
UNIT 14 “THE EXPLOITATION OF STEAM”

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14.0 OBJECTIVES

In this unit our aim is to give you practice in reading comprehension by (a) setting a passage dealing with exploitation of steam, (b) giving a glossary of difficult words, (c) asking questions relating to comprehension of the passage, (d) identifying false statements and correcting them, and (e) drawing your attention to the way some pronouns and demonstratives are used to refer to persons or things already mentioned in the passage. In the vocabulary section, we have set exercises asking you to (a) find words and phrases which mean the same as the words given, (b) change given words or phrases into compound nouns, and (c) fill in the blanks in the sentences by choosing the appropriate words from the list provided. The section on grammar and usage describes (a) the way in which relatives clauses can be reduced (b) and how the present past participles can be used like adjectives to modify nouns. The section on writing gives you some practice in the use of sequence words (such as first, then, finally etc),and expects you to write a brief paragraph on how the steam engine developed from its beginning to the 18th century.

14.1 READING COMPREHENSION

14.1.1 Study Guide

The passage in the beginning describes the ways in which water power was used to work bellows and hammers in iron works and turn cotton-spinning machinery. The limitations of the water power led some scientists to look for an alternative. The rest of the passage gives a historical account of how steam engine developed from its beginnings to the eighteenth century.

After you have read the passage once, read it again with the help of the glossary we have given at the end of the passage. Answer all the question. Check your answers with those given by us at the end of the Unit 4.

14.1.2 Reading the Passage

The Exploitation of Steam

Of all the many factors which contributed to the Industrial Revolution, the most revolutionary and the most impressive was not coal but steam-power. J. L. and Barbara Hammond said that steam-power declared the triumph of industry and the glory of man. From clumsy and inefficient

beginnings it was quickly improved to open up tremendous possibilities for industrial progress. The limitations of muscle-power are obvious, and though water had served well to work bellows and hammers in iron works, or to turn machinery like the water-frame and the mule in the textile industry, it could only be applied in a limited way in Britain. For water-power is most useful in a land with many fast-flowing streams and, apart from areas like the Pennines, Scotland, and Wales, this country's rivers flow slowly. The alpine area of Europe, and much of the United States relied on water-power for much longer than Britain, and hydro-electricity has brought water back into its own in many parts of the world. The geographical limitations of Britain's water-power, however, necessitated finding an alternative solution to the problem.

When water vaporizes it expands 1,800 times. The idea of harnessing this energy is far from new. It was probably used by Hero of Alexandria in the first century B.C. to open temple doors or to pour libations apparently by magic. Hero's writings were rediscovered during the Renaissance and many people, including, for example, the Marquis of Worcester (1601-67), experimented with devices using steam. Regretfully, therefore, we must dismiss the old myth that steam-power was born in the mind of a bright Scots lad called James Watt as he sat one winter's evening watching his mother's kettle boil on the hearth. Watt's contribution to steam is incalculable, but steam-pumps had been used in Britain for over seventy years before he began his work.

The first steam-engine used in industry was invented by Thomas Savery (1650-1715), called 'The Miners' Friend' or 'an engine to raise water by Fire'. It was patented in 1698 and worked on simple principles. It pumped water from wells quite efficiently and was used successfully in Cornish copper-mines, but its limitations were revealed when it was tried in the Broadwater Collieries of Staffordshire in 1706 and was found to be capable of pumping water up no more than 100 feet. When greater pressure was used the boiler burst. Thereafter, Savery's engine was used to supply water in gentlemen's houses or to work fountains—tasks it could perform effectively, though not quite safely as there was no pressure-gauge.

It was Thomas Newcomen (1663-1729), a Dartmouth blacksmith and ironmonger, who produced the first steam-pump to be used widely in industry. It was known as an 'atmospheric engine' because, in contrast to Savery's engine, the steam in the cylinder was not used to drive the pump but only to create a partial vacuum when condensed. Ordinary air pressure drove the piston into the cylinder and this raised the pump which was connected to the piston by a see-sawing cross-beam. A large piston meant that it was possible to gain more force without increasing steam pressure and this made Newcomen's engine much more powerful than Savery's.

