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Professional English

For Tractors and Farm Machines

Навчально-методичний посібник для студентів вищого аграрного навчального закладу I етапу навчання

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ВСТУП

Підготовка інженера-механіка для аграрного сектору з іноземних мов в сучасних умовах навчання із урахуванням існуючих вимог виробництва передбачає посилення уваги до формування у майбутніх спеціалістів навичок професійного усного та письмового спілкування, і це є основним завданням методичної розробки.

Посібник включає 4 розділи, кожен з яких розрахований на 2-3 практичних заняття з англійської мови. Матеріали посібника складають той професійно-орієнтований тематичний мінімум, який мають засвоїти студенти І етапу навчання за напрямом «Процеси, машини та обладнання аграрного виробництва».

Розділи посібника присвячені таким темам, як трактор, двигуни внутрішнього згоряння та сільськогосподарські машини.

Кожен розділ містить тексти, завдання на засвоєння лексики за темою, розвиток навичок говоріння, а також вправи на закріплення граматичного мінімуму.

Всі завдання супроводжуються ключами.

Посібник розроблений для студентів напряму «Процеси, машини та обладнання аграрного виробництва» вищого аграрного навчального закладу І етапу навчання.

Unit 1

Tractors

Lesson 1 Farm tractor

Vocabulary

crawler ['kro:lə] = tracklaying tractors
engine ['endʒın]
grip [grıp]
ground [graund] = soil
horsepower ['hɔ:s,pauə]
implement ['ımplımənt]
increase *v* [ın'krı:s]
linkage ['lıŋkıdʒ]
three-point linkage [θrı:po'nt 'lıŋkıdʒ] = three-point hitch
load *n*, *v* [loud]
measure *v* ['meʒə]
mount [maunt]
mounted
power ['pauə]
produce [prə'dju:s]
PTO (power take-off)
shaft [pi:ti:ou ʃa:ft]
pull [pul]
pulley ['pulı]
belt-pulley ['belt'pulı]
push [puʃ]
supply [sə'plaı]
track [træk]
tyre [taıə]
use *n* [ju:s], *v* [ju:z]
wheel[wi:l]

according to [ə'kɔ:dıŋtə]
because [bı'kɔz]
by means of [baı 'mı: nzəv]
if [ıf]
that [ðæt]

Reading

TRACTORS

Tractor supplies power to machines. The tractor can pull or push implements, it can supply power to machines from the shaft and it can drive machines by means of a belt from a belt pulley.

The tractor power is produced by the engine and is measured by horsepowers (hp) or kilowatts (kw). There are tractors with engine power from 3 to 500 hp.

The crawlers or tracklaying tractors are large, they are used for heavy operations. Large tracks increase the grip of the tractor on the ground and the crawlers are able to push or pull heavy loads and machines.

Most of the tractors have tyres. Wheeled tractors may have mounted implements and machines on them. This is done by the three-point linkage.

The first tractors were wheeled **steam**[1] engines. Farmers called them **traction engines**[2]. They were popular in the UK. Then the American engineers produced the first steam tractor. It pulled heavy farm machines and was used during the **harvest**[3].

How will tractors of the future look like? Will they have diesel engines? Today engineers and producers invent and test new technologies such as **fuel cells**[4] or **diesel-electric hybrids**[5]. The future tractor must be powerful and 'green'.

[1] **steam –** паровий
[2] **traction engines –** тягач
[3] **harvest –** збирання врожаю
[4] **fuel cells –** паливний елемент
[5] **diesel-electric hybrids –** дизель-електричний гібрид

Practice

1. ***Match English phrases with their Ukrainian equivalents.***

1. farm machine	a. потужність трактора
2. wheeled tractor	b. тракторний двигун
3. engine power	c. сільськогосподарська машина
4. tractor power	d. колісний трактор
5. tractor engine	e. потужність двигуна

2. Match synonyms in (A) and antonyms in (B).

	A		***B***		
1.	tyre	a.	tracklaying tractor	1. pull	a. light
2.	crawler	b.	big	2. wheel	b. far
3.	machine	c.	wheel	3. close	c. push
4.	large	d.	implement	4. heavy	d. track

3. Form the words using –er ending. Put them into the sentences.

drive produce use engine	+ *er*	a. *driver* b. c. d.	водій виробник користувач інженер

1. Every … of farm machinery can operate three-point linkage. 2. Tractor power is increased by the … . 3. The … will use new technologies. 4. The … works on a tractor.

4. Choose the correct variant.

A 1. The tractor *drive / drives* machines. 2. Wheeled tractors *have / has* mounted machines. 3. This *is / are* our new implement. 4. Crawlers *is / are* large. 5. The tractor *produce / produces* the power.

B 1. The tractors usually *pull / pulled / will pull* heavy loads. 2. A century ago farmers *use / used / will use* traction engines. 3. The crawler *has / had / will have* large tracks. 4. In 50 years engineers *change / changed / will change* tractor engine. 5. Steam tractors *are / were / will be* popular in the late 1800s and early 1900s.

C 1. The tractors *is / are* produced with engine power from 3 to 500 hp. 2. The tractor power *is* / *are* measured by horsepowers (hp) or kilowatts. 3. Tracklaying tractors *is / are* used for heavy operations. 4. The cultivator *is / are* mounted on the tractor.

5a. Choose the correct beginnings for the questions.

Is	Are	Does	Do

1. … tracks increase the grip of the tractor on the ground?
2. … crawlers large?
3. … this a PTO shaft?
4. … the driver use the three-point linkage?

5b. Match the short answers to the questions in 5a.

a. No, he doesn't.
b. No, it isn't.
c. Yes, they are.
d. Yes, they do.

Lesson 2 Tractor types

Vocabulary

agriculture['ægrɪkʌlʧə]
crop[krɔp]
cultivate ['kʌltɪveɪt]
drive (drove, driven) ([draɪv], [drəuv], [drɪvn])
front[frʌnt]
general-purpose ['dʒen(ə)r(ə)l'pə:pəs] = utility[ju:'tɪllətɪ]
place *v* [pleɪs]
purpose ['pɜ:pəs]
rear [rɪə]
row [rəu]
row-crop tractor
wheeled tractor

Reading

TYPES OF TRACTORS

Four-wheel tractors are produced with engines power from about 18 hp (small tractors) to more than 500 hp (the 'giants'). There are wheeled tractors and crawlers. The wheeled type tractor is most commonly used in agriculture. In the past many wheeled tractors had three wheels.

The wheeled tractors are divided into two basic types. They are **two-wheel-drive** (2WD) and **four-wheel-drive** (4WD)[1] tractors. 4 WD tractors usually have four large **equally-sized**[2] wheels or small front wheels and large rear wheels. Most equal-sized wheel models are large tractors with engine power about 250-500 hp. Ploughing and heavy cultivations are ideal work for these powerful tractors.

According to the purpose tractors may also be classified as general-purpose, row crop, garden and industrial tractors.

The general-purpose tractor does most of the work on the farms. It has powerful hydraulics and is able to pull heavy loads and machines. This group includes large field tractors which are powerful and heavy. Their weight is used to increase wheel grip.

The row-crop tractor has narrow tyres which can be placed closer or farther apart according to the distance between the rows that must be cultivated. It has a lightweight design and good visibility.

Tracklaying tractors or crawlers have low operating speed but they do less damage to the soil than the large powerful wheeled tractor.

[1]**two-wheel-drive** (2WD) / **four-wheel-drive** (4WD) – з приводом на два / чотири колеса

[2]**equally-sized –** однакового розміру

Practice

1. Complete the diagram "Tractor types".

Tractor types

engine power	**wheels/tracks**	**purpose**
– small (18 hp)	– (2)_____	– (4)____-_____ (utility)
– (1)___ (to 500 hp)	– wheeled	– (5)___-_____
	– 2 WD	– (6)_____
	– (3)_____	– (7)_____
	– equally sized wheels	
	– small front+ large rear wheels	

2. Look through the diagram. Write up all the words you don't know the meaning of. Then watch the video "John Deere tractors" and complete the diagram. Be ready to characterize three groups of Deere's tractors.

Tractor types according to the purpose

(1)	**(2)**	**(3)**
(the smallest)	(the most common)	(large field tractors)
(4) _____ hp	(5) _____ hp	(the biggest and most powerful)
– loading gravel	– planting	(6) _____ hp
– moving hay bales	– cutting hay	4WD equal sized
	– pulling hay bales	– cultivating
		– chisel plowing
		– tillage
		– planting

3. Match abbreviations with their meanings.

1.	4 WD	a.	kilowatt
2.	2 WD	b.	four-wheel-drive
3.	hp	c.	horsepower
4.	kw	d.	two-wheel-drive

4. Complete the sentences using the correct form of the verb.

1. Four-wheel tractors … with engines of any size.
   a. produce b. produced c. are produced
2. These engines … enough power for that operation.
   a. produce b. produced c. are produced
3. The word *tractor* … from Latin.
   a. was taken b. take c. took
4. Crawlers … tyres.
   a. doesn't have b. not have c. don't have
5. Where … the farmer … garden tractors?
   a. does uses b. does …use c. do use

Lesson 3 Tractor parts

Reading

TRACTOR PARTS

At the dawn of mechanization the tractor **drawbar**[1] was used to pull various implements because it was very simple. Then some tractors had a drawbar which could be attached to the hydraulic linkage. It was not used for heavy implements.

The three-point (3-point) hitch revolutionized farm tractors and their implements. Almost every tractor today has three-point linkage. This hitch allows to attach and detach implements easily. It transmits much of the weight of the implement to the tractor. So the machines don't need wheels or heavy drawbars. Mounted implements are easily transported. Using the hydraulic system the driver can lower or lift the mounted implements. Hydraulically operated implements can also be attached in front of the tractor.

Early tractors used belts and separate belt pulleys to power stationary equipment. Modern tractors use a power take-off (PTO) shaft which provides the driving force for different implements. It can drive irrigation pumps and cultivation machinery. Some tractors have a belt pulley mounted on the

gear-box[2] and driven by it. Other tractors can have a pulley connected with the power take-off shaft.

NOTES

[1] **drawbar –** причіпний пристрій
[2] **gear-box –** коробка передач

Practice

1. Match tractor parts (A) with their functions (B).

A	B
1. engine	a. enables attachment of the implements to the tractor
2. 3-point hitch	b. contains gears
3. PTO shaft	c. a disc which allows the machine to move
4. gear-box	d. provides rotary power to machinery
5. wheel	e. provides the power of the tractor
6. equipment	f. a tractor with two heavy metal tracks
7. crawler	g. a farm machine
8. implement	h. a set of devices used for a specific purpose

2. Complete the sentences with the modal verbs from the box.

can	may	must

1. The tractor … pull machines. 2. The power … be measured by horsepowers. 3. The tractor … have tracks. 4. The driver … check water in the radiator. 5. Garden tractors … not be used for road making. 6. The power … be supplied to the active tools. 7. The tractors … have tyres. 8. The operator … serve machines properly. 9. The tractor … push heavy loads. 10. The radiator … be clean.

