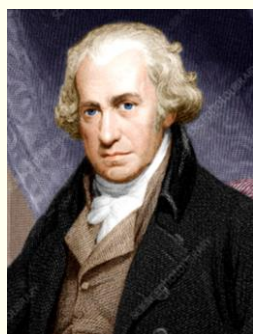
Source 16

John Kay (1704-1779) is remembered for his invention of the **flying shuttle** in 1733, a simple device that improved the existing handloom. In the early 18th century one handloom required four spinners working on spinning wheels to provide enough yarn to keep pace. With Kay's invention, this task could be done faster by one weaver. Since it could be mechanised, it paved the way for the development of steam-powered machine looms.



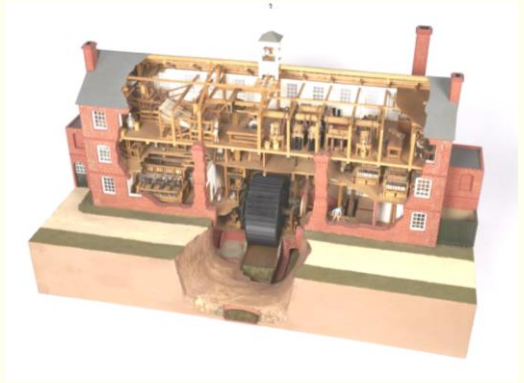
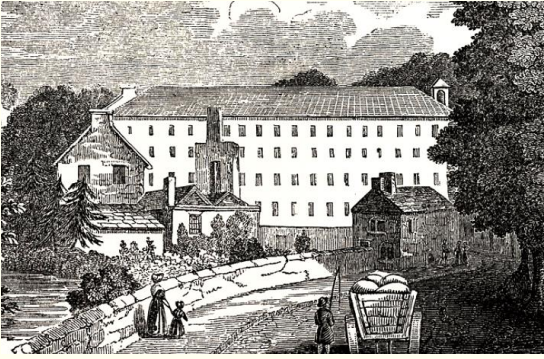
Source 17

James Hargreaves (c.1720–1778) invented the **spinning jenny**, invented in 1764/1765. It was a multi-spindle spinning wooden frame and one of the key inventions that resulted in the industrialization of textile manufacturing during the early Industrial Revolution. This device reduced the amount of work needed to produce cloth, with a worker able to work eight or more spools at once. This grew to 120 as technology advanced. The spinning jenny helped to start the factory system of cotton manufacturing.



Source 18

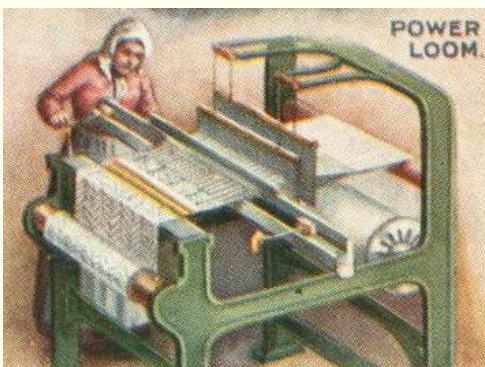
The steam engine was an invention which evolved over time as successive engineers made it more efficient and less cost-effective. The aim was to develop a machine that could replace traditional sources of power such as human and animal muscle, wind and water. The steam engine developed by James Watt (1736–1819) from 1769 was much more efficient in terms of power and fuel consumption than earlier models. Watt did not actually invent the steam engine, but he was the driving force behind making the engine the favourite power source for many factories, mines, agricultural machines and modes of transportation.



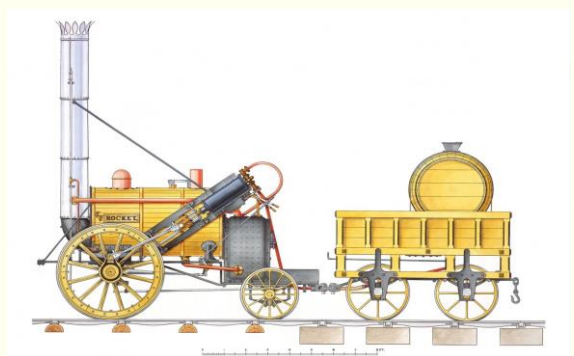
Source 19. Right: Model of a water powered factory mill, showing how the water wheel drives the machines with a series of interconnected cogs, gears and belts.

In 1771 Richard Arkwright (1732–1792) built a huge, multi-storey factory in Cromford, Derbyshire, alongside the fast-flowing River Derwent. He had realised that waterpower was the most efficient way to run machines. Huge waterwheels were installed at the mill. Driven by the river, they provided the rotary motion for the machines. Thereafter, Arkwright's spinning machines became known as water frames.

Water frames meant the machines could now be operated by unskilled labourers. By 1800, a thousand men, women and children were employed in Arkwright's mills and thousands more worked in factories set up by other profit-seeking entrepreneurs. Working life was transformed. Instead of spinning at home, people now worked long, repetitive and exhausting days in huge, multi-storey mills, looking after the machines. In the earliest days of the factory mill, production went on around the clock, with two 13-hour shifts per day. Arkwright came to be known as the founder of the modern factory system.