The first engine was made about 1706 but it was a clumsy affair. The piston did not fit tightly into the cylinder and condensation, which was achieved by pouring cold water on the outside of the cylinder, was far from complete. Moreover, the tap controlling the passage of steam into the cylinder was worked by hand seven or eight times a minute. These difficulties were ironed out by 1720; water was now sprayed into the cylinder to improve condensation, the operation of the taps had been made automatic, and a safety-valve had been fitted to eliminate the danger of explosion.

The improved engine soon became standard equipment in most large mines and it was also used to pump water into canals and to supply drinking-water in towns. It is difficult to know exactly how many were in use by the second half of the 18th century but in 1787 fifty-seven were found around Newcastle, and there were eighteen in Cornish mines in 1780.

(From the *Industrial Revolution* by Keith Dawson)

14.1.3 Glossary

(The numbers refer to the lines in the reading passage).

contributed : helped to bring about.

Industrial Revolution : the economic and social changes arising out of the change from industries carried on in the home with simple machines to industries in factories with power driven machinery—especially such changes (from about 1760) in Britain, the first country to be industrialised.

revolutionary : causing great (and perhaps violent) changes.

triumph :	victory
glory :	high fame and honour won by great achievements.
clumsy :	not well designed; ungainly.
open up :	make possible
tremendous :	very great
muscle-power :	physical strength
obvious :	easily understood; clear
works :	building(s) where industrial or manufacturing processes are carried on.
bellows :	apparatus for blowing air into a fire.
water frame :	Arkwright's spinning-frame, which was driven by water.
mule :	a cotton-spinning machine.
textile :	a woven fabric
Pennines Scotland Wales :	Mountain areas in U.K
Alpine :	mountain areas in Europe
relied :	depended
hydro-electricity :	electricity produced by means of water, especially by water-power.
vaporizes :	becomes steam
harnessing :	using (a river, waterfall etc.) to produce electric power.
pour :	cause a liquid to flow in a continuous stream
libation :	offering of wine to a god
apparently :	obviously
writings :	literary work
Renaissance :	the revival of arts and literature in Europe in the 14th, 15th and 16th centuries. This was a transition from the middle ages to the modern world.
regretfully :	feeling sorry
myth :	story, handed down from olden times, containing the early beliefs of a race (especially explanations of natural events, such as seasons)
lad :	young man; boy
hearth :	fireplace
incalculable :	too great to be calculated
patented :	something invented and protected by an official document; getting a copyright

pumped :	forced up
Collieries :	coal mines
burst :	broke violently apart from internal pressure.
work :	set in motion
pressure-gauge :	meter to measure pressure.
iron monger :	dealer in goods made of metal
partial vacuum :	space from which air has not been pumped out completely
condensed :	changed to liquid
piston :	round plate or short cylinder of wood or metal, fitting closely inside another cylinder or tube in which it moves up and down or backwards and forwards; used in engines of pumps.
see-sawing :	moving up and down, or to and fro
passage :	passing
ironed out :	removed, got rid of
operation :	working
safety :	valve which releases pressure (in a steam-boiler etc.) when it becomes too great.
explosion :	sudden and violent bursting
equipment :	device or apparatus
canals :	channel cut through land to carry water to fields for irrigation.

14.1.4 Comprehension Questions

Exercise 1

Answer the following

1. In what ways, according to the passage, steam-power 'declared the triumph of industry and glory of man'?
2. For what purpose was water used in industry before the steam-power?
3. Why was water-power used in a limited way in Britain?
4. What has led water to be considered very useful once again ?
5. What was the steam-power used for in Alexandria?
6. What does the writer think of James Watt's contribution to the steam-engine?
7. Why was Thomas Savery's engine called 'Miner's friend'?
8. Why did Savery's engine begin to be used for gentlemen's houses or to work for fountains?
9. Why was Newcomen's steam engine called 'atmospheric engine'?
10. What was the function of a large piston in Newcomen's steam engine?