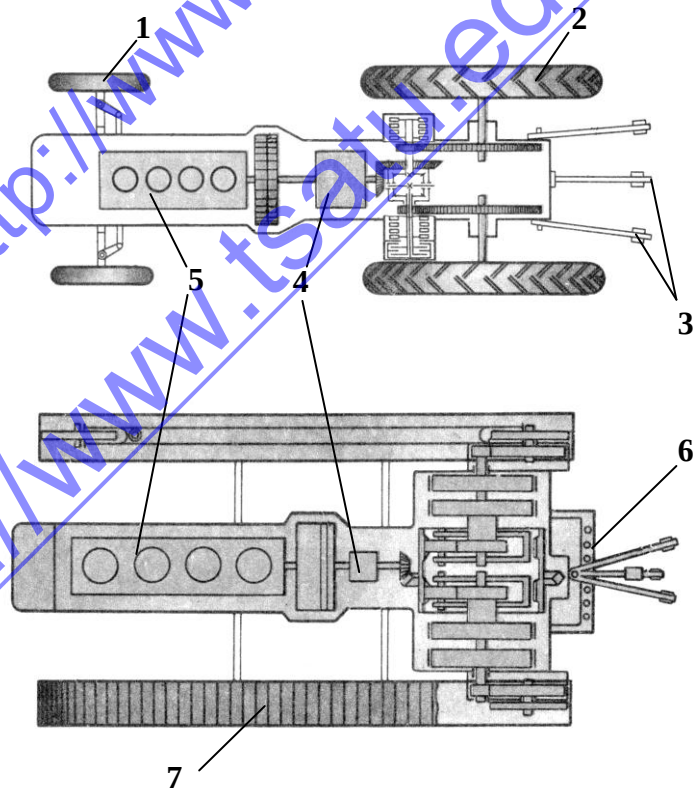
3. Choose the correct variant.

1. Farm machines *is* / *are* supplied by tractor engine power. 2. Crawlers *is* / *are* used for heavy operations. 3. Hydraulic

motor *is* / *are* used to drive different machines. 4. Mounted implements *is* / *are* easily transported. 5. The drawbar *is* / *are* not used for heavy implements. 6. Tractors *is* / *are* classified according to the engine power. 7. The grip of the tractor on the ground *is* / *are* increased by tracks. 8. The implements *is* / *are* mounted on the tractor. 9. The quick hitch *is* / *are* used for farm machines attachment. 10. The distance between tracks *is* / *are* not changed.

4. Label the diagram with letters

a. engine b. drawbar c. front wheel d. rear wheel e. track f. gear-box g. three point linkage



Unit 2
Internal combustion engines

Lesson 1 Engine parts

Vocabulary

be (was, were; been) [bi:] ([wɔz], [wə:], [bi:n])
burn (burnt, burnt) [bə:n] ([bə:nt], [bə:nt])
burning ['bə:nəŋ]
camshaft ['kæmʃa:ft]
chamber ['tʃeımbə]
  combustion chamber
change *v* [tʃeındʒ]
close *v* [kləuz]
compression [kəm'preʃ(ə)n]
crankcase ['kræŋkkeıs]
crankshaft ['kræŋkʃa:ft]
internal combustion engine
flywheel ['flaıwi:l]
force *n* [fɔ:s]
form *v*, *n* [fɔ:m]
fuel [fjuəl]
head [hed]
motion ['məuʃ(ə)n]
move [mu:v]
oil [ɔıl]
open *v* ['əup(ə)n]
part [pa:t]
  reciprocating part
piston ['pıstən]
power ['pauə]
provide [prə'vaıd]
support [sə'pɔ:t]
take (took, taken) [teək] ([tuk], ['teıkn])
this (*pl* these) [ðıs] ([ði:z])
that (*pl* those) [ðæt] ([ðəuz])
valve [vælv]

between [bı'twi:n]
for [fɔ:]
in [in], into ['intu]
of [ɔv]
or [ɔ:]
through [θru:]
when [wen]
where [wɛə]
within [wı'ðın]

Reading

INTERNAL COMBUSTION ENGINE

Internal combustion is the process of the burning of fuel within the engine. The fuel burns within the engine and provides forces. These forces provide the engine power.

Internal combustion engines have stationary, rotary and reciprocating parts.

Stationary Engine Parts. The stationary engine parts are the cylinder block, the crankcase and the cylinder head.

The cylinder block is one of the basic parts of the engine. The process of combustion takes place within the cylinders.

The crankcase is a part of the cylinder block. It supports the crankshaft and the camshaft.

The cylinder heads close the cylinders. The cylinders and the cylinder heads form the combustion chambers. The burning of fuel takes place within the combustion chambers.

Rotary Engine Parts. Rotary engine parts are the crankshaft, the flywheel and the camshaft.

The crankshaft changes reciprocating motion of pistons to rotary motion. The camshaft opens the valves of the engine.

Reciprocating Engine parts. Reciprocating parts are pistons, rings, valves and connecting rods.

The piston moves up and down within the cylinder. It has compression and oil rings.

The engine has valves. They open and close the combustion chamber where the burning of fuel takes place.

The connecting rod links the pistons and the crankshaft. It changes the reciprocating motion of pistons into the rotary motion of the crankshaft.

Practice

1. Match English phrases with their Ukrainian equivalents.

1. engine part	a. поршневі кільця
2. combustion chamber	b. поршневий палець
3. cylinder head	c. блок-циліндрів
4. cylinder block	d. шатун
5. piston rings	e. деталь двигуна
6. piston pin	f. камера згоряння
7. connecting rod	g. голівка циліндрів

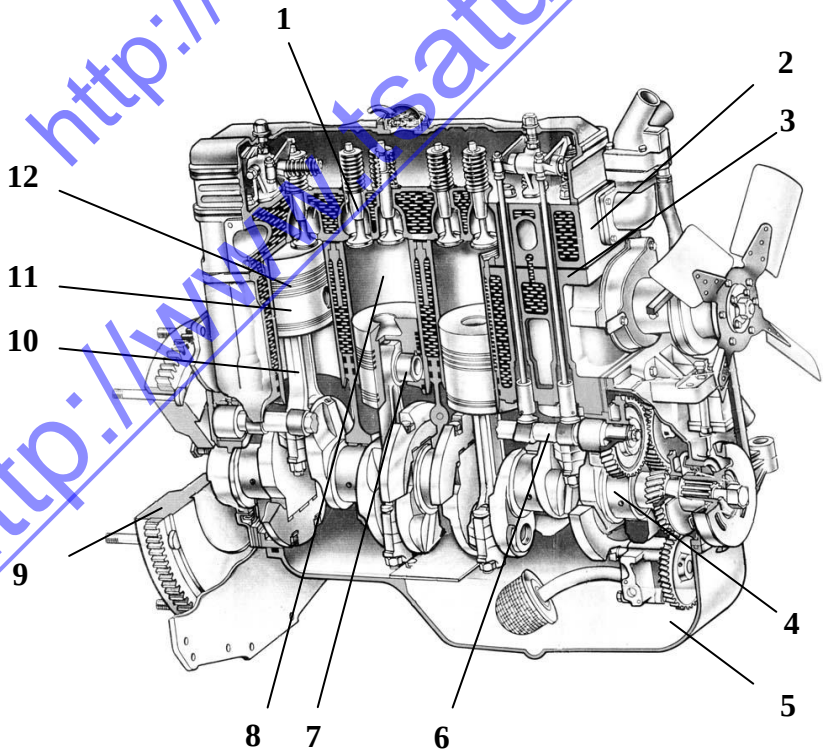
2. Complete the diagram "Engine parts".

Engine parts

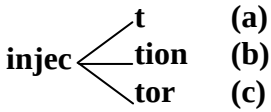
Stationary	**(1)_____**	**(2)_____**
– (3) _____ _____	– (5)_____	– (7)_____
– (4) _____ _____	– (6) _____	– (8)_____ _____
– crankcase	– flywheel	– (9) _____ _____
		– (10) _____ _____
		– valves

3. Label the diagram with letters

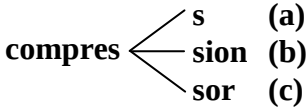
a. camshaft b. combustion chamber c. connecting rod
d. crankcase e. crankshaft f. cylinder block g. cylinder head
h. flywheel i. piston j. piston pin k. piston rings l. valve



4. Form the words and put the right word in the blank.



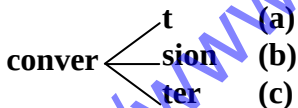
1. …. is produced under high pressure.
2. Special device is used to … fuel into the combustion chamber.
3. An … is a part of the fuel system.



4. For this operation we need an air-….
5. Lack of … is one of basic **failures** that can happen in an engine.
6. The pistons … the fuel mixture.

failure – несправність

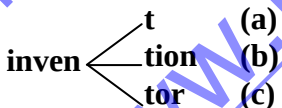
7. An energy … takes place in the internal combustion engine.



8. Scientists will test a **solar** energy … of new type.
9. The crankshafts … the reciprocating motion of the piston into rotary motion of the flywheel.

solar – сонячний

10. Usually engineers patent their ….



11. German … Nicolaus Otto was the first to develop a functioning four-stroke cycle.
12. In 1893 Rudolf Diesel managed to …the compression-ignition engine.

Lesson 2 Systems of engine

Vocabulary

deliver [dɪ'lɪvə]
high-pressure pump
ignite [ɪg'naɪt]
injector [ɪn'ʤektə]
lubricate ['lu:brɪkeɪt]
magneto [mæg'ni:təu]
oil [ɔɪl]
reduce [rɪ'dju:s]
spark [spa:k]
spark plug
storage battery ['stɔ:rɪʤ 'bætərɪ]
wear [wɛə]

Reading

ENGINE SYSTEMS

The engine has four systems. Each of the systems has special functions. These systems are the fuel, the lubricating, the electrical and the cooling systems.

The fuel system of the diesel engine has a high-pressure pump. This pump **forces the fuel**[1] through injectors into the combustion chamber where the burning of fuel takes place. The gasoline engine has no pump, it has a carburettor. The carburettor mixes the fuel and air and transmits this mixture to the combustion chamber. Modern gasoline engines use such technology as **direct injection**[2]. It is not new to the automobile world as it is the standard in diesel engines. The fuel is also comes to the combustion chamber through injectors and then mixes with air inside the cylinder.

The lubricating system provides engine parts lubrication with oil. The engines have oil pumps. These pumps deliver oil to all the parts. There are oil filters between the pump and other engine parts. The oil filters keep the oil clean reducing engine wear.

