МИНИСТЕРСТВО ОБРАЗОВАНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

УЧРЕЖДЕНИЕ ОБРАЗОВАНИЯ
«БРЕСТСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ»

КАФЕДРА ИНОСТРАННЫХ ЯЗЫКОВ

Essential Steps to Understanding Technical Terms: Automotive Domain. Part 1

Брест 2022

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Essential steps to understanding technical terms: automotive domain. Part 1:

пособие по обучению иноязычной профессионально ориентированной лексике на основе использования поликодовых текстов
для студентов специальностей
1-37 01 06 Техническая эксплуатация автомобилей и
1-37 01 07 Автосервис

Брест 2022

УДК 811.111’243:629.087(07)
ББК 81432.1:39.33-08я73
П80

Пособие адресовано студентам 1 курса специальностей 1-37 01 06 Техническая эксплуатация автомобилей и 1-37 01 07 Автосервис. В учебном пособии реализуются положения когнитивного и коммуникативно-когнитивного подходов, а также технологии контекстного обучения.

Пособие составлено в соответствии с требованиями учебной программы «Иностранный язык (английский)» для студентов указанных специальностей дневной, заочной полной и заочной сокращенной форм получения образования.

Основной целью данного пособия является формирование готовности студентов к решению профессиональных задач с помощью иноязычных терминов, ключевых для области технической эксплуатации автотранспортных средств. Текстовый материал заимствован из аутентичных источников, его тематика определена программой подготовки специалистов технического профиля. Издается в 2-х частях. Часть 1.

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Рекомендации по использованию в образовательном процессе пособия «Essential steps to understanding technical terms: automotive domain. Part I»

Пособие “Essential steps to understanding technical terms: automotive domain. Part I» адресовано студентам 1 курса специальностей 1-37 01 06 Техническая эксплуатация автомобилей и 1-37 01 07 Автосервис. В учебном пособии реализуются положения когнитивного и коммуникативно-когнитивного подходов, а также технологии контекстного обучения. Основной *целью* данного пособия является формирование готовности студентов к решению профессиональных задач с помощью иноязычных терминов, ключевых для области технической эксплуатации автотранспортных средств. Кроме того, данное пособие направлено на развитие поликультурной профессиональной языковой личности студента. Достижение поставленных целей осуществляется посредством комплекса заданий, направленных на овладение студентами профессионально ориентированной лексикой на основе использования поликодовых текстов.

Темы разделов соответствуют учебной программе дисциплины «Иностранный язык» для данных специальностей. Пособие состоит из 5 разделов (Units): «Internal Combustion Engine», «Ignition System», «Braking System», «Steering System» и «Suspension System». Разделы пособия имеют схожую структуру: каждый из них включает 6 подразделов: вводный (Introduction) и пять тематических подразделов (Lessons). В каждом из тематических подразделов система автотранспортного средства рассматривается в одном их пяти аспектов: устройство и работа системы; профилактическое техническое обслуживание; возможные неисправности; сравнение характеристик системы / компонентов системы различного типа; история создания системы / компонентов системы.

В пособии используются поликодовые тексты, которые были созданы автором на образовательной платформе Genially. Функциональные возможности данной платформы позволяют предъявлять изучаемый термин в полимодальном формате: визуализировать графическую и звуковую формы термина и его значение с помощью вербального, образного и аудиовизуального блоков поликодового текста; демонстрировать аутентичные специализированные тексты в цифровом виде фрагментарно или целиком; предъявлять симуляции работы систем, узлов и деталей автотранспортных средств; демонстрировать особенности объектов профессиональной деятельности и специфику их функционирования, а также контексты будущей профессиональной деятельности. Поликодовое представление лингвистический и профессиональной информации позволяет развивать познавательную и профессиональную мотивацию студентов путем их «погружения» в предметный и социальный контексты профессиональной деятельности.

В вводном подразделе (Introduction) представлены задания, направленные на осознание студентом графической и звуковой форм термина, его значения и ассоциативных связей с другими лексическими единицами. Выполняя задания, студент самостоятельно осуществляет поиск лексических языковых средств для наполнения содержанием элементов графического организатора «Term Dimensions» (см. Рисунок 1).

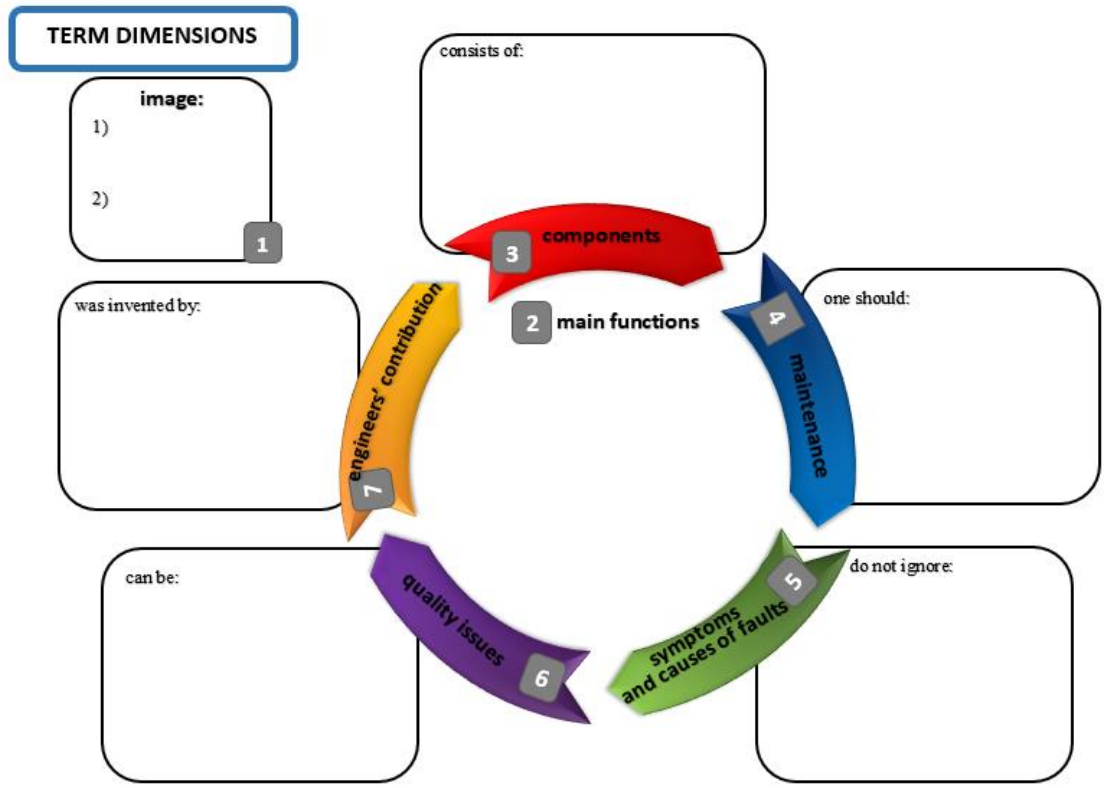


Рисунок 1 – Графический организатор «Term Dimensions»

Согласно заданию, студент анализирует поликодовый текст, извлекает из него лексические языковые средства и фиксирует их в графическом организаторе, что способствует более прочному запоминанию термина и ассоциируемых с ним лексических единиц. Кроме того, личностная вовлеченность студента в проблемно-исследовательскую деятельность по заполнению графического организатора «Term Dimensions» как личностного образовательного продукта делает процесс овладения профессионально ориентированной лексикой значимым и мотивированным для каждого из обучающихся, развивает познавательную и профессиональную мотивации студента.

На первой странице каждого поликодового текста размещена инструкция для студентов по работе с текстом (см. Рисунок 2), поясняющая последовательность работы, а также описывающая навигационный аппарат, т.е. функции интерактивных кнопок и знаков-символов.