Source 20



Source 21

Edmund Cartwright (1743–1823) invented the first **power loom** in 1784-1785. A loom is a device used to weave together cotton threads to produce cotton fabric. Traditional handlooms were slow and required several labourers. Cartwright's invention was significant because it used mechanisation to automate much of the weaving process. His invention turned out to be a huge success because while in 1803 there were just 2,400 power looms in textile factories in Britain, by 1833 that number was as many as 100,000. This resulted in a huge increase in textile manufacture.

George Stephenson (1781–1848) was the engineering entrepreneur who invented the 'Rocket' - the first modern steam-powered **locomotive**. The reason for its invention was the proposed opening of the world's first inter-city passenger railway, the Liverpool & Manchester Railway in 1825. This invention changed the way people travelled long distances using the railways. Its early success was followed by a vast programme of railway construction in Britain. It also made Britain the world leader in terms of railway travel. Stephenson's locomotive became the template for most steam-engine locomotive for the next 150 years, until the invention of the first electric trains.

LO3 i – The great inventions of the early Industrial Revolution

1. Complete the matrix table below as indicated by the three answers given as examples.

Source No.	Name of invented object	Name of inventor	Year of invention
16		John Kay	
17			
18			
19	The factory-mill		1771
20			
21			1784-1785

(14)

2. Briefly explain two impacts which three of these inventions had in the context of the early Industrial Revolution in Britain.

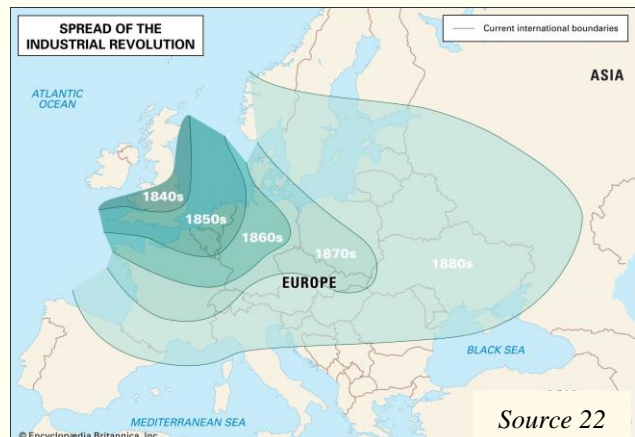
(6)

(Total: 20 marks)

LO3 j - The Industrial Revolution spreads to Western Europe

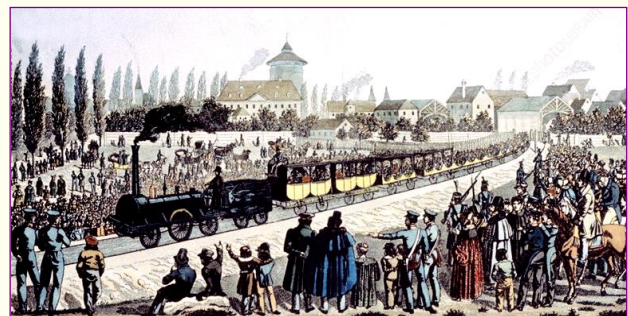
The Industrial Revolution spread to Continental Europe, starting with **Belgium**, since this country was closest to Britain. Its first industries to industrialize were cloth-making, iron works and coal mining. Upon achieving independence from the Netherlands in 1830, the government sponsored the construction of railways and canals to join its rivers. With a free-trade policy like Britain, Belgium became the second largest exporting country in Europe.

The pace of industrialisation was slower in **France** because it had fewer coal resources, poor communications and the conservative outlook of French entrepreneurs who stuck to traditional methods. France's railway age begun in 1845, connecting Paris to the larger cities. Industry made rapid progress under the Second Empire of Napoleon III (1852-1870) with the setting up of commercial banks, the building of new harbours and expanding existing industries in silk, linen, carpets and glassware. France undertook large-scale public works projects in Paris, such as the construction of underground sewage tunnels, the demolition of slum and their replacement by wide boulevards and the construction of the Suez Canal in Egypt (1859-1869). All this made France Britain's major industrial rival by the 1860s.