The cooling system is necessary **to prevent overheating**[3] of the engine. There are engines with water and air cooling.

The electrical system of the engines has a storage battery or a magneto. Magneto provides high voltage and transmits it to the spark plugs for the ignition. Spark plugs ignite the fuel mixture in the combustion chamber.

NOTES

[1]**forces the fuel** − нагнітає паливо
[2]**direct injection –** пряме впорскування
[3]**to prevent overheating** – запобігати перегріванню

Practice

1. Make word combinations.

1.	fuel	a.	pump
2.	spark	b.	engine
3.	gasoline	c.	system
4.	combustion	d.	plug
5.	stationary	e.	injection
6.	high-pressure	f.	part
7.	direct	g.	chamber

2. Which word or word combination is the odd one out?

1. a. piston b. valve c. camshaft d. connecting rod
2. a. injector b. fuel c. pump d. track
3. a. battery b. oil c. magneto d. electric spark
4. a. lubrication b. tracklaying c. cooling d. injection

3. Put the words in the correct order to make sentences (questions).

1. The piston / the cylinder / within / moves.
2. There / pump / the gasoline engine / in / is / high-pressure / no.
3. Diesel / a carburetor / doesn't / engine / have.
4. Is / the diesel engine / there / in / a spark plug?

Lesson 3 Engine operation

Vocabulary

air [ɛə]
bottom dead centre ['botəm ded'sentə], BDC
common ['kɔmən]
cycle [saɔkl]
draw (drew, drawn) [droɔ:] ([dru:], [drɔ:n])
draw in (into)
exhaust [ig'zɔ:st]
heat [hi:t]
intake ['ɔnteik]
inward ['ɔnwəd]
mixture ['mɔkstʃə]
movement ['mu:vmənt]

operate ['ɔpəreɔt]
outward ['autwəd]
stroke [strouk]
power stroke ['pauə strouk]
top dead centre [tɔp ded 'sentə], TDC
because of [bə'kɔzəv]
during ['djuərɔŋ]
from [frɔm]
toward [tə'wɔ:d]

Reading

PRINCIPLE OF ENGINE OPERATION

Engines operate on cycles. The four strokes in a cycle of the internal combustion engine are: intake, compression, power and exhaust.

Intake. During the intake stroke the piston moves to BDC and the intake valve opens. This movement of the piston draws a mixture of air and fuel into the cylinder (in a diesel this movement of the piston draws in air **only**[1]).

Compression. When the piston **reaches**[2] BDC it moves toward the cylinder head (inward motion). The valves do not open and the piston compresses the fuel mixture between the piston and the cylinder head (in a diesel the piston compresses air only).

Power stroke. When the piston reaches TDC, an electric spark ignites the fuel mixture in the combustion chamber of the gasoline engine (in a diesel engine the heat of the highly compressed air ignites the fuel).

When the air-fuel mixture burns it moves the piston with great force.

Exhaust. The exhaust stroke takes place when the piston moves up. The exhaust valve opens and the piston **forces out**[3] the gases. The new cycle will begin in the cylinder.

Because of the four strokes we call this engine a four-stroke-cycle engine. The four-stroke-cycle engine with spark ignition is the most common type of the internal combustion engine.

NOTES

[1] **only** – лише, тільки
[2] **reach** – досягати
[3] **force out**–виштовхувати

Practice

1. Read the text. Can you guess which words and word combinations go in the gaps? Listen and check.

a) ~~TDC,~~ b) four-stroke, c) internal combustion, d) cycle, e) stroke, f) BDC

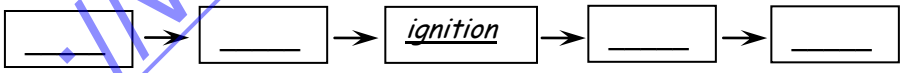
What is the 1._____? It's a movement of the piston from *TDC* to 2._____. Calling an engine 3._____-_____ means its engine 4._____ has four strokes. A four-stroke **petrol** engine uses 5._____ _____.

petrol = gasoline

2. Listen again and complete the working chain.

a) ~~ignition~~, b) compression, c) power, d) exhaust, e) intake

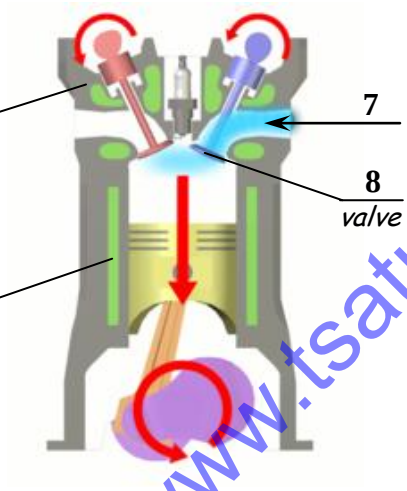
Four strokes must include the 5 key events, common to all combustion engines:

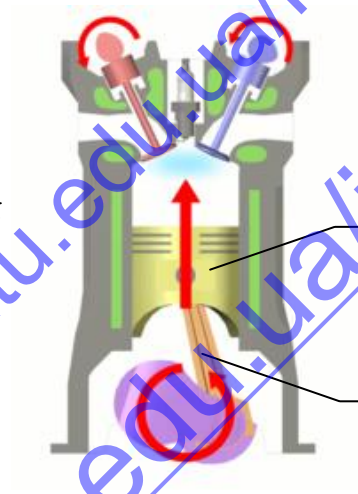


3. Find these items in the diagram.

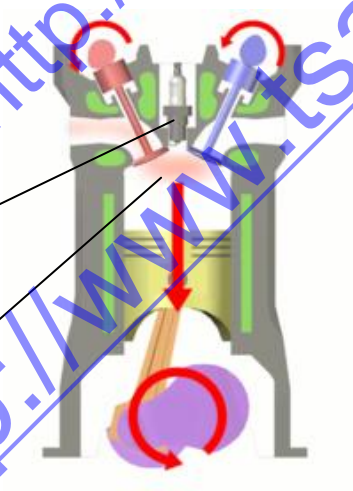
a. ~~valves~~ b. piston c. crankshaft d. camshaft
e. connecting rod f. combustion chamber
g. cylinder block h. cylinder head i. intake stroke
j. power stroke k. compression stroke l. exhaust stroke
m. air-fuel mixture n. burnt gases o. spark plug

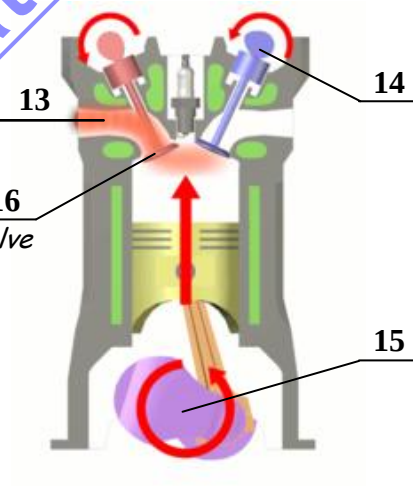
PRINCIPLE OF ENGINE OPERATION





1 _____ _____ 2 _____ _____





3 _____ _____ 4 _____ _____

4. Read the text "Principles of engine operation" and complete the table.

	Strokes			
	Intake	Compression	Power	Exhaust
Valves	*Intake valve opens. Exhaust valve does not open.*			
Piston	*Piston moves toward the crankshaft.*			
Process in the combustion chamber	*Piston draws the air-fuel mixture (air only) into the cylinder.*			

5. Write the questions to the words in bold.

How many strokes are there in one cycle?

There are **four** strokes in one cycle.

1. **The cylinder head** closes the cylinder. (What…?)
2. The intake valves open **during the intake stroke**. (When…?)
3. The burning of fuel provides **forces**. (What…?)
4. The engine has **valves**. (What…?)
5. **The electric spark** ignites the compressed mixture. (What…?)
6. Piston moves **up and down.** (How…?)
7. Piston rings control **the wall lubrication**. (What…?)
8. Engine has **four** systems. (How many…?)
9. **The piston** compresses the fuel mixture. (What…?)
10. There are **two** types of valves. (How many…?)

Unit 3
Farm machines

Lesson 1 Tillage machinery

Vocabulary

attach [ə'tætʃ]
body ['bɔdɪ]
both ... and … [bouθ...ænd]
conventional [kən'venʃənl]
coulter ['koultə]
cut (cut, cut) [kʌt]
deep [di:p]
depth [depθ]
depend (on) [dɪ'pend]
fit [fɪt]
frame [freɪm]
frog [frɔg]
fully ['fulɪ]
furrow ['fʌrou]
harrow ['hærou]
leg [leg]
mouldboard ['mouldbɔ:d]
number ['nʌmbə]
on time
plough [plau] *бр.* = plow *ам.*
prepare [prɪ'pɛə]
reversible [rɪ'və:səbl]
root crops [ru:t krɔps]
rotate [ro(u)'teɪt]
seedbed ['si:dbed]
semi- ['semɪ]
share *n* [ʃɛə]
slice [slaɪs]
soil [sɔɪl]
sow [səu]
till [tɪl]
tillage ['tɪlɪdʒ]
tine [taɪn]
trailed [treɪld]
turn *v* [tə:n]
turn over
weed [wi:d]
wide [waɪd]
width [wɪdθ]

Reading

TILLAGE MACHINERY

The systems of food and fiber production in agriculture are highly mechanized. The tendency has been directed to **multipurpose**[1] machines which till the soil, form seedbeds and

irrigation furrows, plant the seed and apply fertilizer in one pass through the field.

Farming is a closed cycle. Its seasons are connected with times of year. Every farming season includes some farm operations. It's important for farmer to perform all the operations on time.

Spring is time to prepare the soil for sowing seeds. Special *tillage machines* are used for this operation. The preparation of seedbeds usually involves plowing, harrowing and cultivating. The primary purpose of plowing is to turn over the upper layer of the soil, bringing fresh nutrients, while burying weeds and the residues of previous crops. It also aerates the soil, and allows it to hold moisture better.

Different types of plows such as *mouldboard, disc, reversible* and *chisel* are used for this operation. The type of a plow depends on the soil, region and soil condition. Plowing is a **power-consuming**[2] operation, so it requires a powerful tractor.

The harrowing of the plowed soil is designed to break clods, level the surface and destroy weeds. The most common types of harrows are *disc harrow*, *chain harrow* and *tine harrow*. Modern *power harrows (rotary* or *reciprocating tine power harrows)* are more efficient because of their active **working tools**[3].

Cultivators are used often after plowing for **stubble cleaning**[4] and clods breaking. A lot of cultivators are used on farms (*cultivators with rigid* or *spring tines, with shares*). *Power-take-off* or *rotary cultivators* are also very popular.