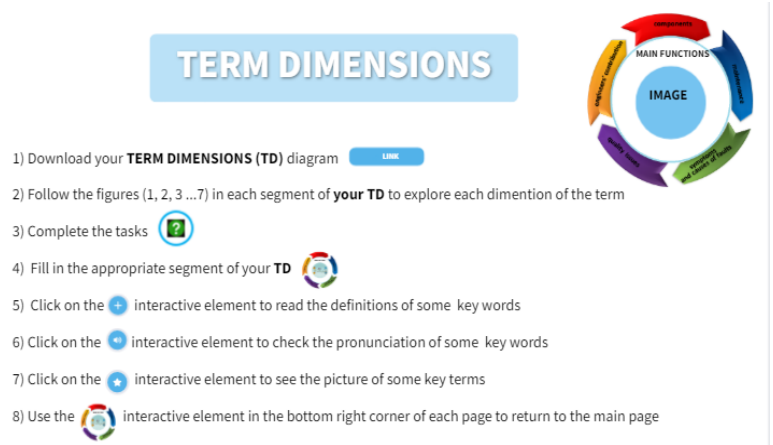


Рисунок 2 – Инструкция для студентов по работе с поликодовым текстом

Так, вначале студентам предлагается скачать шаблон графического организатора «Term Dimensions». На первом занятии преподавателю необходимо познакомить студентов со структурой данного графического организатора и объяснить правила наполнения его лексическими языковыми средствами: отдельными терминами, глагольными словосочетаниями и т.д.

Данные лексические средства извлекаются студентом из поликодового текста в результате выполнения им аналитических заданий. Задания и примеры их выполнения размещены на каждой интерактивной странице поликодового текста. Название каждого элемента графического организатора соответствует номеру интерактивной страницы поликодового текста, представленного на Genially. Например, на странице поликодового текста «Braking system» в верхнем левом углу находится знак-символ красного цвета, на котором указан номер и название интерактивной страницы (3 components). Идентичный знак-символ расположен в основании элемента графического организатора, который студент должен заполнить, выполнив задание на интерактивной странице поликодового текста (см. Рисунок 3).

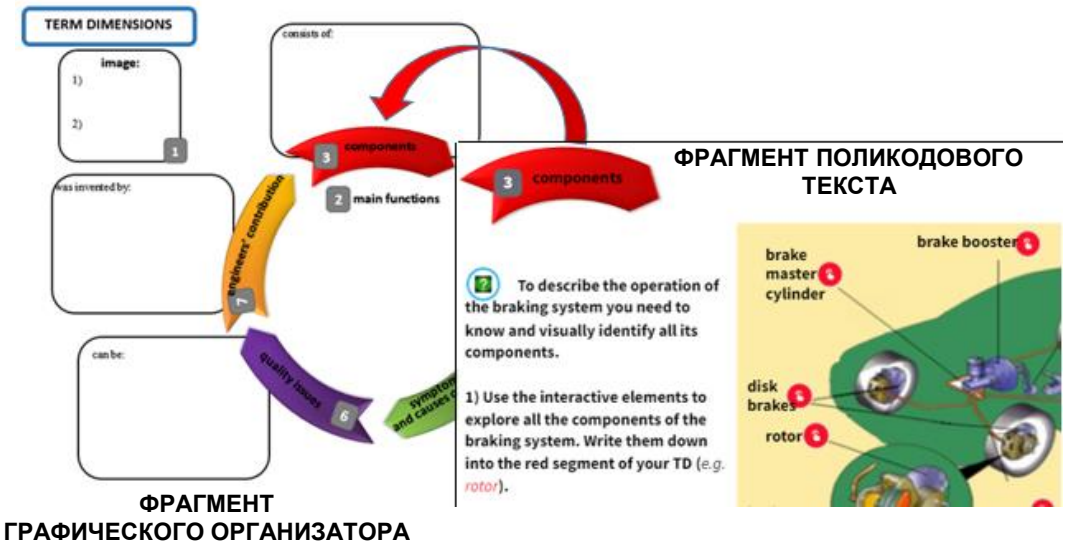


Рисунок 3 – Соответствие знаков-символов в поликодовом тексте и графическом организаторе

Анализируя поликодовый текст на каждой из интерактивных страниц, студент овладевает графической и звуковой формами термина, понимает его значение, а также осознает наличие различных ассоциативных (синтагматических, парадигматических и тематических) связей между термином и другими единицами лексической системы. Иными словами, студент знакомится с возможным лексическим окружением термина в речевом сообщении как компоненте профессиональной коммуникативной ситуации. Например, в области технической эксплуатации автотранспортных средств к данным ситуациям можно отнести, выявление и анализ причин возникновения отказов и неисправностей агрегатов, узлов, деталей средств технического обслуживания, диагностирование и ремонт автотранспортных средств. В данных профессиональных коммуникативных ситуации речевое сообщение специалиста выполняет следующие функции: описание особенностей функционирования узлов, деталей автотранспортных средств; описание неисправностей; обсуждения причин отказа узлов, деталей автотранспортных средств; консультирование рабочих автотранспортной организации по вопросам профилактического технического обслуживания автотранспортных средств; описание неисправности и её причин; изложение возможных способов ремонта оборудования и мер по предупреждению его отказа; аргументирование специалистом своего выбора оптимальных материалов для организации профессиональной деятельности и т.д.

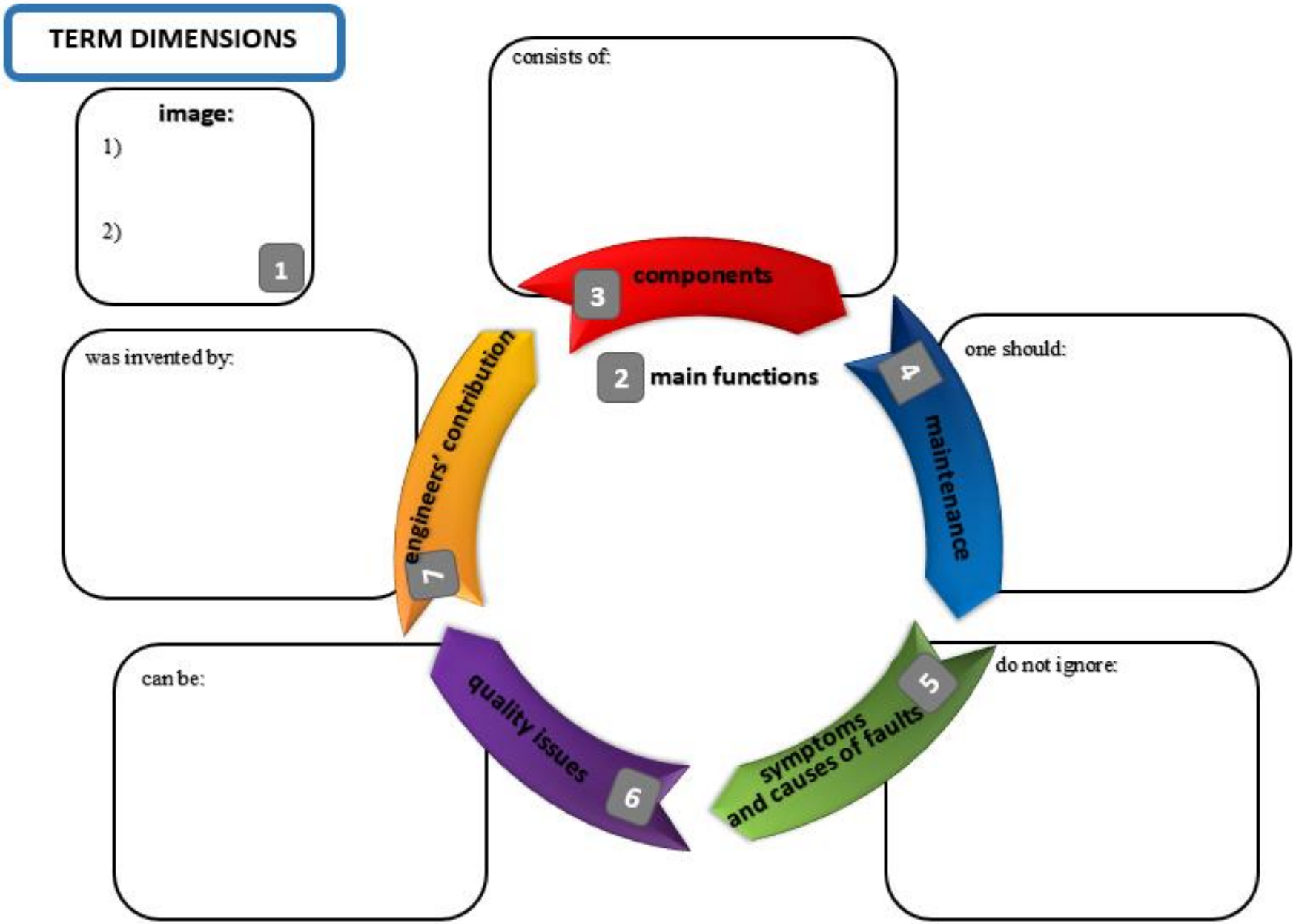
Графический организатор «Term Dimensions», наполненный студентом лексическими языковыми средствами, является ориентировочной основой, на которую должен опираться обучающийся, выполняя задания в каждом тематическом подразделе под названием «Lesson». Задания тематических подразделов пособия ориентированы на укрепление структурных связей между значением термина и его графической / звуковой формой в рецептивных видах речевой деятельности: 1) поиск студентом определенных терминов в тексте / списке терминов; 2) расположение терминов в порядке, представленном в аудиозаписи; 3) обозначение компонентов объекта профессиональной деятельности на рисунке; 4) соотнесение рисунков и фрагментов аудиозаписей.