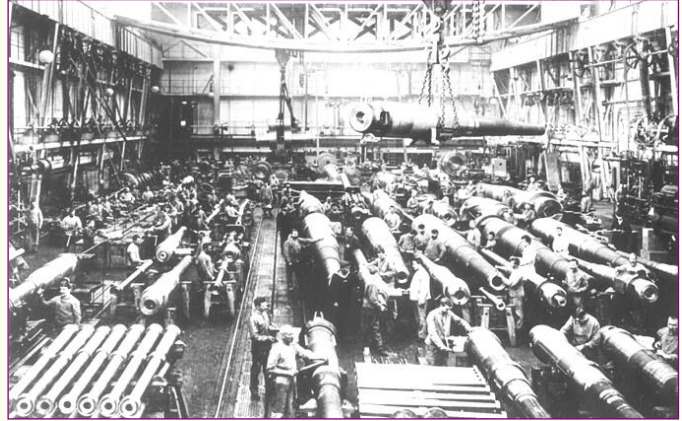
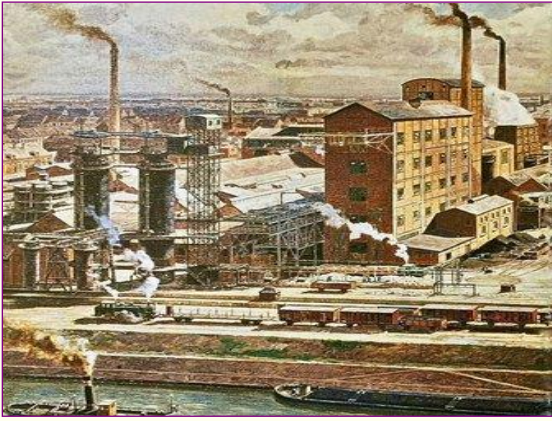
Source 23. Below Left: Railway lines in Europe by 1850.

Source 24. Below Right: People watching the first German train in 1835 which train ran for 7 km from Nuremberg to Furth. It took 12 minutes to complete the journey. It caused a sensation, and soldiers found it difficult to control the crowds.



In the **German Confederation**, apart from the Zollverein (customs union), the greatest stimulus for industrialisation was the construction of railways, which started in 1835. By 1850 the railway mileage was twice that of France but half that of Britain. Germany's industrialization was limited to a few scattered areas, mostly found in Prussia because it was divided in 39 independent states. When unification was finally achieved in 1871, German industry boomed in the production of iron, steel, coal, chemicals and in foreign investment. This rapid advance has been partially attributed to Prussia's education system which put great emphasis on scientific and technical training.

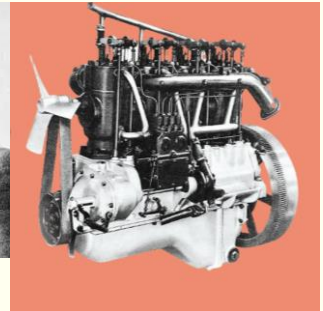
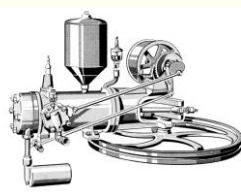
The expanding steel industry after 1860 led to the construction of new shipbuilding yards at Hamburg, Bremen and Stettin, and the further expansion of the arms industry by Alfred Krupp in the Ruhr region. The chemical industry also revolutionised the production of armaments in the manufacture of explosives using nitro-glycerine, the dynamite and the blasting gelatine. Sulphuric acid resulted in the production of fertilisers which greatly increased crop production to feed Germany's and the world's fast-growing population. Though Germany became the greatest industrial producer in Europe by 1914, she was still behind Britain in the extent and value of her trade.



Source 26. Left: A 19th century chemical plant in Germany.

Source 27. Right: One of Krupp's factories producing armaments, 1909. Photo credit: Alamy

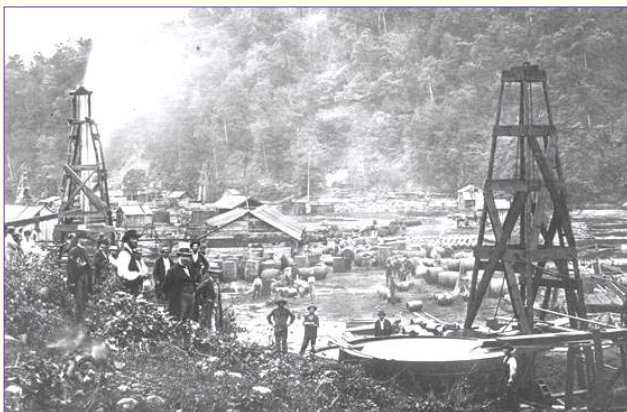
In 1859 mineral oil was extracted for the first time in Pennsylvania, USA. In the 1870s other oil wells were discovered in Ohio and Texas. Oil soon became suitable for raising steam to drive machines. When refined and turned into diesel or petrol, it helped to bring about the invention of the internal combustion engine by Karl Benz (Germany, 1886) and the compression ignition engine by Rudolf Diesel (Germany 1892). These engines resulted in the invention of the first motorcar by Benz in 1886 and the aeroplane by the Wright brothers (1903, USA).



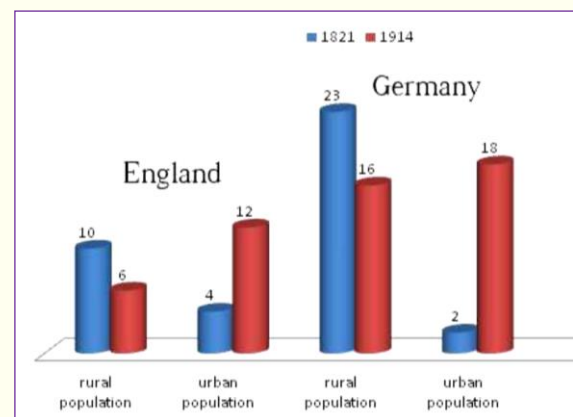
Source 28. Left: Carl and Bertha Benz driving an automobile, 1894.