NOTES

[1] **multipurpose –** багатоцільовий
[2] **power-consuming –** енергоємний
[3] **working tools –** робочі органи
[4] **stubble cleaning –** очищення від стерні

Practice

1. Match a line in A with a line in B.

A	B
1. furrow	a. is any of various implements used to level the ground
2. harrow	b. is a thin flat piece cut from something
3. seedbed	c. is a long narrow channel made in the ground by a plough
4. slice	d. is the place where something grows
5. mouldboard plow	e. has two mouldboard ploughs mounted back-to-back
6. disk plow	f. is used for deep tillage without turning of the soil
7. reversible plow	g. has large rotating disks which cut and turn the soil
8. chisel plow	h. is equipped with coulters and shares

2. Complete the sentences using the proper preposition.

at	in	by	across	from	on

1. The working depth is regulated … a depth wheel.
2. Rotary-tine power harrows have tines fitted on rotors … the width of the machine.
3. Seed harrows are mounted … small tractors.
4. … the end of each pass the plow is turned on its frame.
5. Disk diameter varies … 30 to 75 cm.
6. Some trailed plows are … common use.

3. Complete the gaps with the proper verb form. Find mentioned plow parts in italic at the figure.

PLOUGHS

A plough ___ (be) an implement with one or more mouldboards which ___ (cut) and ____ (turn) the soil. Modern

ploughs ____ (be) commonly fully mounted on the tractor hydraulic system or semi-mounted. A semi-mounted plough ____ (not be) lifted off the ground.

The soil engaging parts, *disc coulter* and the body of the plough _____ (attach) to *legs*, which _____ (bolt) to the plough *frame*. The base of a plough body ____ (call) the frog. The *share* ____ (cut) the bottom of the furrow slice. The *mouldboard* ____ (lift) and _____ (turn) the furrow slice.

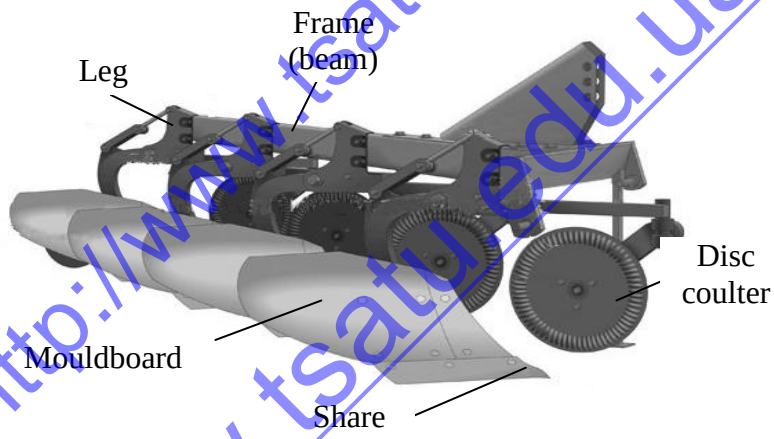


Fig. 1. Parts of a plough

4. Complete the sentences with the proper form of the verb given.

1. Different mouldboard types … their special surface.	a. prepares
2. Disks … by bearings.	b. is prepared
3. Disk harrows … and consolidate the soil.	c. use
4. Rotary cultivator … for stubble cleaning.	d. is used
5. Rotating disks … the soil slice.	e. turn
6. Farmers … different cultivation machinery.	f. is turned

7. The side of the furrow … by the coulter.	g. produce
8. Tractor hydraulic linkage … semi-mounted implements	h. is produced
9. This harrow … by our plant.	i. cut
10. Reversible plow … mechanically or hydraulically.	j. is cut
11. The tractor … for the work.	k. supports
12. Plow … the soil for sowing.	l. are supported

Lesson 2 Other farm machines

Vocabulary

aerate [eə'reɪt]
dry [draɪ]
fertilizer['fɜːtɪlaɪzə]
  apply fertilizers
gather['gæðə]
harvest ['hɑːvɪst]
  combine harvester [kəm'baɪn 'hɑːvɪstə]
healthy['helθɪ]
irrigate['ɪrɪgeɪt]
  irrigating machine
mechanized ['mekənaɪzd]
pest[pest]
  harmful ['hɑːmful]pest
pick up [pɪkʌp]
process['prəuses]
protect[prə'tekt]
seeder ['siːdə]
  seeding machine
sowing ['səuɪŋ] machine
planter ['plɑːntə]
  drill [drɪl]
self-propelled ['self prə'peld]
sprayer['spreɪə]
spreader['spredə]
weed control [wiːd kən'trəul]
swath[swɔθ]
windrower[wɪnd'rɔuə]

Reading

When the soil is ready farmers sow using special *seeding machines*. Usually fertilizers are applied during sowing. Also fertilizing may be a separate farm operation. *Fertilizer spreaders* are used to do it.

Summer is growing time for most crops. It's necessary to help the crop to grow healthier and faster. So, during this period farmers use different types of *cultivators* to control the weeds, aerate the soil and *sprayers* to protect the plants from harmful pests. To supply soil with water *irrigating machines* are used.

Some crops such as grain crops are harvested in summer. To harvest various crops *combine harvesters* are used. C*ombine harvesters* are self-propelled farm machines which realize the full cycle of harvesting. They cut, **thresh**[1] and separate the grain from the **straw**[2] and **chaff**[3]. *Combines* also may be used to pick up and thresh crops which have been cut and left in the swath by *windrowers*.

Fall is the time for harvesting all other crops. Most crops are harvested mechanically by different *combine harvesters*, but some crops are still gathered by hand. Such farming operations as crops drying and processing are also mechanized.

NOTES

[1] **thresh –** молотити

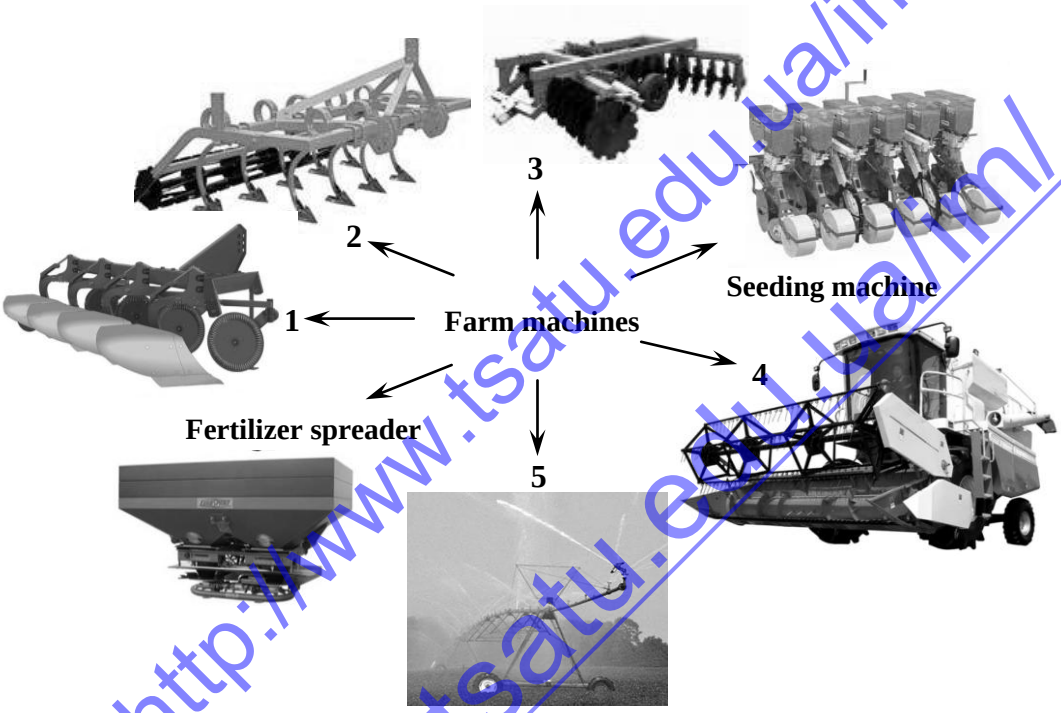
[2] **straw –** солома

[3] **chaff –** полова; дрібна солома

Practice

1. ***Write farming operations in the correct order.***

- ☐ sowing
- ☐ plowing
- ☐ harvesting
- ☐ harrowing
- ☐ fertilizing
- ☐ cultivation (weed control)
- ☐ spraying
- ☐ irrigation
- ☐ processing



2. Complete the diagram with farm machines you know.

3. Match farming operations (A) with their definitions (B).

A	B
1. sowing	a) gathering of a crop
2. plowing	b) turning over the upper layer of the soil
3. harvesting	c) supplying soil with mineral and organic nutrients
4. harrowing	d) destroying weeds
5. cultivation	e) preparing food
6. fertilizing	f) supplying soil with water
7. spraying	g) placing seeds or a crop in the soil
8. irrigation	h) leveling the ground, breaking up clods,
9. processing	i) protecting plants from pests

4. Put the words in the correct order to make sentences.

1. three / are / main / there / of / ploughs /types.
2. have / working / power / active / harrows / tools.
3. tillage / used / too / the cultivators / for / are.
4. is / plough / a / the moulboard / part.

Lesson 3 Combine harvesters

Vocabulary

auger ['ɔ:gə]
beater ['bi:tə]
capacity [kə'pæsətı]
chaff [ʧɑ:f]
concave ['kən'keıv]
consist of[kən'sıst]
crop [krɔp]
cutter bar ['kʌtə'ba:]
direct *v*[dı'rekt]
divide [dı'vaıd]
divider [dı'vaıd]
drum [drʌm]
fall (fell, fallen)
[fɔ:l] ([fel], ['fɔ:lən])
flow [flou]
grain [greın]
keep (kept, kept) [ki:p]
([kept])
leave (left, left) [li:v] ([left])
lift [lıft]
reel [ri:l]
separate *v*['sepəreıt]
sieve [si:v]
space [speıs]
straw [strɔ:]
straw walker [strɔ: 'wɔ:kə]
tank [tæŋk]
thresh [θreʃ]
trailer ['treılə]
unit ['ju:nıt]

Reading

COMBINE HARVESTERS

Combine harvesters are used to harvest various crops. The combine cuts the crop, threshes it and separates the grain from the straw and chaff.

The mechanism of a combine harvester can be divided into three sections. They are cutting, threshing and finally separating the grain from the straw and chaff.

To cut the crop a reciprocating type cutter bar is used. By means of tines a large auger directs the crop to the main elevator which lifts the crop to the threshing mechanism.

The threshing mechanism consists of a front beater, a heavy rotating drum, a concave and a rear beater.

Threshing takes place between the drum and concave. There are spaces between the concave bars, so the threshed grain is allowed to fall through onto the grain pan.