В тематических подразделах большое значение придается усилению ассоциативных связей между термином и его лексическим окружением в языковом сознании студента. На это направлены задания на восстановление именных и глагольных словосочетаний, восстановление скриптов профессиональных видео обзоров, подбор синонимов, исправление неверных утверждений. После этого студенты переходят к выполнению заданий, которые направлены на расширение ассоциативных связей терминов в процессе их использования в устной и письменной речи и предусматривают описание обучающимся симуляций работы систем, узлов и деталей автотранспортных средств, создание инфографиков, инструкций, презентаций и временных шкал.

В тематических подразделах студенты знакомятся и с профессиональными коммуникативными ситуациями, которые являются компонентами видов и подвидов профессиональной деятельности, в

которых согласно образовательным стандартам высшего образования на первой ступени специальностей 1- 37 01 06 Техническая эксплуатация автомобилей и 1-37 01 07 Автосервис должны быть компетентны выпускники учреждений высшего образования технического профиля.

Работа с пособием предполагает аудиторные групповые занятия под руководством преподавателя, а также самостоятельную работу студента во внеаудиторное время.


TERM DIMENSIONS
image:
1)
2)
1
consists of:
3 components
2 main functions
4 maintenance
one should:
5 symptoms and causes of faults
do not ignore:
6 quality issues
can be:
7 engineers' contribution
was invented by:

UNIT 1. INTERNAL COMBUSTION ENGINE

Introduction

Introductory Tasks. *Follow the link https://tinyurl.com/yckrkbe5 to complete tasks 1-6 or use the QR-code:*

Follow the link https://tinyurl.com/mwzm56ey to download the Term Dimensions file (see page 1) or use the QR-code:

Lesson 1. INTERNAL CONBUSTION ENGINE OPERATION

Task 1.1 *As an automotive engineer, you should know how an internal combustion engine operates. This text describes a four-stroke cycle. Read it and underline the terms that denote components involved in the four-stroke cycle in your TD.*

TIP! Follow the link to read the text "INTERNAL COMBUSTION ENGINE" on ClilStore: *https://multidict.net/cs/9713* ***or use the QR-code:***

INTERNAL COMBUSTION ENGINE

The majority of reciprocating engines operate on what is known as four-stroke cycle. To complete the cycle of operations, four strokes of the piston are used. This involves two complete revolutions of the crankshaft, the intake and exhaust valves being mechanically opened and closed at the correct times. Starting with the piston at top dead centre and the crankshaft rotating clockwise (looking from the front of the engine), the strokes operate as follows.

First stroke. With the intake valve open and the exhaust valve closed the piston moves in a downwards direction drawing in a mixture of petrol vapour and air. This is called the intake stroke.

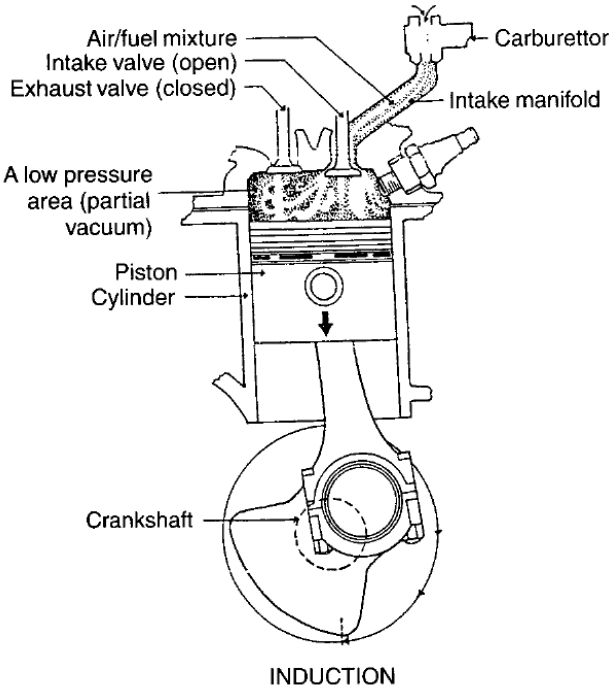


Fig. 1 First stroke

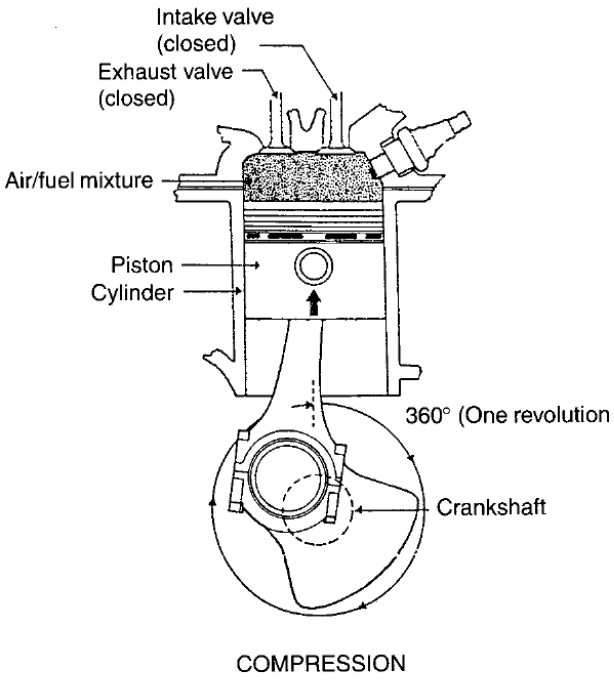


Fig. 2 Second stroke

Second stroke. The piston moves up with both valves closed, thus compressing the mixture into the combustion chamber at the top of the cylinder. This is the compression stroke.