Source 29. Centre: Benz's internal combustion engine of 1886.

Source 30. Right: Rudolf Diesel (1858–1913), inventor of the diesel engine.



Source 31. Photograph of an oil field in Pennsylvania in 1862.



Source 32. Rural and urban population (in millions) in England and Germany in 1821 and 1914.

Source: <https://www.researchgate.net>

By 1900 industrial production in the USA was larger than any country in Western Europe, followed by Germany, Britain having fallen in third place. By 1914 oil had replaced coal in most factories and power stations. In the manufacturing industries making use of electric power, the USA became the leading power, also followed by Germany.

LO3 j - The Industrial Revolution spreads to Western Europe

1. From the map of source 22, identify **one** European country experiencing the Industrial Revolution:

(a) By the 1840s: _____

(b) By the 1850s: _____

(c) By the 1860s: _____

(d) By the 1870s: _____

(e) By the 1880s: _____

(f) In the 1890s: _____ (6)

2. Identify from the map source 23 two major European cities that were linked by the railway by 1850:

(a) In France: _____

(b) In Germany: _____ (4)

3. Use source 24 to help you answer. Why do you think the first railway in Germany caused such a commotion among the people? (2)

 _____ (2)

4. Use sources 26 and 27 to help you answer how Alfred Krupp contributed to the transformation of Germany into a major economic and military power in Europe by 1914.

 _____ (2)

5. Briefly explain how the discovery of mineral oil in 1859 transformed the Industrial Revolution.

 _____ (2)

6. Use the data shown in source 32 to calculate the following:

		England	Germany
(a)	The decline in the number of people (in millions) living in the countryside between 1821 and 1914 in:		
(b)	The rise in the number of people (in millions) living in the cities between 1821 and 1914 in:		

(4)

(Total: 20 marks)

LO3 k – Living Conditions during the Industrial Revolution

Population growth in the industrial towns



1750 ^[11]		1861 ^[13]	
Town	Pop'n	Town	Pop'n
London	675,000	London	2,804,000
Bristol	45,000	Liverpool	443,900
Birmingham	24,000	Manchester	338,300
Liverpool	22,000	Birmingham	296,000
Manchester	18,000	Leeds	207,200
Leeds	16,000	Sheffield	185,200
Sheffield	12,000	Bristol	154,100

Source 33. Left: Central London in the late 19th century.

Source 34. Above: Table showing the rapid growth of Britain's main industrialized cities.

With the growth of population, the older towns became more crowded. All the problems of urban areas without sanitation soon appeared: building of slums, polluted cities caused by the burning of coal, poor sanitation, the spread of disease, drunkenness and crime. In Europe population rose from 266 million in 1850 to 460 million in 1914. Another 50 million migrated to North America. In the large industrial towns, the previous community spirit of the village was missing since people came from different parts of the country. On the other hand, villages lost their skilled craftsmen who went to work in the factory mills.

The bourgeoisie

The educated rich middle and upper classes were also known as the bourgeoisie. They believed in a free-market economy (or *laissez-faire*) because this ideology limited government control over the economy and left them free to maximize their profits, often at the expense of the workers. In these circumstances, the rich became richer while the poor became even poorer. *Laissez-faire* resulted in competition and rivalry between firms and even nations. Late in the 19th century, some countries moved away from *laissez-faire* and opted for protectionism by imposing high tariffs on imports, as a way to protect their local industries from foreign competition.



Source 35. The Parisian bourgeoisie at the time of the Industrial Revolution from a late 19th century painting.

Appalling conditions for the lower classes



Source 36. Left: Working class dwellings in 19th century Britain.

Source 37 and 38. Centre and right: young children were compelled to do dangerous jobs in the coal mines and on machines.

The early phase of industrialisation generally resulted in long hours of work, low wages, female and child labour, dangerous machines, collapse and flooding of mines, unhealthy environments in factories and slums. **The Poor Law of 1834** in Britain compelled the unemployed to work in bleak public factories known as workhouses. Factory workers had to work 12 to 14 hours a day. Working class parents were often constrained to send their children to work in factories or mines from the age of five. Factory owners imposed harsh discipline on the workers. At times workers got exhausted trying to keep pace with the machines. After many years of complaints and petitions falling on deaf ears, the British Government set up a Commission to investigate abuses related to the working conditions of women and children. The result was the Ten-Hour Bill of 1847. The industrialists also accepted the principle that Government could intervene to regulate industry.

Protests by the working classes

In 1811, in Nottingham, Britain, **Ned Ludd** (alias called Luddites) set up a movement of textile workers to oppose the use of cost-saving machinery by raiding factories and destroying the machines. In 1819, 60,000 working-class people marched in an area in Manchester called St Peter's Fields. The authorities used force to disperse the protesters. Twenty were killed and hundreds were injured. The incident became known as the Peterloo Massacre. In the 1820s and 1830s the Chartist Movement in Britain organised peaceful protest marches in support for universal male suffrage and other civil rights.



Source 39. Left: a group of Luddites smashing machines in a factory mill.