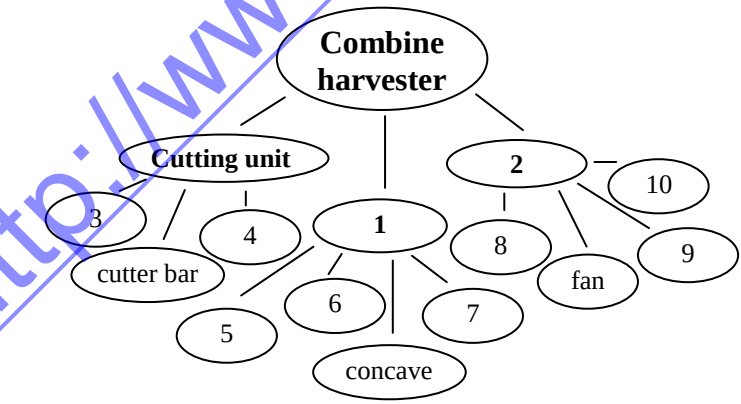
To separate the grain from the straw is the main function of separating mechanism. It consists of two parts: the straw walkers and the grain sieves.

The grain separated from the straw moves through the straw walkers and is directed to the grain pan under the concave. Then the vibrating action of the sieves separates the threshed grain. The fan provides a flow of air to keep sieves clean.

The harvested grain is directed to the grain tank.

Practice

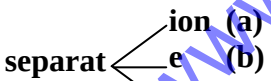
1. Complete the bubble network.

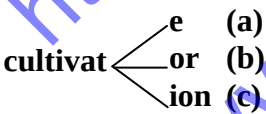


2. Complete word combinations matching (A) and (B).

A	B
1. front	a. mechanism
2. combine	b. walker
3. grain	c. tank
4. straw	d. bar
5. threshing	e. beater
6. threshed	f. harvester
7. cutter	g. grain

3. Form the words and put the right word in the blank.





1. The function of the straw-walkers is to … the grain from the straw.
2. Modern combine uses the rotary grain …
3. The combine harvester is a machine, that does cutting, threshing and … in one operation.
4. All power-driven … machinery is very efficient.
5. Usually farmers … the soil after ploughing.
6. Rotary … has L-shaped blades.

4. Complete the sentences using the correct form of the verb.

1. The crop … to the threshing drum.
   a) feeds b) feed c) is fed d) is feeding
2. The cylinder position … changeable.
   a) isn't b) aren't c) doesn't d) don't
3. What does the reel …?
   a) do b) did c) does d) done
4. What does the fan …?
   a) provided b) provide c) provides d) providing

5. Complete the gaps with the proper verb form. Find mentioned plow parts in italic at the figure.

WINDROW OR SWATH HARVESTING

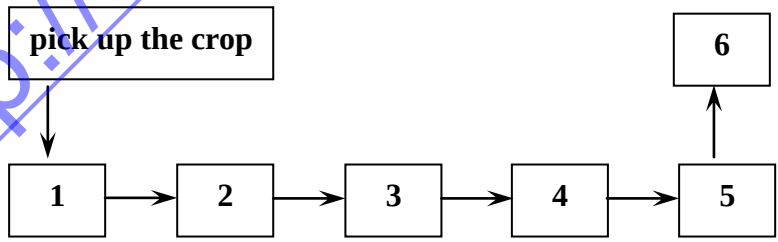
Combine harvesters are mostly used to cut and thresh in one operation, but they may be used to pick up and thresh crops which have been cut and left by windrowers. Modern windrowers ____ (be) self-propelled machines. They just ____ (cut) the crop and ____ (lay) one or two swaths on the field. This process _____ (call) windrowing or swathing.

The combine ____ (lift) the crop. Then it ____ (direct) by the auger to the centre of the platform where it _____ (pick up) by the elevator and lifted to the drum (cylinder).

Threshing _____ (take place) between drum and concave. Chaff and grain _____ (collect) by a grain pan. This mixture ____ (move) into the sieves. Unthreshed grain may be directed either to the drum or to a special re-thresher.

6. Complete the process of windrow harvesting putting the operations in order.

a. chaff and grain collecting
b. re-threshing of unthreshed grain
c. directing the crop to the elevator
d. grain separating
e. threshing
f. lifting the crop to the threshing cylinder



7. Read the statements 1-5 about windrow (swath) harvesting. Decide if they are true (T) or false (F).

1. Cutting and threshing are usually performed in one operation by a combine harvester. ***T/F***
2. Swathing means separating the grain from the straw. ***T/F***
3. Windrowers are designed for cutting, threshing and separating the crop. ***T/F***
4. A self-propelled machine has a large variation in forward and reverse speeds. ***T/F***
5. Combines are usually trailed machines. ***T/F***

Unit 4
Readings on farm machines

Lesson 1
Farm mechanization and automation trends

Read the materials from the Vision 2020 and Strategic Research Agenda[1] and define the challenges of agricultural engineering technologies. Pay attention to the underlined words and expressions.

Preface

The community of agricultural engineering in Europe has formulated, for the very first time, a common vision of how agriculture and its driving engineering technologies could look in 2020 and of the strategic technological necessities to translate this vision into reality. This vision shows the future fields of research on Agricultural Engineering and Technologies (AET). Within these fields, the first specific topics for research and technological development have been defined. With growing knowledge, further topics will arise and will be added continuously into plans during the coming years. The paper is called the Vision 2020 and the AET Strategic Research Agenda (SRA).

The European agricultural machinery sector is a world leader in supplying enabling technology to the various businesses of crop and livestock farming. With this, AET is a part of the value-added chain for food production as well as for the increasingly important production of bio-materials and energy crops.

[1]Vision 2020 and Strategic Research Agenda of the European Agricultural Machinery Industry and Research Community for the 7th Framework Programme for Research of the European Community. − Brussels, 2006.

Though the statements of this important paper are built from a scientific base, the messages are of high relevance for practical applications in future due to the significant input from industry.

Vision 2020

Agriculture in the year 2020

Agriculture is still under significant EU regulation, with subsidies for nature conservation and regional support through structural funding. Structural change in general continues but broad regions have stabilized at a high farm size. The proportion of the workforce in agriculture is still decreasing with a major impact coming from increasing farm size.

Precision Agriculture has been accepted as the only efficient and sustainable farming system. It is used in different ways.

In "Precision Livestock Farming", animals are kept under "near free range" conditions. No animal is tied up and nearly all livestock housing has natural ventilation. Feed supply, milking of dairy cows and healthcare are undertaken by both fixed and, increasingly, by mobile robots. A wide range of sophisticated sensors gather and transmit information to the management systems and people by wireless networks. Feed production and feed preparation are largely delegated to contractors and other types of cooperation.

In "Precision Crop Farming", site-specific treatment is the common approach. Conventional tillage, conservation tillage and no-till systems are in use. Autonomous field scouts gather management information. On-the-go variable-rate technology is based on online-sensors (soil, water, crop growth, infestation) and application maps. Several new types of harvesting technology driven by new logistical solutions are used. They measure yield and components, dividing the material flow "on demand" into different storage locations according to quality parameters measured on-the-go. Post-harvest management,

including dehumidification of crops with high moisture contents, begins immediately after harvesting.

In Horticulture, robots have taken over most of the hand work in orchards and in viticulture. Other precision farming technologies are accepted. The greenhouse sector has saved 40-50% of energy consumption by the use of solar energy (smart storage, optimal use and supply), wind energy and biofuels. With an optimal control strategy and dehumidification of the air, zero energy use is being achieved. CO2 emission has been dramatically reduced and automation and robotics are common in greenhouse businesses.

Technology

European agricultural technology for field work and for livestock husbandry leads the world. Electronics, automation and robotics are widely used. Wireless communication technologies offer access to broadly spread farming facilities and link them to decent ralised web-based processing and information sources. Sophisticated up-to-date software packages, expert systems and fixed and mobile farm technology are provided for the farmer.

Farm power and machinery has changed to use renewable energy sources like bio-based synthetic fuel, hydrogen and fuel cells. New power train systems include decent ralised electric drives. Tractors and self-propelled farm machinery still operate with a driver onboard but are fully automated. Unmanned followers are in use for some production technologies like harvesting. The first small autonomous vehicles are being deployed for scouting, weeding and cultivation. Automatic data gathering for documentation purposes and for improved farm management is a fundamental component in all farm equipment technologies.

Farm equipment is more specialised and more optimised than ever before. Based on standardised electronic communication, the tractor is controlled by the implement and responds to the requirements of soil and plant in the most suitable

way. Pest management and plant protection measures have moved significantly from solely chemical applications to adopting highly precise physical treatments. Fertiliser application technology reacts to the needs of small areas of the crop or even single plants.

European manufacturers of agricultural engineering technologies are the number one players worldwide. They have the highest rate of world exports of agricultural technology and they lead the world in the development of future-oriented new technologies. The big European manufacturers continue to be part of multinational global businesses, but the main development centres of new enterprises are located in Europe to access the knowledge economy and infrastructure.

Overall agricultural technology is an enabling technology, underpinning high efficient processes in agriculture and related areas. It enables:

- production of healthy food and feed and of renewable resources of required quality
- reduction of human workload in all fields of agriculture processes
- high efficiency in agricultural machines and processes
- appropriate animal husbandry
- sustainable handling of natural resources
- maintenance of the landscape and biodiversity

The European Agricultural Machinery industry's worldwide leadership in technology and exports extends beyond tractors and self-propelled working machines into specialist sectors such as milking equipment, climate control engineering for greenhouses and livestock production, efficient farm buildings, and precision application of fertilizers, animal manures and chemical sprays. All this is dependent on continuing innovation and development to maintain the world position and the high level of technical employment in this sector. Agricultural technology enterprises are providing the potential for the agriculture and food industry

to be a major component of the European economy, as well as for the developing sector for biomass utilisation in the production of energy and materials.

Bioenergy and Renewable Materials

The production of renewable materials from agriculture and forestry and their use for energy generation and materials has a long tradition, though suppressed over the last two centuries in many sectors by the availability of oil and natural gas. The accompanying dramatic development of internal combustion engines and petrochemistry means that renewable raw materials have been almost completely replaced by fossil raw materials. The concerns over greenhouse-gas driven climate change require that we find new and improved ways of feeding biological materials into industry both as energy sources and as construction materials.

Fossil energy sources need to be replaced by renewable energies. Utilisation of hydroelectricity, wind power and solar energy are growing, and alongside these we must address the use of biomass for energy generation. The use of renewable raw materials for material production is also increasing in importance. As well as the more favourable greenhouse gas balance, the biodegradability of biomass-based products and decreased risks to human health make them attractive. Other positive aspects of the cultivation and utilisation of renewable raw materials include their contribution to the development of multifunctional agriculture, the creation of new jobs in rural areas and the maintenance of cultural landscapes.

Development of bioenergy production on the farm will of course be dependent on EU and member state energy policy. With energy prices at the levels of the last decade, on farm use was the only competitive approach without subsidy.