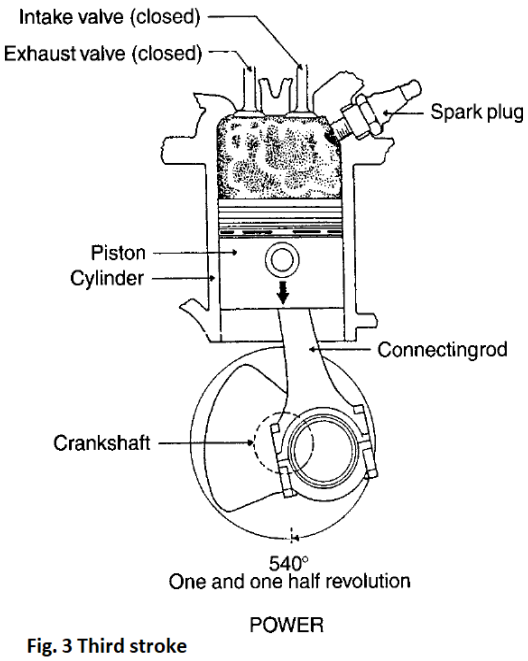


Fig. 3 Third stroke

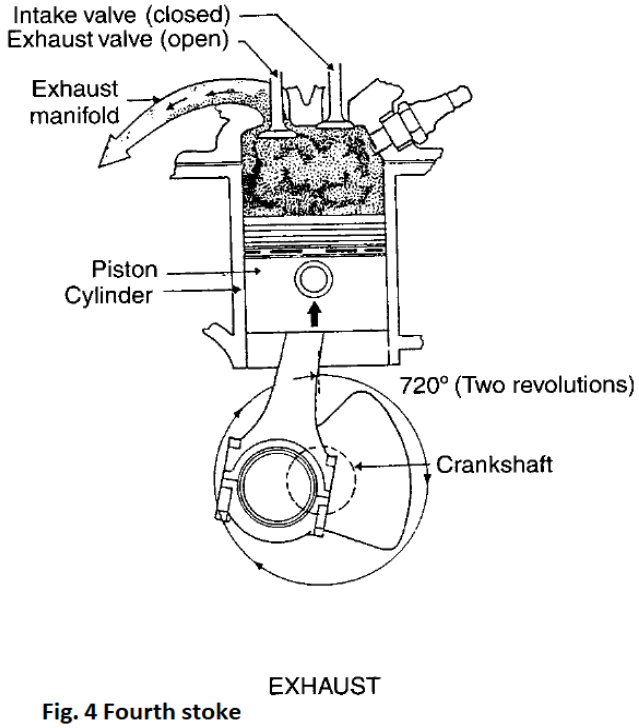


Fig. 4 Fourth stoke

Third stroke. At the end of the compression stroke a spark occurs at the spark plug. This ignites the mixture which burns very rapidly heating the gas to a very high temperature which also raises its pressure. This forces the piston down the cylinder and is called the power stroke.

Fourth stroke. As the piston begins to rise the exhaust valve opens and the spent gases are forced out of the cylinder. This is called the exhaust stroke. At the end of this stroke the exhaust valve closes and the intake valve opens.

This cycle of intake, compression, power and exhaust operates on a continuous basis all the time the engine is running. The four-stroke cycle is illustrated in Fig. 1-4.

Task 1.2a *To explain how an internal combustion engine works, you need to know the terms, which denote the components involved in its operation.*

Look over the list of automotive terms. Circle the terms referring to the engine parts involved in the four-stroke cycle.

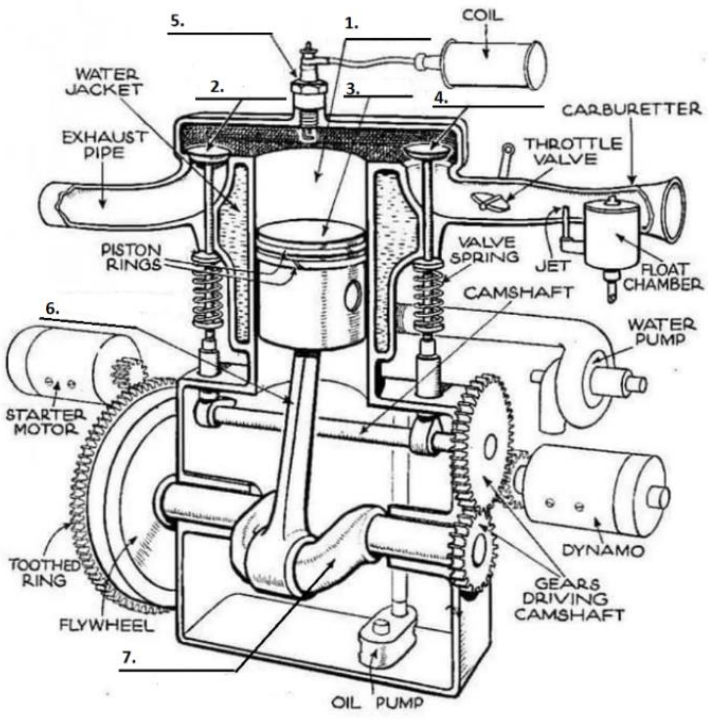
A crankshaft, a hood, an exhaust valve, an intake valve, a cylinder, a rotor, a piston, a spark plug, brakes, a transmission, a combustion chamber, a master cylinder.

Task 1.2b *Put the following terms in the order you hear them:*

TIP! Follow the link to listen to the list of the terms *https://tinyurl.com/drfv5ew9* ***or use the QR-code:***

A camshaft, a crankshaft, a piston, a cylinder, an exhaust valve, an engine, a cylinder block, an intake valve, a flywheel, a timing belt, a connecting rod.

Task 1.2c *Label the unmarked engine parts in the picture using the information from the text (see Task 1.1) and your TD:*



Task 1.3 *Use the information in the text (Task 1.1) and your TD to restore the phrases that can help you describe the four-stroke cycle:*

a) four-stoke / two-stroke / diesel / petrol / combustion + NOUN;
b) intake / compression / power / exhaust + NOUN;
c) exhaust / inlet / outlet / throttle + NOUN.

Task 1.4a *Watch a professional review, fill in the gaps in the notes taken by a student with the verbs describing the actions of the engine parts.*

TIP! Follow the link to watch the review *https://tinyurl.com/mreahf9w* ***or use the QR-code:***

Stroke. When a piston 1._____to the end of its range whether up or down.

Intake. The piston 2._____sucking an air fuel mixture into the cylinder through the intake port with both intake valves open.

Compression. Valves are closed. The piston 3._____back up compressing the fuel and air mixture for more powerful combustion.

Power stroke. An electrical spark 4._____the compressed fuel and air mixture and the resulting combustion forces the piston to the bottom of the cylinder again. A connecting rod 5._____ this power to the crankshaft.

Exhaust stroke. The piston 6._____back up, 7._____ the mixture out through open exhaust valves and the exhaust port.

Pistons 8._____ turns firing. Camshafts 9._____ spring-loaded valves open in turn. Cam gears and a timing belt or chain 10._____ everything to the crankshaft. The crankshaft 11._____ piston power out of the engine. RPM stands for revolutions per minute (crankshaft). The engine block 12._____ the crankshaft and cylinders. And the cylinder head 13._____ valves, ports, cams, etc. A geared flywheel 14._____ at one side of the crankshaft for connection to a transmission.