Source 40. Centre: Peterloo Massacre in Manchester in 1819.

Source 41. Right: A pro-working class Chartist rally in Britain in the

Socialism and social democracy

Discontent among the poorer classes expressed itself in the growth of socialism and in bitter clashes with the richer classes during the revolts of the Paris June Days of 1848 and the Paris Commune in 1871. After 1870, a milder form of socialism came into being in the form of Socialist Democratic Parties. These political parties pledged to reform society without resorting to violent revolution. The first of these parties was set up in Germany in 1867. By the 1890s social democracy became a strong force among the working classes of France, Spain, Italy and Russia. Britain's Labour Party was one of the last to be set up in 1900. Democracy and socialism reduced some of the powers and privileges of the aristocracy and the upper middle class.

Trade Unionism

The growth of large-scale industries and the concentration of working-class people in the large industrial centres brought about movements aimed at improving the conditions of the workers, namely, trade unionism and socialism. In Britain trade unions were recognised by law in 1871, in France and Spain in the 1880s, in Germany in 1890 and in Russia in 1906. Trade unionism introduced the principles of the general strike and collective bargaining, which in previous years were resisted by force by the authorities and by the factory owners.

Reform by government action and improvement in living standards

To improve the conditions of the workers, from the 1830s governments started enacting basic humanitarian legislation; opened spaces in cities for recreation; improved underground sewage and fresh water supply; introduced free primary education. In the 1880s, Germany was the first country to enact welfare legislation, such as accident and sickness insurance and a retirement pension. All these led to better health, better nutrition, better clothing, and a longer life expectancy for the working classes.

In the late 19th century, as work became more skilled, pay and conditions in factories gradually improved. Women workers became more independent than before. Wealth created in industry spread to the lower middle classes and to some of the working classes who could afford to move away from the slums.

Environmental damage

One major negative consequence of industrialisation was the ever-increasing pollution and environmental damage to the countryside, rivers, lakes and the atmosphere. This was due to the rapid growth of cities, the burning of fossil fuels in the atmosphere and the discharge of chemical waste in rivers and lakes. Industrial sites, such as old factories, mine fields and plants that fell in disuse were left abandoned, causing a bad eye sore in the environment. Lately, governments started investing heavily to rehabilitate some of these areas, such as the famous Old London Docks.



Source 42
Air-pollution in cities was caused by unregulated burning of coal, the main fossil fuel at that time.

LO3 k – Living Conditions during the Industrial Revolution

1. Observe sources 33 and 34 and then identify **four** problems caused by the rapid increase of people who went to live in the cities during the Industrial Revolution.

(4)

2. Briefly explain **two** ways how the bourgeoisie class benefitted from the Industrial Revolution.

(4)

3. Briefly explain **two** ways how the working class was affected by the Industrial Revolution.

(4)

4. Identify **three** ways by which the working-class people protested against the bad working conditions of the early Industrial Revolution? Use sources 39 to 41 to help you answer.

(3)

5. Give **three** examples that show how did certain governments in Europe intervened to improve the living conditions of the working classes during the Industrial Revolution in the 19th century.

(3)

6. Briefly explain why did the Industrial Revolution bring about an increase of environmental pollution?

(2)

(Total: 20 marks)

LO3 I – Technological developments of the Industrial Revolution

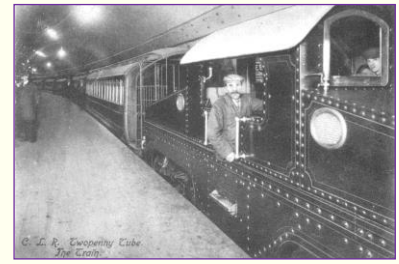
The railway



Source 43. The 'Rocket' locomotive (1829)



Source 44. The first roofed train station Easton, England (1837)



Source 45. An underground train in London (1903)

1825	The first railway line connected the towns of Stockton and Darlington in England. The line was intended to transport passengers and coal. The wagons were pulled by a steam engine.
1829	The locomotive called the Rocket sets a speed record of 47 km/h.
1830	The Liverpool-Manchester Railway marked the first steam passenger service having proper stations, platforms, timetables and ticketing offices. This development proved the viability of rail transport.
1837	The Leipzig-Dresden Railway Company opened the first long-distance German railway line.
1863	The first underground railway (6.4 km) Metropolitan Railway opened in London. The adapted steam engines held condensed steam which was let out only at particular tunnel locations that had air vents. This was the first step for a new mode of underground urban transit that led to the modern Subway, U-Bahn or Metro.
1879	The first electric railway was demonstrated at the Berlin Trades Fair.
1881	The first public tram line opened in Berlin, Germany.
1883	The first electric tram line using electricity served from an overhead line opened in Austria.
1890	The City & South London Railway was the first deep-level underground tube railway in the world and the first major railway to use electric traction.

The steamship



Source 46. The Great Western (1838)



Source 47. The Great Eastern (1857)



Source 48. The sinking of the Titanic in April 1912

The first iron steamship went to sea when it crossed the English Channel to Paris in 1822. It carried passengers and freight at an average speed of 8 knots (14 km/h).