11. In what ways was the first engine made about 1706 very clumsy ? How was it modified by 1720?

12. Mention some of the purposes for which the steam engine began to be used.

13. To which steam engine (Savery's or Newcomen's) does the following description fit?

The water in the boiler is heated to make steam, which passes, when the valve is opened, into the tank. The tank is then doused with water from a pipe above, and the steam condenses, creating a partial vacuum. Thus, water is drawn up the pipe, and forced out.

True and False statements

Exercise 2

Identify the false statements and correct them.

1. Coal had absolutely no role to play in bringing about the industrial revolution.
2. Steam power turned out to be a powerful force only gradually.
3. Britain did not depend on water power at all.
4. Many researchers during the Renaissance were inspired by Hero's writings and used steam to do whatever he had done.
5. Savery's steam engine was not found fit for pumping more than 100 feet deep.
6. The first pump to be used widely in industry was produced by Newcomen and not by Thomas Savery.

Contextual Reference

Exercise 3

Complete the following after studying the passage.

1. 'It' in line 5 refers to
2. 'It' in line 9 refers to
3. 'This country' in line 11 refers to
4. 'Its' in line 14 refers to
5. 'It' in line 18 refers to
6. 'It' in line 30 refers to
7. 'It' in line 47 refers to

14.2 VOCABULARY

Compound Nouns

Exercise 4

Compound nouns occur frequently in scientific and technical writing because they help to put as much information as they can into as few words as possible. 'Steam-power' 'water-frame', 'water-power', 'hydro-electricity' are some of the compound nouns used in the reading passage in this unit.

There are three things to notice about compound nouns. First, some compound nouns are joined by hyphen (-) and some are not. There are no strict rules for the use of hyphens.

It is very important to use hyphens with care in longer compounds in order to make the meaning clear. The example **old taxi stand** could mean either:

a taxi stand which is old
a stand meant for old taxis.

If the second alternative is meant the compound should be written as:

old taxi - stand.

Second, remember that a **hospital for animals** becomes **an animal hospital** because the first half of a compound is never plural. This is because the first noun is in the place of an adjective and adjectives in English are never plural. Also remember that it is not plural even with a plural number:

A scale which measures upto 100 kilograms.

A 100 kilogram scale.

Write out the following passage changing the words or phrases underlined into parts of compound nouns:

The box for the tools is kept in the room for storages. Besides the standard tools, it should contain a ruler for measuring up to 100 centimeters, some wire made of aluminium, some nails 2 inches long, a number of plugs with three pins, some wire for fuses and a can containing oil. If any tools are missing the incharge of the workshop should be informed.

Find words or phrases in the passage that mean the following:

Exercise 5

A. Striking _____

B. Honour _____

C. Physical strength _____

D. Vast _____

E. Clear _____

F. Option _____

G. Obviously _____

H. Literary work _____

I. Popular belief _____

J. Great _____

K. Extensively _____

L. Blast _____

M. Self-moving _____

N. Incomplete _____

Exercise 6

Fill in the blanks in the following sentences with the appropriate words from the list given below:

contributed

relied

necessitated

pour

revealed

burst

eliminate

condensed

ironed out sprayed

1. He _____ the coffee out of the saucepan into the jug.

2. Steam is _____ to water when it touches a cold surface.

3. The increase in population has _____ a greater food supply.

4. He lost control of the scooter when the back tyre of his scooter _____.

5. Drinks _____ to his ruin.

6. They always _____ on us because we helped them whenever they were in difficulty.

7. Research has _____ that excessive smoking over a long period causes cancer of the lungs.

8. Both of them had not been on speaking terms for very long time. But recently all their misunderstandings have been _____ by the intervention of a common friend.
9. Small pox has been almost completely _____ from India.
10. The entire colony was _____ with insecticides to destroy flies and mosquitoes.

14.3 GRAMMAR AND USAGE

14.3.1 Reduced relative clauses

Exercise 7

Many active and passive relative clauses can be shortened or reduced in the following ways

A. When the relative clause contains a verb in the passive:

Most of the energy which is required by the body is derived from carbohydrates and fats.

Rope which is made of nylon does not rot.

These two sentences can be reduced as follows:

Most of the energy required by the body is derived from carbohydrates and fats.