Task 1.4b *Add the verbs you inserted (Task 1.4a) to your TD. Connect them and the engine components (from the blue segment of your TD) performing the actions these verbs describe.*

Task 1.5a *Replace the underlined verbs, which denote the actions of the engine parts, with their synonyms using the following list of words:*

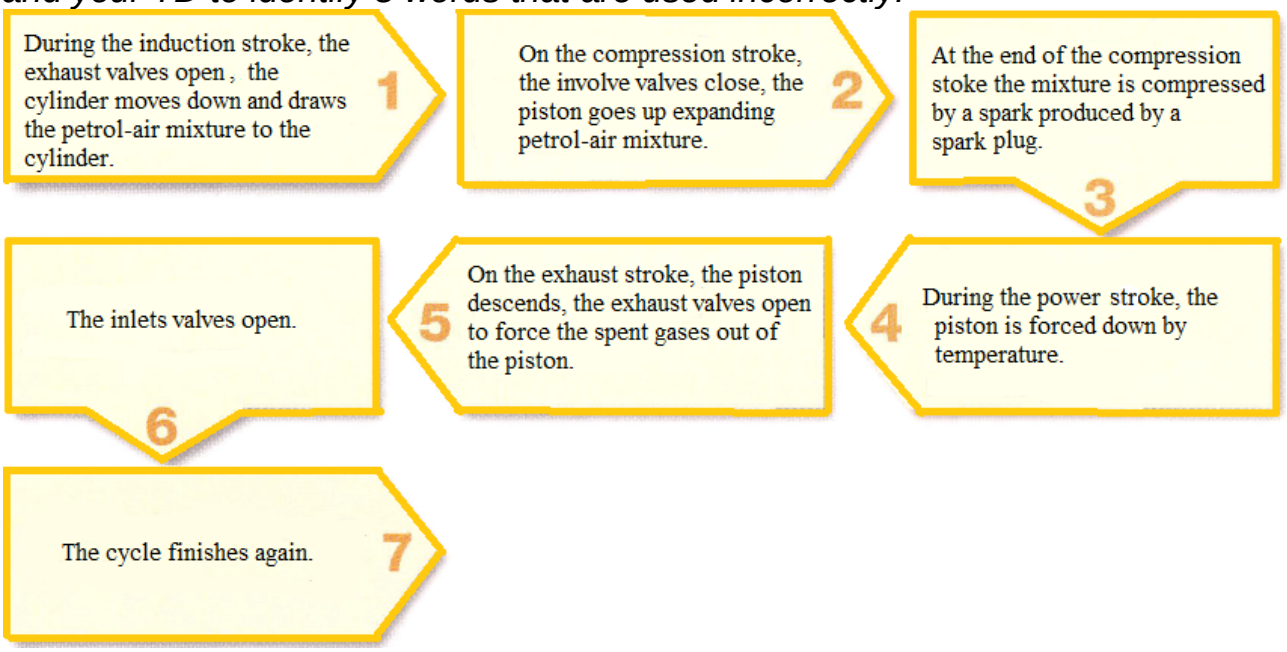
force	go down / travel down	be located	ascend
transfer	accommodate	connect	transmit

1. The piston descends sucking an air fuel mixture into the cylinder through the intake port with both intake valves open.
2. The piston goes up compressing the fuel and air mixture for more powerful combustion.

3. A connecting rod transfers this power to the crankshaft.
4. Camshafts with specially shaped cams push spring-loaded valves open in turn.
5. Cam gears and a timing belt or chain link everything to the crankshaft and it all spins together.
6. The crankshaft translates piston power out of the engine. It has counterweights to balance against.
7. The engine block holds the crankshaft and cylinders.
8. A geared flywheel sits at one side of the crankshaft for connection to a transmission.

Task 1.5b *Add the verbs from the list (Task 1.5a) to the red segment of your TD. Connect them and the engine components, performing the actions these verbs describe.*

Task 1.6 *Study the diagram. Use the information in the text (see Task 1.1) and your TD to identify 8 words that are used incorrectly.*



Task 1.7 *Student A: You are a professional engineer invited to deliver a lecture at a university. Study the internal combustion engine simulation and describe the engine operation to the students using the simulation.*

TIP! Follow the link to watch the simulation *https://tinyurl.com/2p9hh3kw* ***or use the QR-code:***

Student B: You are a student. You are going to listen to the lecture on the internal combustion engine delivered by a professional engineer. Prepare 10 questions concerning ICE operation you would like to know answers to. Listen to the lecture. At the end of the lecture, ask the questions that haven't been answered by the lecturer.

Lesson 2. ENGINE MAITENANCE

Task 2.1a *As an automotive engineer, you should be able to develop the guidance for car owners on keeping their engines in the best condition.*

Listen to 4 descriptions that will help you develop the guidance. Match them with the pictures (a-d).

TIP! Follow the link to listen to the descriptions *https://tinyurl.com/yfj42hn7* ***or use the QR-code:***

a) oil filter	b) air filter	c) motor oil	d) fuel filter
			

Speaker:	1.	2.	3.	4.

Task 2.1b *Listen again and restore the phrases that will help you develop the guidance:*

a) VERB + engine oil / oil filter / drive belts / fuel filter;
b) VERB + the engine parts / fuel injectors;
c) VERB + impurities / dirt / dust / rust;
d) VERB + the performance of your car engine / continuous oil flow.

Task 2.2 *Develop the guidance explaining to vehicle owners why it's important to change filters and motor oil at regular intervals. Use the information in the chart below, your TD and the following phrases:*

- It's generally best/a good idea to...

- One thing you should/have to do is to...
- The best/most important thing (to do) is to ...
- The main recommendation is/would be…

Maintenance Interval	Number of month or kilometers (miles), whichever comes first								
	Months	6	12	18	24	30	36	42	48
	x1000 km	12	24	36	48	60	72	84	96
	x1000 miles	7.5	15	22.5	30	37.5	45	52.5	60
ENGINE									
Drive belts						I			
Engine oil		R	R	R	R	R	R	R	R
Engine oil filter		R	R	R	R	R	R	R	R

Chart symbols: I: Inspect: Inspect and clean, repair, adjust, fill up; R: Replace

Lesson 3. HEALTH AND SAFETY POLICY STATEMENT

Task 3.1 *To supervise junior staff of a motor vehicle repair business you will need to provide them with information about working safely.*

*Read the text "*HEALTH AND SAFETY GUIDANCE "*and use the information in the text and your TD to restore the phrases that will help you write HEALTH AND SAFETY POLICY STATEMENT concerning servicing and repairing engines:*

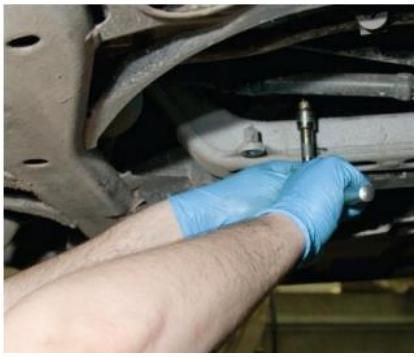
a) engine +NOUN (x2);
b) VERB + engine oil;
c) VERB + engine;
d) VERB + safe systems of work;
e) VERB + protective clothing;
f) VERB + personal hygiene and cleanliness;
g) VERB + self inspection;
h) VERB + extraction or exhaust equipment;
i) VERB + couplings and flexible connections;
j) VERB + leaks;
k) VERB + catalytic converters.

TIP! Follow the link *https://multidict.net/cs/9714* ***to read the text "****HEALTH AND SAFETY GUIDANCE"* ***or use the QR-code:***

HEALTH AND SAFETY POLICY STATEMENT

This guidance is aimed at owners, managers and self-employed operators of motor vehicle repair (MVR) businesses. There are a number of health and safety issues to consider when changing engine oil.

1. Frequent and prolonged contact with used engine oil may cause dermatitis and other skin disorders, including skin cancer, so avoid unnecessary contact. Adopt safe systems of work and wear protective clothing (see Figure 1), which should be cleaned or replaced regularly. Maintain high standards of personal hygiene and cleanliness.



Encourage employees exposed to used engine oil to carry out self inspection. If you have any doubts, consult a doctor.