The *Great Western* was the first steamship built for regular trans-Atlantic crossings using a side-wheel paddle steamer, built by Isambard Kingdom Brunel in England in 1838. It inaugurated the era of the trans-Atlantic Ocean liner. Brunel's last major project, the *Great Eastern*, was built in 1857 with the intent of linking Great Britain with India, via the Cape of Good Hope, without any coaling stops. It was one of the first ships to be built with a double hull and with watertight compartments and was the first line to have four chimney funnels.

The first iron steamship that went to sea when she crossed the English Channel to Paris in 1822. It carried passengers and freight at an average speed of 8 knots (14 km/h). It was the biggest liner throughout the rest of the 19th century with a gross tonnage of 20,000 tons and had a passenger capacity of thousands. It was finally superseded by the *Titanic* which however sunk on its maiden voyage in 1912.

The decline of the steamship occurred after the Second World War when most of these ships who survived had their engines replaced by diesel ones. Diesel engines require far less supervision and maintenance than steam engines and as an internal combustion engine it did not need boilers and water supply, therefore they required less space and were cheaper to build.

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The automobile



Source 49. Carl Benz Motorwagon of 1886



Source 50. The early cars of the 1890s



Source 51. Ford Model T of 1908, the first car to be produced by mass production

Although the automobile was first invented and perfected in Germany and France in the 1880s and 1890s, the United States, namely through Henry Ford, quickly came to dominate this industry in the first half of the 20th century. Below are some key landmarks in the early development of the automobile:

1886	Carl Benz built the first motor car, and he named it the Benz Patent-Motorwagen Benz soon improved on this design to create a proper, four-wheeled automobile in 1891.
1895	Michelin created the first pneumatic tyre for cars, made of reinforced rubber and inflated with compressed air.
1903	The Ford Motor Company in the USA was set up, selling 1,700 cars in its first year of business.
1912	The electric ignition was invented, eliminating the cranking mechanism needed to start cars until this time.
1912	A police officer invented the first electric traffic light, which was installed on a street in Cleveland, Ohio, USA.
1913	The Ford Motor Company invented the first moving assembly line for building cars.
1921	4-wheel brakes were invented, making it easier for motorists to stop safely.

The automobiles of the 1920s and 1930s had the following features introduced to them in this order: the four-wheeled brakes; front suspension system; the car radio; the flashing indicator light and air conditioning. In the 1950s the power steering and the seat belt were added. Improvements in design and performance of the motorcar continue right up to the present-day.

Artillery



Source 52. A muzzle-loading field gun of the Napoleonic Wars (1800–1815)



Source 53. An early British breech-loading field cannon first used in 1859



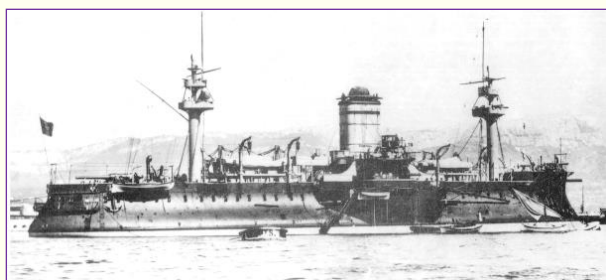
Source 54. Above: A repetitive rifle of the 1870s
Source 55. Below: A revolver used during the American Civil War (1861–1865)

A **muzzleloader** is any firearm into which the projectile and the propellant charge is loaded from the muzzle of the gun, musket or rifle. Firearms before the mid-19th century were almost entirely muzzle-loading, while modern firearms are generally breech-loading. A **breechloader** is a firearm in which the user loads cartridge or shell via the rear (breech) end of its barrel. Breech-loading became more successful with improvements in precision engineering during the 19th century Industrial Revolution. The first breech-loading guns were used during the American Civil War (1861–1865).

Breech-loading guns provide the advantage of reduced reloading time, because it is far quicker to load the projectile with increased accuracy. Unloading a breech-loader is much easier as well, as the load can be extracted by hand from the breech end; unloading muzzle-loaders requires drilling into the projectile to drag it out through whole length of the barrel.

Revolving pistols and rifles were an attempt to increase the rate of fire of rifles by combining them with a revolving firing mechanism. An important invention was the way cartridges were stored and used in the weapon. The repeating rifle was a breech-loader first used by infantry soldiers during the American Civil War (1861–1865). It used copper cartridges stored in a removable seven-round tube magazine, enabling the rounds to be fired one after another. When the magazine was empty, it could be exchanged for another. This revolutionary firearm invention made the centuries-old musket obsolete. By 1914, nearly all the armies of the Great Powers had switched to the breech-loading field guns and the removable cartridge rifles and pistols.

Ironclad warships



Source 56. The French 'Redoutable' was the first generation of battleship built almost entirely of steel in 1876.



Source 57. HMS 'Dreadnought', one of the second generation of battle cruisers of the British Navy in 1906.