To realize any of these opportunities, given the likely continuing volatility in fuel prices, requires a continuing research and development focus on high efficiency production and

conversion technology. Bioenergy feeding into national energy systems will contribute to the vision of a sustainable energy economy and forms part of the challenge for European industry to take the lead in non-food production and utilisation technologies.

The agricultural production of renewable raw materials can benefit from advances in food crop production technologies, particularly those related to improvements in sensing and management of crop-soil systems. However completely different plant species, cultivation, harvesting and post-harvest techniques are often involved. The systems engineering for optimal production, handling and management of what will be bulky, low unit-value commodities will need specific research and development.

The targets for production of renewables include biomass for energy, bio-diesel, vegetable oil, bio-ethanol, fibre production and ingredients for green chemistry (innovative chemical technologies that reduce or eliminate the use or generation of hazardous substances in chemical products). In developing energy crops and renewable materials, it will be of great importance to address systems problems and seek integrated solutions. Farm crops that can provide biomass may also be able to provide fibres for industrial use. Optimising the production of higher value fibre or other industrial product streams is likely to be an integral part of making some on-farm biomass crops viable. This will require involvement of producers and users in the research and development programs, and this will be particularly important for the development of the engineering technologies for handling, processing, separating and storage of materials.

Lesson 2
The global market for agricultural machinery and equipment[2]

Read the text about world's largest producers and users of farm machinery and equipment. Pay attention to the underlined words and expressions.

The cultivation of land has been a fundamental task for humans around the world since the dawn of civilization. But today individual countries differ greatly in their farm activity and agricultural output. In many advanced economies, less than five percent of the labor force is at work on the land as small farms have become agri-business establishments. This is due primarily to capital investment, technical advances, intensive land use, and higher labor productivity.

In North America, Western Europe, and portions of the Pacific Rim, farm incomes are sufficiently high and equipment financing sufficiently available to make the acquisition of agricultural machinery affordable and astute. Economies ofscale and scope dictate land consolidation and the use of machinery over vast acreages, though some small farms still survive. (In the United States, farm productivity has leveled off recently and many small operators have shut down.) The situation is the reverse in Africa, Asia, and Latin America. Farm incomes are still low, capital is scarce, and equipment often consists of hand-held plows.

It is ironical and tragic that national economies that could benefit most from productivity improvements in their farming

[2] The global market for agricultural machinery and equipment by Mehta, Anand, Gross, Andrew C. Publication: Business Economics, 2007http://www.allbusiness.com/economy-economic-indicators/economic-indicators/5497022-1.html

communities are the least able to make necessary capital investments. However, there is reason for optimism; the situation is changing as shown by the projected differences in regional growth rates. Thus, while the developed regions still constitute a vast market for all kinds of agricultural machinery, growth of purchases is slow in the United States, Japan, and Western Europe. In the four major regions of Asia/Pacific, Latin America, Africa/Mid-East and Eastern Europe annual growth is considerably higher The fastest growth is in China which continues its march to industrialization and exporting.

The world's largest equipment-producing countries are the United States, China, Germany and Italy. They are followed by India, France, Brazil, Canada, South Korea, and the UK. Producers in the major developed countries have a large, diversified domestic market; possess technical, managerial and marketing expertise; and have ready access to capital and labor. But manufacturers are making significant investments in developing countries and/or forming partnerships with domestic producers in these countries. The faster growth in Asia/Pacific and Latin America, along with continuing advantages in labor costs (though declining), make such investments attractive.

The top three producers of machinery are Deere & Company, CNH Global (Italy/Neth), and AGCO; together they account for one-third of the global market. Other key players are Kubota, Yanmar, CLAAS, Iseki, and Same Deutz-Fahr.

Tractors

Farm tractors account for 29 percent of the world farm machinery market. They are valued for their versatility since they can pull plows, rakes, mowers, planters, etc. Tractors are available in a wide range, from under 40 to over 400 horsepower. Equally important, they are now equipped with the latest technological advances, such as satellite-based guidance systems, variable transmissions, and other electronic controls, while still meeting requirements for pollution control. On a unit basis, the

two largest markets are China and India, with the United States as a distant third. All major manufacturers offer tractors as part of their portfolio. The largest are Deere & Company, CNH Global, AGCO, Mahindra & Mahindra, and Kubota. Deere makes midrange tractors in Brazil, Mexico, China, and India; but the larger, more sophisticated ones are still made in the United States for domestic use and for exports to Asia and Europe. Moreover, Deere is deeply involved in a number of joint ventures, especially in China.

Planting, seeding and fertilizing machinery

This category is only six percent of the total global demand, but its growth rate is projected above five percent annually in the current five-year period. Higher crop prices, especially for corn, should stimulate planting activity and henceinvestment in such goods in both developed and developing economies. Diverse product lines in this category include general purpose planters as well as specific ones, such as corn and cotton planters and sugar cane loaders. Other items are manure spreaders and fertilizer distributors. Many planters can be attached to or pulled by tractors. The leading suppliers include AGCO, CNH Global, Deere, Kverneland, and Kukje.

Haying machinery

Haying machinery is used in preparation and collection of hay (i.e., dried grass and similar items). Specific goods in this category include mowers, rakes, balers, stackers, and the like, made by large companies such as AGCO, CLAAS, CNH Global, Deere, and smaller ones such as Gehl, Krone, and Kubota. The Norwegian firm, Kverneland, has a major division called "Grass" with three business units: bailing, mowing, and haying equipment. These product families offer many options for users such as mowers with single or double-swath features, disc or drum brakes.

Plowing and cultivating machinery

This is the smallest category with five percent of all machinery sales; but its growth rate is slated to be the highest. Increased crop demand and production underlie this trend, along with movement of medium-size farmers from manual or animal-operated plows to tractor-pulled implements. A wide variety of products is utilized for soil preparation and planting: plows, harrows, cultivators, weeders, pulverizers, rollers, and land levelers. Notable suppliers are AGCO, Bush Hog, Deere, Iseki, Kukje, Kverneland, and Thrige Howard. A Japanese manufacturer, Yanmar, makes tillers (a generic term that covers cultivators, plows, and harrows) that are available with gasoline engines, detachable plows, and ergonomic handles; user-friendly features include low noise, high torque, and good fuel economy.

Other agricultural equipment

There is much diversity within this category, which accounts for almost 20 percent of global sales. Included here are: sprayers that dispense pesticides, fertilizer compounds, or water; dairy-related equipment; hog, cattle, and poultry-related equipment such as incubators and feeders; feed grinders; crushers; and irrigation equipment.

Product and process technology

A regional president of Deere & Company has been quoted recently, stating that "there are more lines of computer code in these tractors than there is in the space shuttle" (New York Times, March 11, 2007). The article went on to describe how tractors can be guided by satellite technology and how an intelligent system can provide extra horsepower upon demand. Many manufacturers now use technology and product design for improved performance as well as building their brand image. Emphasis is also given to ease of maintenance and reduced downtime. Several leading firms devote over three percent of their sales to research and development.

Process technology is equally important, with emphasis on smart assembly lines and smooth supply chain operations. Among factory automation techniques are CAD/CAM (computer-aided design) and manufacturing, robotics, computerized machining centers, and ultrasonic inspection of parts. Since cost of materials and components (such as, engines, axles, tires, and transmission units) represent about half of total shipment value, agricultural equipment buyers lean on their suppliers to offer both high quality and low prices. But rationalizing supply chains and sharing proprietary technologies, while reducing costs per unit, are difficult tasks.

Lesson 3
Up-to-date Farm Machines

Read the text about the application of the cutting-edge agricultural engineering and technologies. **Pay attention to the underlined words and expressions.**

Innovative Farm Machinery Industry[3]

Agricultural engineering and technology is of worldwide importance to food production and to meeting the increase in world demand that will result from population growth and increasing incomes in developing countries. The challenge for the industry is to develop and implement systems that produce high-quality and safe food and feedstuffs while also being efficient, environmentally acceptable, and sustainable. These systems of appropriate agricultural technology are also required

[3]Advanced Machinery Engineering and Manufacturing Systems by Tony Grift, Department of Agricultural and Biological Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA, 2009.

for production and utilisation of renewable raw materials and must also take into account the social implications, e.g. the shaping of rural areas, the preservation of cultural landscapes, etc.

Agricultural machinery manufacture is now driven further to meet key development goals:

- automation and ICT (information and communication technologies) requirements for both advanced land-based production systems and innovative machinery manufacture;
- energy-efficient machines and production systems, including bioenergy production;
- machines and systems that protect the soil, water and aerial environments, minimising use of energy and water;
- increased use of technology in rural communities, providing and sustaining employment in attractive well-paid jobs.

Automation of innovative machinery may be considered as an example area that draws on many of these opportunities:

- the development of mathematical techniques to handle uncertain (fuzzy) systems and identify probabilistic approaches to manage them;
- the availability of high speed and low cost devices to process information rapidly and define optimal decisions;
- rapid communication systems that allow information from field machines, remote sensors and databases to be utilised in complex decision processes;
- increasing availability of new physical and biological sensors (biosensors) that are the first step in monitoring system performance and open the door to real time control;
- increased understanding of the performance of biological systems and materials at the finest scales (nanotechnology and molecular science).

This enables many agricultural systems currently to require substantial manual labour at low skill levels (and therefore poorly paid) and in difficult environments. Automation is an important

target if these production systems are to be sustainable. The delicate nature of fruit and vegetable harvesting and the risks of repetitive strain injury associated with manual handling operations are particular examples. Others arise in the high levels of aerial pollutants in livestock or mushroom production environments. Automation and new technology allow to redefine environments and reduce loads on the workforce, while also bringing in higher skilled employment associated with new machinery management.

Addressing these issues up-to-date farm machines meet these challenges:

- safety and quality demands: monitor and control growth and development as well as treatment needs at the level of a single plant (or animal) or of a small area in the field;
- measurement and quality control (chemical/physical state, physiological development, disease incidence, future text/taste) during the growing process;
- tools for flexible chain management: optimal process control for growing (rearing) and harvesting to meet customer requirements, not just production-oriented.

A major new demand is for data harvesting and mathematical modelling. The systems models must be appropriate to practical management of the processes, leading to decision models. The modelling methods need to be able to interpret variable and uncertain data as an input to decision-making. This is a vital element in getting strong solutions based on automation or utilising new sensing systems. The innovations here open up control opportunities and in addition the availability of extensive, accessible and detailed records open routes to enhanced traceability and communication in the food chain.

Development and Application of Sensors in Farm Machines

Quality assurance in agriculture and food production is increasingly becoming a matter of public importance, and is the

subject of regulations on food safety and feed hygiene. The approach builds a comprehensive concept of quality that extends from farm to fork, including process quality and hygiene management as well as specific attributes of the product itself.