Fig. 1 – Wear nitrile gloves to reduce hand contamination when draining used engine oils

You may need to run engines for diagnostic purposes but exhaust fumes irritate the eyes and respiratory tract, and are a risk to health if you breathe them in. Carbon-fuelled engine fumes contain carbon monoxide, a poisonous gas. Prolonged exposure to diesel fumes, especially blue or black smoke, may lead to coughing and breathlessness. Long term repeated exposure to diesel fumes over a period of about 20 years may increase the risk of lung cancer.

Exhaust fumes can quickly reach harmful concentrations, particularly from cold or intermittently run engines (when run indoors without exhaust ventilation). Provide extraction or exhaust equipment, preferably by direct coupling to the vehicle exhaust (see Figure 2). It should ventilate to a safe place in the open air – where fume will not be drawn back into the workshop or affect other premises or people nearby. This is particularly important when working in a vehicle inspection pit. Maintain couplings and flexible connections in good condition to prevent leaks.

Fig. 2 – Exhaust extraction

Don’t rely on catalytic converters to run engines safely indoors. They are less effective when exhaust gases are relatively cool, e.g. from vehicles idling for long periods or used intermittently for short periods. Catalytic converters do not remove toxic oxides of nitrogen.

Task 3.2 *Use some of the phrases from Task 3.1 to label the pictures in the “Safety and health at the motor vehicle repair shop” infographic below (Figure 3), which is created to instruct the workers at the motor vehicle repair shop to maintain safe and healthy working conditions:*

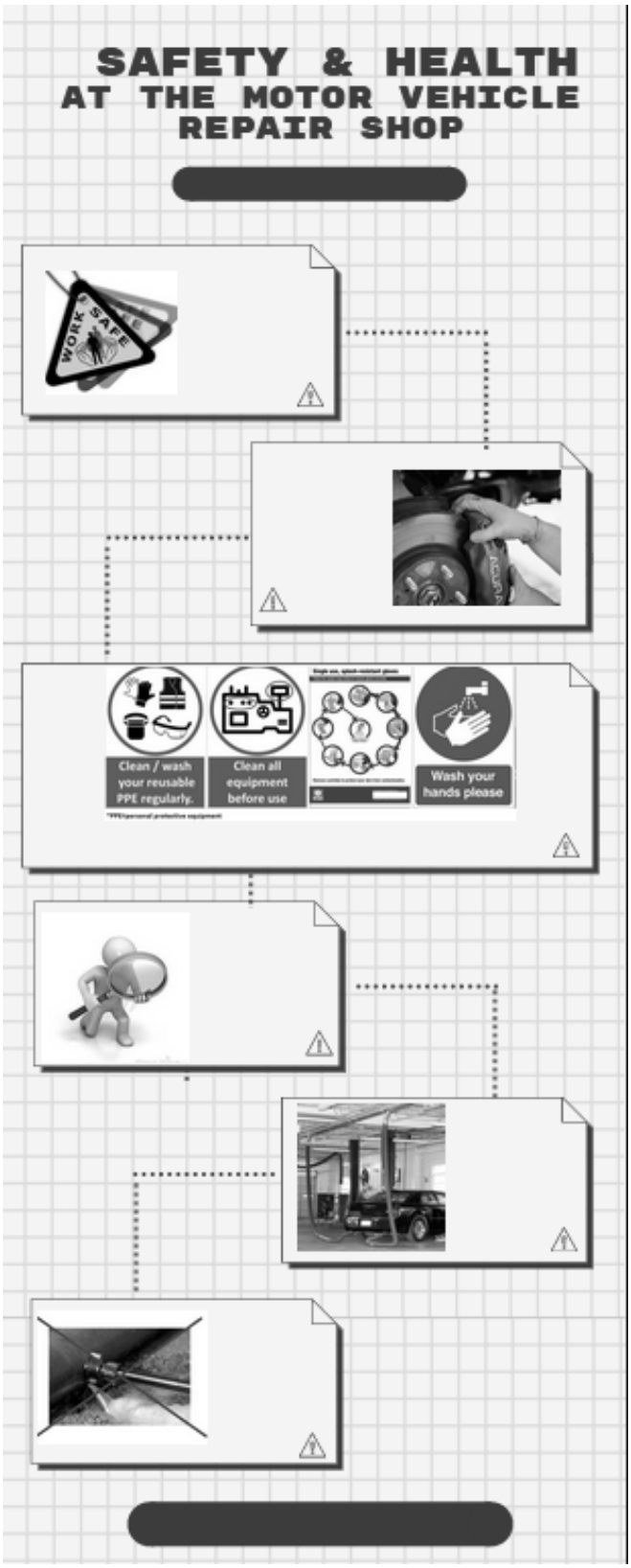


Fig. 3 – Safety and health at the motor vehicle repair shop

Task 3.3 *Use the information in the text (Task 3.1), your TD, the infographic and the following template to write HEALTH AND SAFETY POLICY STATEMENT concerning servicing and repairing engines. Include into your policy statement the information about: personal protective equipment to be worn and precautions to be undertaken:*

HEALTH AND SAFETY POLICY STATEMENT
This is the health and safety policy statement of: *the name of organization*
Our health and safety policy is to: • prevent accidents and work-related ill health; • manage health and safety risks in our workplace; • maintain safe and healthy working conditions.
All employees should: • co-operate with supervisors and managers on health and safety matters; • …… • …… • …… • …… • …… • …… • …… • report all health and safety concerns to an appropriate person (as detailed above).

Lesson 4. ASSESSMENT OF THE INTERNAL COMBUSTION ENGINE PERFORMANCE

Task 4.1 *As an automotive engineer you will assess the ICE performance and safety.*

Look over the list of the adjectives (from your TD) that can help you describe the ICE performance. Listen and put them in the table below according to their stress pattern:

TIP! Follow the link to listen to the list of adjectives *https://tinyurl.com/yckvbw5s* ***or use the QR-code:***

Innovative, efficient, incredible, reliable, precise, thrilling, powerful, distinctive, significant, compact, quiet, exceptional, refined, formidable.

oO	Oo	Ooo	oOo	Oooo	oOoo

Task 4.2 *Replace the definitions provided in bold with the appropriate adjectives from your TD.*

1. Volvo modular engine might not be the most **small, but arranged so that everything fits neatly into the space available** engine configuration ever made but the noise it makes is pretty special.

2. The S90 is ideal if you like the look and feel of a Volvo sedan and prefer the feel of a larger mid-size car with a **very effective and can do a lot** engine.

3. As a rule, the smaller the engine the more **work well without wasting time, or energy** it is.

4. The engines deliver rapid acceleration, **something that can be trusted or depended on** performance and the ability to maintain a high cruising speed.

5. Multi-Link rear suspension, a **very powerful or impressive, and often frightening** engine and impeccable engineering come together to produce a vehicle capable of going zero to 100 in just four seconds.

6. The use of piezo injectors allows Ford to be very **exact, clear, and correct** in the injection process, the result of which is a clean and complete combustion process.

7. TDI clean diesel engines deliver **unusual and likely not to happen often** power and performance while maintain low level of fuel consumption and emissions.

8. These **extremely good, large, or great** V10 engines are mated to a 7-Speed DL800 dual-clutch transmission for lightning-fast shifts and improved acceleration.