Ironclads were the first generation of steam-powered warships built of timber and covered with iron plates as much as 11 cm thick. They were invented because wooden warships were vulnerable to explosive or incendiary shells. The first ironclad battleship, *La Goire*, was launched by the French Navy in 1859, followed by *HMS Warrior* built by the Royal Navy in 1861. Germany's first ironclad, *SMS Hansa* was completed in 1875. The ironclads often carried a battery of two to six heavy guns, the number varied depending on the size of the casemate. Some were even armed with torpedoes.

By the start of the Anglo-German naval race in 1899, a second generation of warships had developed, built entirely of iron and steel. This development marked the end of the former ironclads. By this time, the term ironclad gave way to 'battleship' or 'battle cruiser'. By the outbreak of the First World War in 1914, warships called 'dreadnoughts' became equipped with diesel engines, armed with huge revolving gun casemates and torpedo tubes.

The fighter aircraft



Source 58. The first air flight of the 'Wright Flyer' in 1903.



Source 59. A RAF bi-plane fighter aircraft used in World War I.

The American Wright brothers invented and flew the first airplane in 1903. In 1909, they also invented the world's first military airplane. Following its use in the First World War, aircraft technology continued to develop. In 1927, Charles Lindbergh, made a nonstop solo flight on a single-engine aircraft from New York to Paris in 33.5 hr. In 1939, the German *Luftwaffe* (air force) used the first jet fighter aircraft. During the Second World War, fighter and bomber aircrafts were used by all the belligerent powers. After that war, aviation companies across the world sought to develop large, safe and comfortable jet airliners such as the Boeing 707.



Source 60. Commercial air travel dates back to the late 1920s. The photo shows a 12-passenger airplane of the Western Express flying between Los Angeles and San Francisco in 1928.

Industrial centres and mass production



Source 61. Left: Krupps factory complex in Essen, Germany, c. 1896

Source 62. Centre: The assembly line in Henry Ford's automobile factories was introduced in 1909.

Source 63. Right: The use of interchangeable parts introduced in Ford's factories in 1913.

Industrial centres were one of the direct consequences of the Industrial Revolution. They occurred gradually as industries started to adopt more specialized and mechanized methods of production, such as the textile industry in Britain in the late 18th century, moving production in large factories situated in the cities. The concentration of production in one place gave rise to large and complex industrial centres within or close to the major European cities. This development resulted in a sharp and constant increase in population of industrial cities accompanied by poor housing and living standards among the labouring classes.

In 1908, the American engineer and entrepreneur Henry Ford (1863–1947), produced a new automobile, the 'The Lizzie', as the Model T was known. It proved such a success, that Ford soon had more orders than the company could satisfy. As a result, he put into practice new techniques of production that were to revolutionise the modern industry: standardized interchangeable parts and the moving assembly line.



Source 64. Henry Ford's Model T of 1908

Interchangeable parts are parts of a machine that are made identical to each other so that they fit exactly when replacing a broken or a malfunctioning part. Mass production was made possible with his other innovation, the assembly line. This significantly reduced the time required to produce an automobile, kept production cost low and made products more affordable for many more people.

LO3 I – Technological developments of the Industrial Revolution

1. Use the picture sources and information in pages 15 to 18 to help you complete the following matrix table.

	Area of industrialisation	Positive effect	Negative effect
(a)	The railway		
(b)	The steamship		
(c)	The automobile		
(d)	Ironclad warships		
(e)	Artillery fire		
(f)	The aircraft		
(g)	Mass production		
(h)	Industrial centres		
(i)	Interchangeable parts		

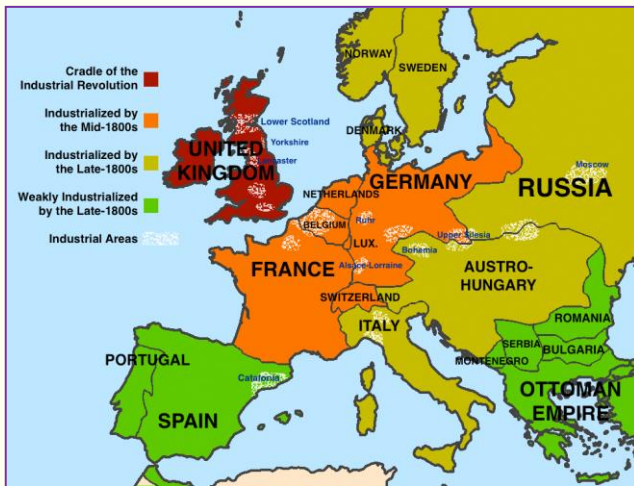
(18)

2. Why was the invention of electricity in the 1860s an important turning point in the Industrial Revolution?

(2)

(Total: 20 marks)

LO3 m – Positive and negative impacts of the Industrial Revolution



Source 65. Industrialization in 19th century Europe

Economic Changes	<ul style="list-style-type: none"> •Expansion of world trade •Factory system •Mass production of goods •Industrial capitalism •Increased standard of living •Unemployment
Political Changes	<ul style="list-style-type: none"> •Decline of landed aristocracy •Growth and expansion of democracy •Increased government involvement in society •Increased power of industrialized nations •Nationalism and imperialism stimulated •Rise to power of businesspeople
Social Changes	<ul style="list-style-type: none"> •Development and growth of cities •Improved status and earning power of women •Increase in leisure time •Population increases •Problems – economic insecurity, increased deadliness of war, urban slums •Science and research stimulated

Source 66. The effects of the Industrialization Revolution

The impact of the early Industrial Revolution explained under these categories.