In agriculture, process quality control begins with the selection of the production location and seed, and extends to the ability to deliver outputs from the farm to the consumer in ways that preserve key characteristics that the consumer desires, with minimal risks. The main goal is a comprehensive quality management that delivers consumer specifications. The organisational solutions for quality management in food production must give due regard to technical feasibility and economic efficiency.

Sensors enable data capture for automatic control functions and documentation. They are therefore of central importance for quality assurance tasks and procedures. In the plant production process chain, the use of sensors is particularly important for the capture of process and quality parameters concerned with growth, harvesting, transport and logistics, storage, preparation and selection, and processing. Density and crop mass measurements based on laser, radar or lidar (a detection system that works on the principle of radar, but uses light from a laser) help in risk assessment for diseases and serve as inputs for predictive models for crop quality or expected quality of the end product.

During growth, parameters influencing future product quality need to be captured. In this approach to developing "speaking plants", changes in mass and constituents during the growth period provide significant indicators. Crop information concerning growth conditions (e.g. water stress or nutrient deficiencies) and plant health (e.g. mycotoxin risk) can support important decisions concerning subsequent crop management measures and harvesting.

For optimal timing of harvesting, sensors are required that can determinecrop maturity. Recording plant product parameters, e.g. using near infrared (NIR) measurements, permits separation into different quality levels in the harvesting machine or in the subsequent transport or storage chain. The recording of quality data facilitates operations and provides new opportunities e.g. for the control of marketing or for bringing the product to the market at the optimal quality stage. In addition measurable parameters corresponding to the subjective quality perceptions of consumers. For further processing, plant agricultural products must be unambiguously classified. Product identification using a 'biological fingerprint', combined with recorded quality characteristics, allows providing product-oriented traceability that can extend beyond processing. The widespread implementation of new sensors and sensor applications linked to rapid analytical systems can support quality evaluation throughout the production process.

For livestock production, similar sensor developments capture components of conditions and product quality throughout the chain from animal feeding to livestock product distribution. New sensing methods, particularly based on biosensors, enhance biosecurity and address concerns about disease.

Robotics in Crop Production

Farmers need information about the crop and soil status before and during the growing season. Robotic scouts can be used for this purpose. They can travel to a predetermined location, take a soil sample to determine moisture levels, use an electric probe to measure pH. During the growing season, robotic scouts can measure nitrogen and water stress in plants using optical sensors, as well as insect and weed infestations using cameras. Scouting robots can also serve to 'ground truth' information from remote sensing images.

Although individual robots are too small to carry out tasks that require high lifting capacity such as bringing in fertilizers

and removing the harvested grains, they can be used in situations where relatively little power is required. A good example of this is weeding, where weeds can be treated with a small amount of highly concentrated chemical (microspraying) or alternatively, mechanical weed control.

A major limiting factor of field robots is their energy consumption and hence, action radius. Although robots may be powered by fossil fuels, a far more elegant method consistent with their use to lessen the environmental impact of farming is using locally available sources such as sunlight. If robots are used for harvesting, they may even consume some of the crops for their own operation. Indeed, this is similar to using biological counterparts such as a horse harvesting hay.

GPS Technologies for Precision Farming

GPS (Global Positioning System) technology relies on satellites and radio waves to define the exact position of the user. The technology has advanced to the point where location can be within millimeter accuracy on the best equipment. The devices used in most farming applications are accurate to within one inch. Accuracy aside, the most promising feature of personal GPS systems is the precision variable rate applications of pesticides, herbicides and other materials. This feature saves on materials, costs and environmental pollution while also improving crop yield.

Growers in California's central valley, where GPS is being used mostly in tomato, cotton, almond, pistachio and other similar crops, are convinced of the validity of GPS precision farming. They call the technology ‘one of the bright spots in the dismal farming environment’.

Tractors equipped with GPS can make perfectly straight, parallel lines, without the use of field markers or tracking devices or even manual steering (except at row ends). The system can run even in reduced visibility; dense fog, a moonless night or heavy dust. Because of hands-free steering, operators are free to

monitor everything else in the field. Importantly, the technology offers repeatability, meaning the tractor can return to precisely the same spot in the field the next week, month or growing season.

GPS technology also allows farmers to literally manage their fields by square feet. GPS-based precision farming systems enable precise guidance for field operations, gather and map data on tillage, seeds planted, weeds, insect and disease infestations, cultivation and irrigation. Using topographic maps of the field, farmers can employ the GPS computer system for precise applications of pesticides, fertilizers, seed and other materials.

Precision farming starts with identifying whether or not there is variability in crop yields within a field. Variable rate, which requires GPS navigation, allows growers to apply only what is needed to a specific portion of the field: no overlap, underlap or skips in the field.

There are some of the key benefits obtained through the use of GPS navigation:

− Perfect plant/row alignment: this allows mechanisation of weeding, pruning, and harvesting, resulting in considerably lower labour requirements.

− Tree/branch development: exact distance between each tree means that branch development will be uniform, allowing also, consistent yield for each tree. If plantation trees are not planted exactly the same distance apart, branches of both trees can cross, causing alternation of yield where some trees produce larger amounts of branches, but less fruit, meaning lower yields.

− Less damage to plants: planting mechanically guarantees less damage to plants, which means a lower percentage of losses during the plantation establishment.

− Superior root development: when planting is mechanically GPS guided, the machine opens a deep ditch in the soil, under the exact place where the plant will be planted. This allows a larger development of the roots as they find the earth

broken, also allowing faster growth rates and better plant nutrition, hence an earlier and larger harvest.

− Higher planting speed: higher speed in planting allows plantation establishment and harvesting to be completed sooner, resulting in earlier yield and returns.

− Less labour required: lower manual labour requirement for planting, allows the planting process to be completed faster, with less human error.

***

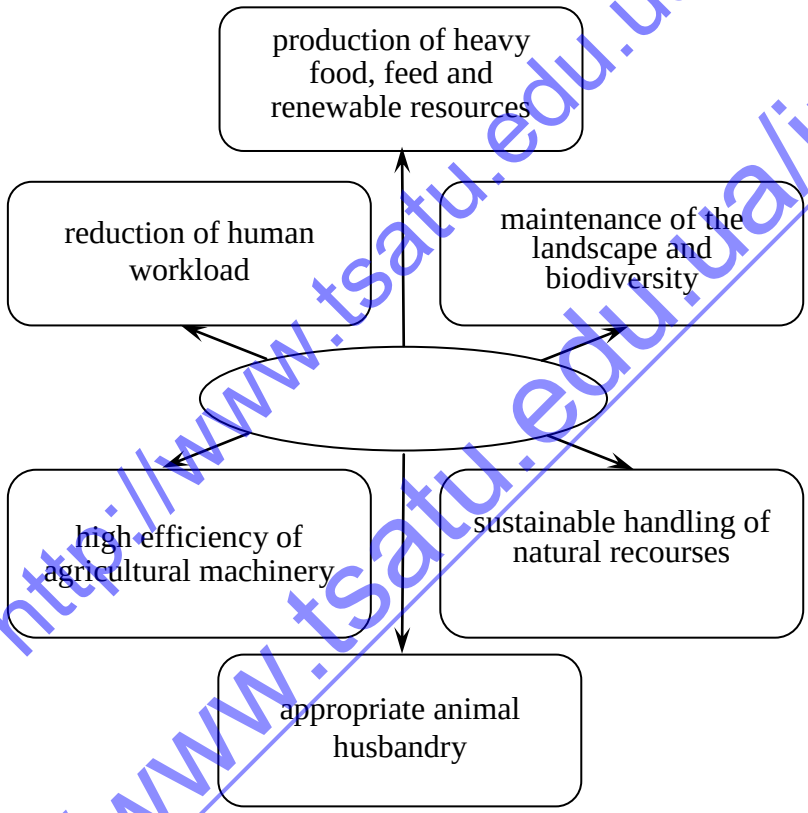
Therefore the trend of changing farming operations to optimize income, minimize environmental impact, and produce sustainable farming operations will continue and all innovative technologies can play a major role in this process.

Whether the technologies will be adopted widely in farming depends on many factors such as cost of machinery, effectiveness, added benefit to farmers, ease of operation, reliability, interchangeability, standardization, safety, and legislation. It is most likely that machinery manufacturers will focus on integrating up-to-date technologies in their machines, and focus on systems optimization.

Therefore, there is an urgent need to develop a completely automated farming system that can be launched and put into operation without human intervention. This effort may form the ultimate challenge in agricultural automation from which technologies can spin off to benefit humanity on terra mater.

Practice

1. ***Complete the diagram according to the text.***



2. ***Mark the items which are associated with future agricultural technologies and farm machinery.***

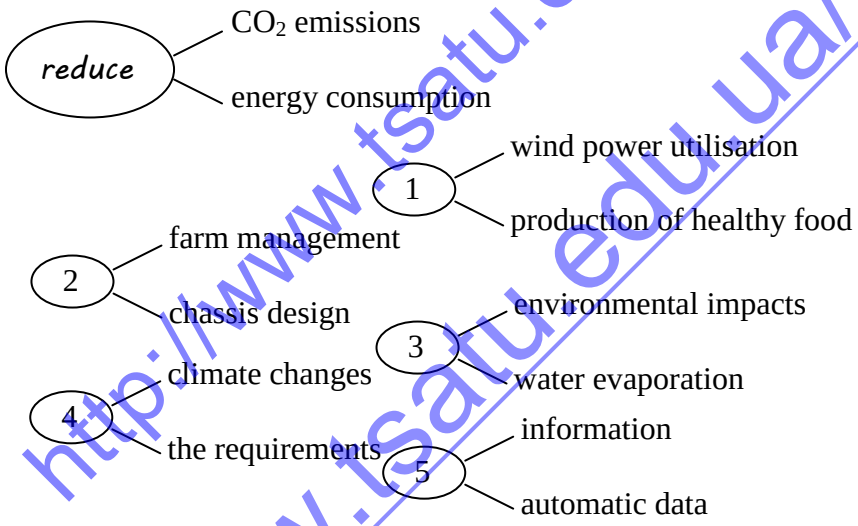
- ☐ hydrogen
- ☐ hand work
- ☐ fossil fuels
- ☐ communication technologies
- ☐ solely chemical applications
- ☐ electric drives
- ☐ driver
- ☐ unmanned followers

3. *Summarize the main ideas of the Vision 2020 using the prompts.*

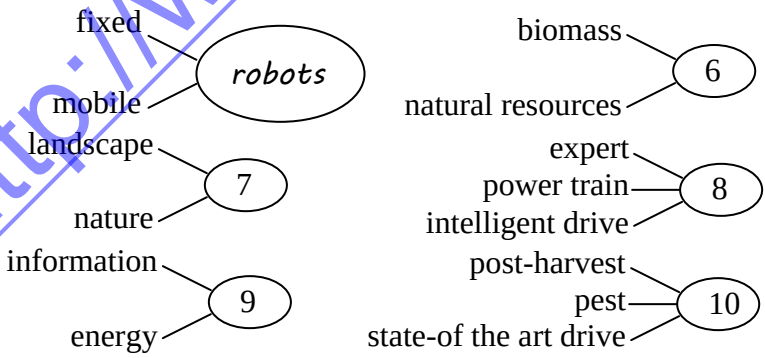
Agriculture	• regulation • nature conservation • funding • workforce • farm size	stabilize decrease increase
Precision livestock farming	• 'near free range' conditions • fixed and mobile robots • management systems • feed production and preparation	keep tie up undertake gather transmit delegate
Precision crop farming	• site-specific treatment • tillage • no-till systems • autonomous field scouts • online-sensors • application maps • post-harvest management • dehumidification of crops	use gather drive measure include
Horticulture	• robots • handwork • energy consumption • solar energy • biofuels • dehumidification of the air • CO_2 emissions	take accept save use reduce

4. *Look at these examples then put the words and phrases in the correct spaces.*

a) gather b) improve c) increase d) respond to e) control



a) systems b) utilisation c) sources d) conservation e) management



5. ***Choose the correct preposition and complete the sentences.***

depend address tie	up to on Ø	1. In 'Precision Livestock Farming' animals are not … . 2. World position and the high level of technical employment in agriculture … continuing innovation. 3. We must … the use of biomass for energy generation.