Task 4.3 *Look over the engine specifications of BMW 7 Series and Ford Ka Plus 1.2 Ti-VCT below. Compare the engines using the adjectives from your TD. Use the following phrases:*

more +adjective / adjective + -er than
_____is as + adjective + as _____
_____is not so / as + adjective + as _____
*Both **A** and **B** have _____*
*Unlike **A**, **B** has_____*
***A** (offers) _____, whereas **B** (offers) _____*
*Compared to **A**, **B** _____*
*As opposed to **A, B** _____*

ENGINE SPECIFICATIONS	
BMW 7 Series	
Engine Type	Petrol
Displacement	3000 cm^3
Cylinder	6
Power	340PS @ 5500-6500rpm
Torque	450Nm @ 1500-5200rpm
Ford Ka Plus 1.2 Ti-VCT	
Engine Type	Petrol
Displacement	1196 cm^3

Cylinder	4
Power	86 PS @ 6300 rpm
Torque	112 Nm @ 4000 rpm
Nm=Newton metres	

Task 4.4 *Work with a partner and prepare a 5-minute presentation about the greatest engines you can buy today. Give you presentation to the group.*

TIP! You can follow the link to find some useful information to make your presentation *https://tinyurl.com/yu4xetmw* ***or use the QR-code:***

Lesson 5. HISTORY OF THE INTERNAL COMBUSTION ENGINE

Task 5.1 *Look over the list of the breakthrough inventions in the automotive industry. Listen and put them in the order you hear them.*

TIP! Follow the link *https://tinyurl.com/2b8v6m98* ***to listen to the list of the breakthrough inventions or use the QR-code:***

A two stroke engine, a hydrogen powered engine, a four stroke engine, a gas powered engine, a V8 internal combustion engine, a diesel powered engine, a rotary internal combustion engine, a liquid fuel powered engine.

Task 5.2 *Use you TD to help you match the breakthrough inventions in the automotive industry with their developers.*

1. a two stroke engine	a) Charles and Frank Duryea
2. a liquid fuel powered engine	b) Jean Joseph Lenoir
3. a four stroke engine	c) Rudolf Diesel
4. a gas powered engine	d) Cadillac engineers
5. a V8 internal combustion engine	e) Nikolaus Otto
6. a diesel powered engine	f) Julius Hock

Task 5.3 *Carry out research on the Internet to add some information to the timeline (https://tinyurl.com/yckrkbe5). Present your timeline to your groupmates and describe the developments in the automotive industry you have added.*

UNIT 2. IGNITION SYSTEM

Introduction

Introductory Tasks. *Follow the link https://tinyurl.com/37bztpeb* to complete tasks 1-6 or use the QR-code:

Follow the link https://tinyurl.com/vwyvdb9n to download the Term Dimensions file (see page 1) or use the QR-code:

Lesson 1. CONVENTIONAL IGNITION SYSTEM OPERATION

Task 1.1 *As an automotive engineer, you should know how an ignition system operates. Read the text below and underline the terms that denote components of an ignition system. Add the missing terms to your TD.*

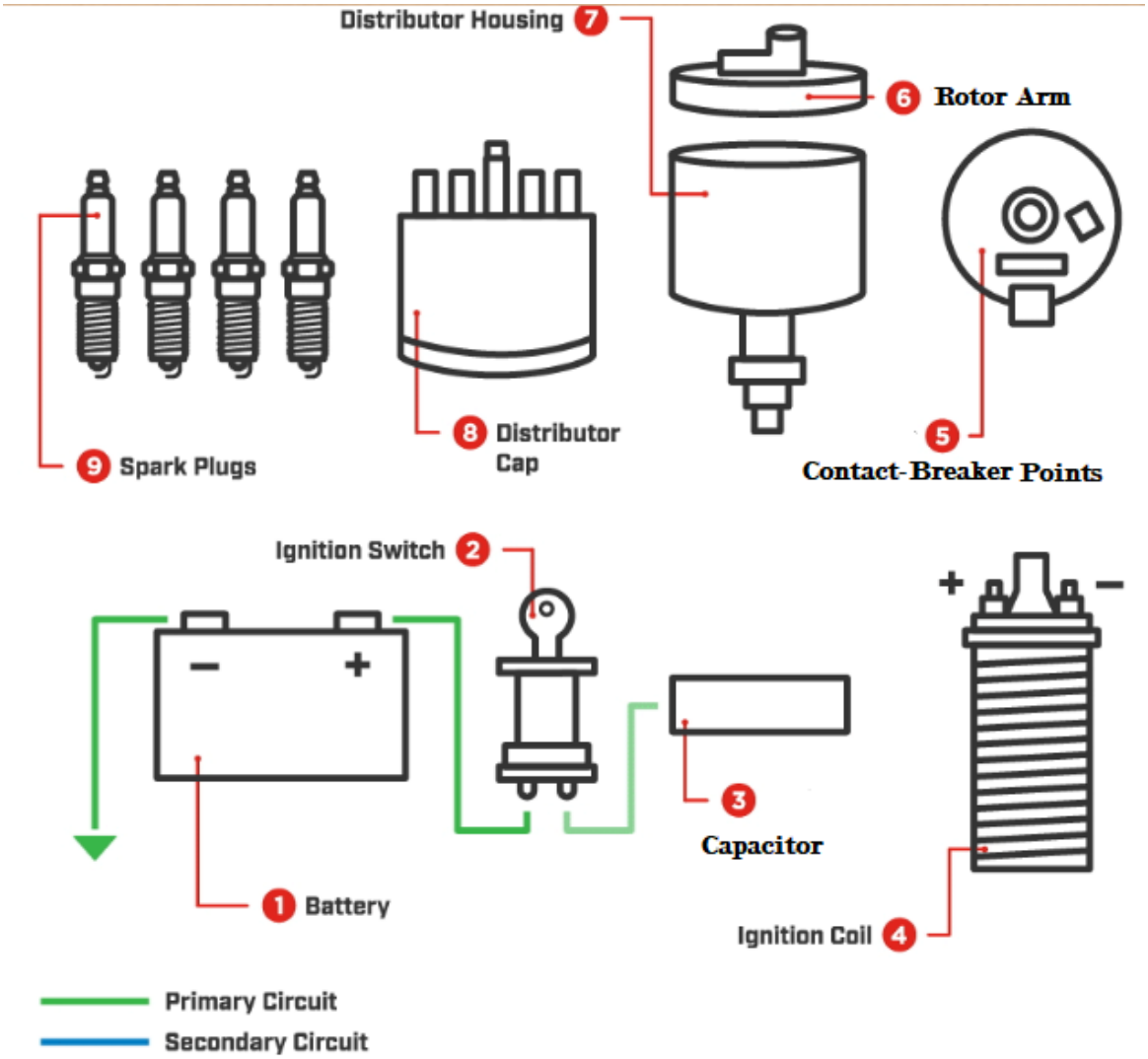
TIP! Follow the link https://tinyurl.com/4wmbmshr to read the "CONVENTIONAL IGNITION SYSTEM OPERATION" text on Clilstore or use the QR-code:

CONVENTIONAL IGNITION SYSTEM OPERATION

An automotive ignition system is divided into two electrical circuits – the primary and secondary.

The primary circuit carries low voltage. This circuit operates only on battery current and is controlled by the contact-breaker points and the ignition switch. When the ignition key is turned on, a low voltage current from the battery flows through the primary windings of the ignition coil, through the breaker points, and back to the battery. This current flow causes a magnetic field to form around the coil.

The secondary circuit consists of the secondary windings in the coil, the high tension lead between the distributor and the coil on external coil distributors, the distributor cap, the distributor rotor arm, the spark plug leads, and the spark plugs. As the engine rotates, the distributor shaft cam turns until the high point on the cam causes the contact-breaker points to separate suddenly. Instantaneously, when the contact-breaker points open (separate) current flow stops through the primary windings of the ignition coil. This causes the magnetic field to collapse around the coil. The capacitor absorbs the energy and prevents arcing between the points each time they open. This capacitor also aids in the rapid collapse of the magnetic field.



The line of flux in the magnetic field cut through the secondary windings of the ignition coil, creating a high voltage - high enough to jump the gaps between the rotor arm and the distributor cap terminals, and the electrodes at the base of the spark plug. Assuming that the engine is properly timed, the spark reaches the air-fuel mixture in the cylinder, and combustion begins.