	Positive impact	Negative impact
Economic impact	The creation of new jobs in industry.	Working class people were given very low wages.
Social impact	Cheaper machine-made products on the market, e.g., cotton-made clothing.	Greater social inequality: the rich became richer while the poor became poorer.
Political impact	The rise of social democracy and trade unionism.	Industrialists took control of parliaments, e.g., liberalism
Technological impact	Inventions that made everyday life more comfortable. e.g., the railway	Inventions that made warfare more deadly and destructive, e.g., the machine-gun
Scientific impact	An effective cure found against deadly diseases, e.g., X-Rays.	The invention or discovery of dangerous objects or substances, e.g., the dynamite
Environmental impact	Improvement in sanitation, e.g., underground sewage.	Pollution, e.g., dumping industrial waste in rivers and lakes

Conclusion

The first industrial revolution began in Great Britain in the mid-to-late 1700s when innovation led to goods being produced in large quantities due to machine manufacturing. The second industrial revolution was a period of groundbreaking advancements in manufacturing, technology, and industrial production methods from around 1870 to 1914, such as steel production and the application of electricity and mass production methods in industry. This period witnessed the invention of technological marvels such as the telegraph, the telephone, the automobile, and the radio. The third industrial revolution began in the 1950s, is considered as the move from mechanical and analogue electronic technology to digital electronics.

While it is commonly believed that in the late 20th century the Industrial Age was supplanted by the **Information Age** (also known as the 'Computer Age' or 'Digital Age') marked by the shift from traditional industries to information technology. However, much of the economy of developing countries in the Third World is still based on the traditional manufacturing industries.

LO3 m – Positive and negative impacts of the Industrial Revolution

1. Copy the effects of the Industrial Revolution as listed in source 66 in page 20. Then decide whether each effect is positive, negative or both by inserting a tick (✓) in **one** of the adjacent columns. (16)

		Change brought about by Industrialisation	Positive impact	Negative impact	Both
(a)	Economic Changes	Expansion of world trade	✓		
(b)					
(c)					
(d)					
(e)					
(f)					
(g)	Political Changes				
(h)					
(i)					
(j)					
(k)					
(l)		Rise to power of businesspeople			✓
(m)	Social Changes				
(n)					
(o)					
(p)					
(q)					
(r)					

2. During which Industrial Revolution were these inventions made? Answer by inserting a tick (✓) in the right column. (4)

	Invention	1 st Ind. Rev. (1750–1870)	2 nd Ind. Rev. (1870–1914)	3 rd Ind. Rev. (post-1914)
(a)	The computer			
(b)	Gas lamps			
(c)	The satellite			
(d)	The production belt			
(e)	The jet engine			
(f)	The factory mill			
(g)	Electric power in industry			
(h)	The diesel engine			

(Total: 20 marks)

LO3 hijklm – Essay Questions on the Industrial Revolution

Carefully read these essay titles and then choose one to answer.

PAPER MQF 2-3

1. (a) List **four** reasons why the Industrial Revolution started in Britain? (8)
(b) Discuss why the reasons mentioned in (a) changed Britain's economy during the Industrial Revolution (12)
2. (a) Briefly describe how the early Industrial Revolution affected the life of women and children. (8)
(b) Explain the impact of any **three** inventions that occurred during the Industrial Revolution in the 19th century? (12)
3. (a) Explain how the Industrial Revolution spread to Germany in the 19th century? (8)
(b) Compare and contrast Britain and Germany as the largest two industrial powers in Europe by 1900. (12)
4. (a) List **four** positive and **four** negative consequences of the Industrial Revolution in 19th century Britain and/or Europe. (8)
(b) Chose any **two** mentioned in (a) and discuss them in more detail. (12)

PAPER MQF 1-2

1. (a) Identify **four** reasons why the Industrial Revolution started in England. (4)
(b) Identify **four** important inventions made during the Industrial Revolution in Britain before 1800. (4)
(c) Explain the impact of the **four** inventions mentioned in (b). (12)
2. (a) List **four** working conditions of the working classes during the early phase of the Industrial Revolution. (4)
(b) Identify **four** types of workers that would have lived under these conditions. (4)
(c) Describe the living conditions of these three categories of people during the early Industrial Revolution: (i) factory workers; (ii) mine workers; (iii) the bourgeoisie. (12)
3. (a) List **six** inventions made during the Industrial Revolution between 1800 and 1914 in the following fields: (i) transportation; (ii) weaponry and warfare; (iii) industrial production. (6)
(b) Mention **one** positive and **one** negative consequence of the Industrial Revolution. (2)
(c) i. Identify **four** important inventions made during the early Industrial Revolution. (4)
ii. Briefly explain **one** positive and **one** negative effect of any **two** inventions given in (b). (8)