6. Put energy sources into the correct boxes.

~~hydrogen~~ hydroelectric solar coal oil (petroleum) nuclear natural gas waste wind wood geothermal vegetable oil crop residues	
Fossils	**Renewables**
	hydrogen

7. What do these abbreviations from the texts stand for?

AET, EU, CAD, ICT, GPS.

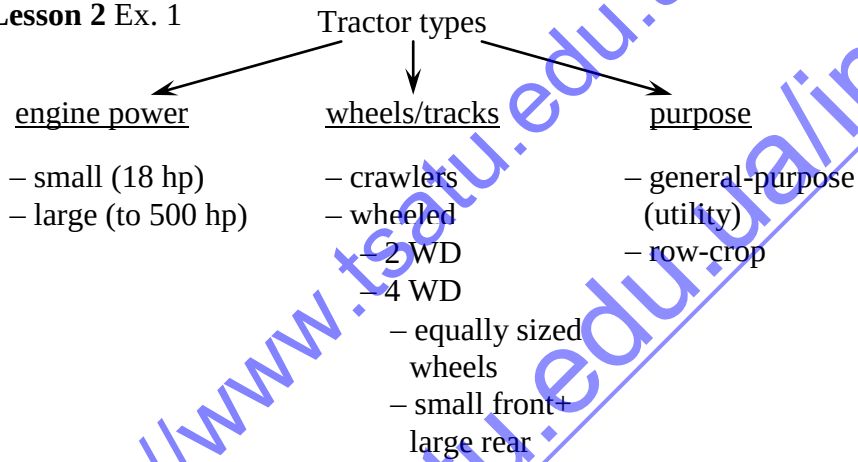
8. Match the companies with the countries.

CLAAS	
CNH Global	Germany
Deer & Co	Italy / Netherlands
Kubota	Japan
Kverneland	The USA
AGCO	Italy / Germany
Same Deutz-Fahr	Norway
Yanmar	

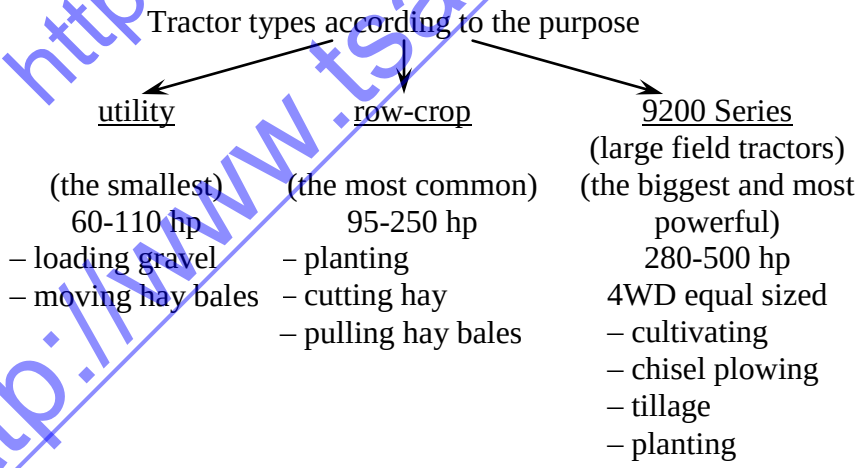
Answer key

Unit 1

Lesson 2 Ex. 1



Ex. 2



Lesson 3

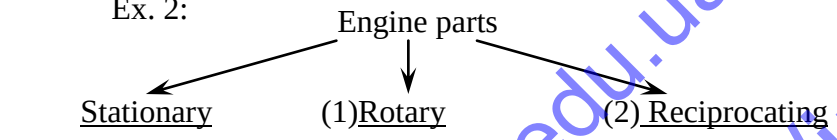
Ex. 1**:** 1e 2a 3d 4b 5c 6h 7f 8g

Ex. 4: 1c 2d 3g 4f 5a 6b 7e

Unit 2

Lesson 1

Ex. 2:



– (3) cylinder block
– (4) cylinder head
– crankcase

– (5) crankshaft
– (6) camshaft
– flywheel

– (7) piston
– (8) piston pins
– (9) piston rings
– (10) connecting rods
– valves

Ex. 3: 1l 2g 3f 4e 5d 6a 7j 8b 9h 10c 11i 12k

Lesson 2

Ex. 2: 1c 2d 3b 4b

Ex. 3: 1. The piston moves within the cylinder. 2. There is no high-pressure pump in the gasoline engine. 3. Diesel engine doesn't have a carburetor. 4. Is there a spark plug in the diesel engine?

Lesson 3

Ex. 1, 2:

What is the *1* ***stroke***? It's a movement of the piston from ***TDC*** to *2* ***BDC***. Calling an engine *3* ***four-stroke*** means its engine *4* ***cycle*** has four strokes. A four-stroke petrol engine uses *5* ***internal combustion***.

Four strokes must include the five key events, common to all combustion engines: **intake, compression, ignition, power, exhaust**.

Ex. 3: 1i 2k 3j 4l 5g 6h 7m 8a 9b 10e 11f 12o 13n 14d 15c 16a

Ex.4:

	Strokes			
	Intake	Compression	Power	Exhaust
Valves	Intake valve opens. Exhaust valve does not open.	Valves do not open.	Valves do not open.	Exhaust valve opens. Intake valve does not open.
Piston	Piston moves toward the crankshaft.	Piston moves toward the cylinder head.	Piston moves toward the crankshaft.	Piston moves toward the cylinder head.
Process in the combustion chamber	Piston draws the air-fuel mixture (air only) into the cylinder.	Piston compresses the fuel mixture between the piston and the cylinder head (air only)	The air-fuel mixture burns and moves the piston with great force.	Piston forces out burnt gases.

Unit 3 Lesson 1

Ex. 1: 1c 2a 3d 4b 5h 6g 7e 8f

Ex. 2: 1 by 2 across 3 on 4 at 5 from 6 in

Ex. 3: is cut turn are is not

are attached is bolted is called cuts lifts turns

Ex. 4: 1g 2l 3e 4d 5i 6c 7j 8k 9h 10f 11d,b 12a

Lesson 2 Ex. 1: 1 plowing 2 harrowing 3 sowing 4 fertilizing 5 irrigation 6 cultivation 7 spraying 8 harvesting 9 processing

Ex. 2: 1 mouldboard plough 2cultivator 3 disc harrow 4 combine harvester 5 irrigating machine

Ex. 3: 1g 2b 3a 4h 5d 6c 7i 8f 9e

Ex. 4: 1. There are three main types of ploughs. 2. Power harrows have active working tools. 3. The cultivators are used for tillage too. 4. The mouldboard is a plough part.

Lesson 3 Ex. 1: 1 Threshing unit 2 Seperating unit 3,4 reel, auger 5, 6, 7 front beater, drum (cylinder), rear beater, 8, 9, 10 straw walkers, sieves, grain pan.

Ex. 2: 1e 2f 3c 4b 5a 6g 7d

Ex. 3: 1b 2c 3a 4c 5a 6b

Ex. 4: 1c 2a 3a 4b

Ex. 5: are cut lay is called
lifts directs picks up
takes place are collected moves

Ex. 6: 1c 2f 3e 4d 5a 6b

Ex. 7: 1T 2F 3F 4T 5F

Unit 4 Ex. 1: **Enabling technology use**

Ex. 2: hydrogen, communication technologies, electric drives, unmanned followers

Ex. 4: 1c 2b 3e 4d 5a 6b 7d 8a 9c 10e

Ex. 5: 1 tied **up** 2 depend **on** 3 address **to**

Ex. 6: Fossils: coal, oil (petroleum), natural gas

Renewables: hydroelectric, solar, nuclear, waste, wind, wood, geothermal, vegetable oil, crop residues.

Ex. 7: AET: Agricultural Engineering and Technologies, EU: European Union, CAD: Computer Aided Design, ICT: Information and Communication Technologies, GPS: Global Positioning System

Ex. 8: CLAAS (Germany), Deer & Co, AGCO (The USA), CNH Global (Italy / Netherlands), Kubota, Yanmar (Japan), Kverneland (Norway), Same Deutz-Fahr (Italy / Germany)

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

1. Англійська мова : підручник / Г.І. Бородіна . - К.: Вища школа, 1994. − 205 с.
2. Wikipedia. The Free Encyclopedia
Режим доступу: http://en.wikipedia.org/wiki
3. Vision 2020 and Strategic Research Agenda of the European Agricultural Machinery Industry and Research Community for the 7th Framework Programme for Research of the European Community. − Brussels, 2006.
4. FarmersGuardian.com (electronic edition)
Режим доступу:http://www.farmersguardian.com/tractors-of-the-future/24326.article
5. FarmIndustryNews.com (electronic edition)
Режим доступу:
http://farmindustrynews.com/tractors/future-tractor-power-diesel-electric-hybrids
6. FarmIndustryNews.com (electronic edition)
Режим доступу:http://farmindustrynews.com/tractors/coming-soon-electric-tractors
7. AgWired. News from the world of agribusiness. (electronic edition)
Режим доступу:http://agwired.com/category/farm-machinery/
8. Agriaffaires.co.ua (electronic edition)
Режим доступу:http://www.agriaffaires.co.uk
9. TheEarthObservatory (electronic edition)(electronic edition)
Режим доступу:
http://earthobservatory.nasa.gov/Features/PrecisionFarming/

http://www.tsatu.edu.ua/im/

http://www.tsatu.edu.ua/im/