Rope made of nylon does not rot.

B. When a relative clause contains a verb in a continuous tense :

The plane which is flying at an altitude of 2,140 meters is subjected to pressures of 80 kilonewtons per square meter.

The bus which was carrying a marriage party met with an accident.

These can be reduced as:

The plane flying at an altitude of 2,140 meters is subjected to pressures of 80 kilonewtons per square meter.

The bus carrying a marriage party met with an accident.

C. When the relative clause contains which has/have:

A diesel engine which has a running speed of 75 to 250 rev/min. is called a slow-speed diesel engine.

The cars which have less petrol consumption are more popular.

These can be reduced in two ways:

A diesel engine having a running speed of 75 to 250 rev/min is called a slow-speed diesel engine.

OR

The cars having less petrol consumption are more popular.

OR

The cars with less petrol consumption are more popular.

D. When a relative clause contains a verb in the simple present:

Bronze which contains 0.8% phosphorus is called phosphor bronze.

Mathematics is a compulsory subject for students who specialize in science.

These can be reduced in the following way:

Bronze containing 0.8% phosphorus is called phosphor bronze.

Mathematics is a compulsory subject for student specializing in science.

Reduce the following relative clauses :

1. The driving belt which transmits power to the pulley is 9 mm thick.
2. Cargoes which have a low stowage factor are usually put at the bottom of the hold.
3. Rays which pass through a lens either converge or diverge.
4. Food which has been broken down by enzymes is absorbed through the lining of the intestine into the blood.
5. Diseases which are caused by viruses are often difficult to cure.
6. A person who has a specialization in computers can get a very good job these days.
7. A sailor who is working aloft should wear a safety harness.
8. The passengers who were sitting in the second class compartment did not receive any serious injury.

14.3.2 Participle Modifiers

Exercise 8

The present participle(the-ing form of the verb) and the past participle (the -ed form of the verb) can be used like adjectives to modify a noun.

Examples

a swimming pool = a pool which is used for swimming.

the improved engine = the engine which had been improved.

Convert the following relative clauses to participle modifiers:

1. a diet which is properly balanced.
2. Muscles which contract
3. a flower which a multilated
4. an aeroplane which is flying
5. a leg which is broken.

14.4 WRITING

Sequence words

Exercise 9

First, then, next, after that, afterwards, later, eventually, finally are some of the time sequence words. They are generally put at the beginning of the process or the event that they introduce.

Example :

First soak a small quantity of asbestos wool in water. Then, push the asbestos wool to the bottom of a heat resistant test-tube finally heat the part of the test tube containing the charcoal and collect the gas.

Fill in the blanks in the following passage with appropriate sequence words :

Building a ship's hull

_____, the steel plates and bars are off-loaded from lorries or railway wagons. _____, they are stored in the stockyard ready for processing. _____, they are conveyed to the preparation shop by magnetic cranes. _____ they are coated with primer paint to prevent corrosion. _____, they are cut to the correct size by gas torches. _____, they are joined together to form larger units. _____, at the building berth they are welded together to form the hull.

Based on the passage you have just read on 'The exploitation of steam' write a brief historical account of how the steam engine developed from its beginnings to the eighteenth century. You may like to include the following points :

1. The purpose for which steam-energy was used in Alexandria.
2. The popular myth about the inventor of the first steam-engine.
3. Experiments done by such scientists as Marquis of Worcester, etc.
4. Thomas Savery's engine : the first steam-engine and its limitations.
5. Thomas Newcomen's 'atmospheric-engine' : the new changes
6. The extensive use of the steam-engine in the 18th century.

14.5 LET US SUM UP

In this unit we have given practice in -

- i) Understanding a science passage dealing with the exploitation of steam.
- ii) identifying and correcting the false statements
- iii) finding out objects or persons which have been referred to by certain pronouns and demonstratives used in the passage.
- iv) finding out words/phrases which mean the same as the given words.
- v) changing words/phrases into compounds nouns.
- vi) reduced relative clauses.
- vii) participle modifiers
- viii) sequence words
- ix) writing a paragraph based on the hints provided.

14.6 ANSWERS TO THE EXERCISES**Exercise 1**

1. Steam-power brought about a revolution in the field of industry; the industry was no longer carried on water-power; it had begun to be worked with steam-power. This revolution was the work of men's imagination and this was man's great achievement.

2. It served the industry to work bellows and hammers in iron-works and turn the water-frame and the mule in the textile industry.
3. Water-power was used in a limited way in Britain because of its geographical limitations: did not have fast flowing rivers. As a matter of fact, water-power depended on fast flowing rivers.
4. It is considered to be useful once again because it is found to be a source of electricity.
5. Steam was used in Alexandria for opening temple doors or for giving offering of wine to gods. This action was made to look as if it was done by some mysterious power.
6. The writer thinks that although James Watt's contribution to the steam-pump was enormous he did not invent it.
7. Thomas Savery's engine was called 'Miner's friend' because it helped the miners by raising the water from great depths.
8. Savery's steam-engine was used for gentlemen's houses or to work fountains, because in both the cases water to be pumped was not very deep, and this steam-engine was found very effective for pumping water from lesser depths.
9. It was called 'atmospheric-engine' because it was air pressure rather than steam in the cylinder which raised the pump and made it work.
10. It helped to increase its force without increasing steam pressure and thus made it more powerful than survery's engine.
11. The piston did not fit tightly into the cylinder and condensation was not complete. The tap controlling the passage of steam into the cylinder was handled manually. These limitations were overcome by 1720. Water was sprayed into the cylinder to improve condensation. The operation of the tap was made automatic. A safety-valve was introduced to eliminate the danger of explosion.
12. It began to be used for the following :
 - a) to pump up water in the mines.
 - b) to pump water into canals and
 - c) to supply drinking-water to towns.
13. Savery's steam-engine.

Exercise 2

1. False. Coal did not have a very impressive role to play in bringing about the industrial revolution.
2. True.
3. False. Britain didn't depend on water power as much as did the Alpine area of Europe and much of the United states.
4. False. Many researchers during the Renaissance were inspired by Hero's writings and experimented with devices which could work with steam.
5. True.
6. False. The first pump to be used widely industry was produced by Newcomen and not by Thomas Savery.

Exercise 3

1. Steam-power,
2. water,
3. Britain,
4. water's,
5. steam-power,
6. Savery's steam-engine called 'Miner's friend',
7. The first steam engine.

Exercise 4

The tool box is kept in the store-room. Besides the standard tools, it should contain a 100 centimeter measuring ruler, some aluminium wire, some 2 inches long nails, a number of three-pin plugs. Some fuse-wire and an oil-can. If any tools are missing the workshop incharge should be informed.

Exercise 5

- | | | | |
|----------------|------------------|------------------|---------------|
| A. impressive, | B. glory, | C. muscle power, | D. tremendous |
| E. obvious, | F. alternative, | G. apparently, | H. writings |
| I. myth, | J. incalculable, | K. widely, | L. explosion, |
| M. automatic, | N. partial. | | |

Exercise 6

- | | | | |
|-----------------|---------------|------------------|----------------|
| 1. poured, | 2. condensed, | 3. necessitated, | 4. burst, |
| 5. contributed, | 6. relied, | 7. revealed, | 8. ironed out, |
| 9. eliminated, | 10. sprayed. | | |

Exercise 7

1. The driving belt transmitting power to the pulleys is 9 mm thick.
2. Cargoes having a low stowage factor are usually put at the bottom of the hold.
3. Rays passing through a lens either converge or diverge.
4. Food broken down by enzymes is observed through the lining of the intestine into the blood.
5. Diseases caused by viruses are often difficult to cure.
6. A person having a specialization in computer can get a very good job these days.
7. A sailor working aloft should wear a safety harness.
8. The passengers sitting in second class compartment did not receive any serious injury.

Exercise 8

- | | | |
|------------------------------|------------------------|------------------|
| 1. A properly balanced diet. | 2. Contracting muscles | |
| 3. a mutilated flower. | 4. a flying aeroplane, | 5. a broken leg. |

Exercise 9

First, Then, Eventually, Then, Next, Later, Finally.