As the distributor continues to rotate, electrical contact between the rotor arm and distributor cap terminal is broken, stopping the secondary flow. At the same time, breaker points close to complete the primary circuit, allowing the primary current to flow. This primary current will again create a magnetic field and the cycle is repeated for the next cylinder in the firing order.

Task 1.2a *To explain how an ignition system works, you need to know the terms, which denote the components involved in its operation.*

Look over the list of automotive terms. Circle the terms referring to ignition system components.

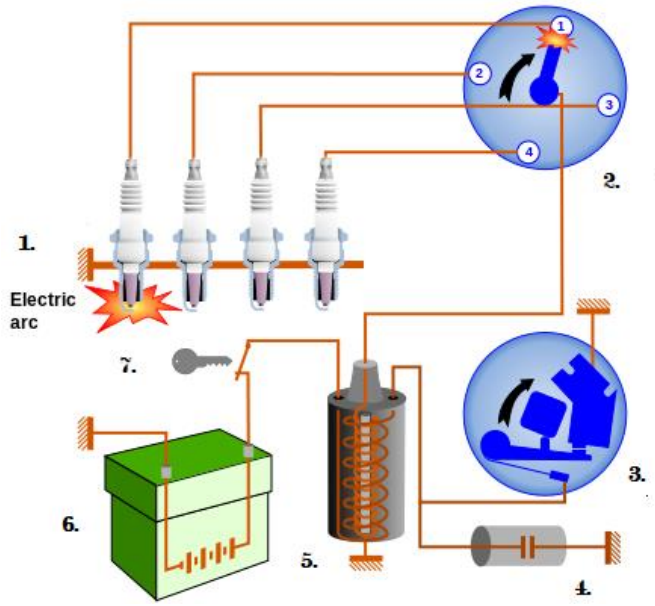
A crankshaft, contact-breaker points, an exhaust valve, a rotor arm, a distributor, a drive, a capacitor, a spark plug, HT leads, a transmission, a coil, an ignition switch, a piston, a distributor cap.

Task 1.2b *Put the following terms in the order you hear them:*

TIP! Follow the link to listen to the list of the terms *https://tinyurl.com/bdjech6j* ***or use the QR-code:***

A spark plug, a distributor cam, an ignition switch, a Low Tension lead, a distributor, a drive, a High Tension lead, a coil, a plug cap, a plug lead, a rotor arm, contact-breaker points.

Task 1.2c *Label the unmarked ignition system parts in the picture using the information in the text (see Task 1.1) and your TD:*



Task 1.3 *Use the information in the text (see Task 1.1) and your TD to restore the phrases that can help you describe the ignition system components:*

a) primary / secondary + NOUN (x2);
b) NOUN +switch / coil;
c) battery / low voltage / high voltage / primary + NOUN;
d) High Tension / Low Tension + NOUN.

Task 1.4a *Watch a professional review and restore its script by filling in the gaps with the verbs describing the actions of the ignition system parts.*

TIP! Follow the link to watch the review *https://tinyurl.com/2p89zwvj* ***or use the QR-code:***

The ignition system 1**.**_____ the spark that 2**.**_____ the fuel and air in a gasoline engine. The ignition coil 3**.**_____ the 12-volt supplied by the battery to around 20,000 volts. Although older vehicles used a single ignition coil and a mechanical distributor to 4**.**_____ a high voltage to each spark plug, most vehicles now have a smaller ignition coil for each cylinder of the engine. The engine computer 5**.**_____ when a spark should 6. _____ by the signal it receives from the crankshaft position sensor. The timing is further 7**.**_____ according to readings from other sensors such as the knock sensor (датчик детонации), which listens for the noise created when the spark happens too early, the throttle position sensor (датчик положения дроссельной заслонки), and the mass airflow (датчик массового расхода воздуха) or manifold pressure sensors (датчик давления на впускном коллекторе). When the engine computer 8**.**_____ the coil, the high-voltage 9. _____ the gap between the electrode and the ground strap on the spark plug igniting the compressed air and fuel in the cylinder to create an explosion that pushes the piston downwards. Failed or worn ignition system components 10**.**_____ misfires when the fuel is not burned correctly in the cylinder. This 11**.**_____ rough running, loss of power, and increased fuel consumption.

Task 1.4b *Add the verbs you inserted (Task 1.4a) to your TD. Connect them and the ignition system components (from the blue segment of your TD) performing the actions these verbs describe.*

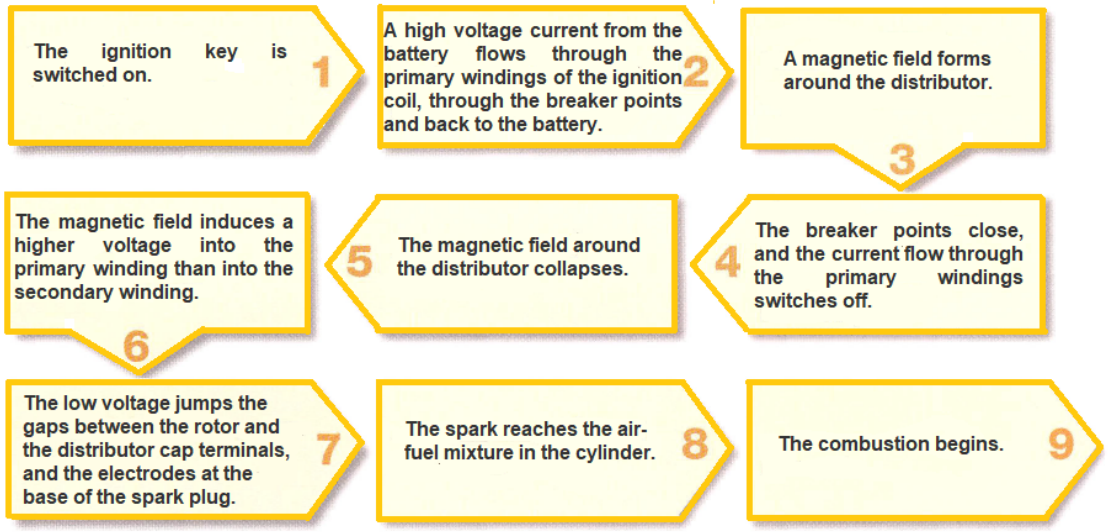
Task 1.5a *Replace the underlined verbs, which denote the actions of the ignition system components, with their synonyms using the following list of words:*

transfer	deliver	accumulate	enable
drive	cope with	give	

1. A spark plug must <u>withstand</u> very high voltages, pressures and temperatures.
2. An ignition coil <u>stores</u> energy in the form of magnetism and <u>delivers</u> it to the distributor via the HT lead.
3. An ignition switch <u>provides</u> driver control of the ignition system.
4. The contact-breaker points <u>are operated</u> by a rotating cam in the distributor.
5. A capacitor <u>allows for</u> a more rapid break of primary current and hence a more rapid collapse of coil magnetism.
6. A distributor <u>directs</u> the spark from the coil to each cylinder in a preset sequence.
7. Plug leads <u>transfer</u> the spark from the distributor to the plugs.

Task 1.5b *Add the verbs from the list (Task 1.5a) to the red segment of your TD. Connect them and the ignition system components, performing the actions these verbs describe.*

Task 1.6 *Study the diagram. Use the information in the text (see task 1, page 2) and your TD to identify 7 words that are used incorrectly.*



Task 1.7 *Student A: You are a professional engineer invited to deliver a lecture at a university. Study the ignition system simulation and describe its operation to the students using the simulation.*

TIP! Follow the link *https://tinyurl.com/474f3uze* ***to watch the simulation or use the QR-code:***

Student B: You are a student. You are going to listen to the lecture on the ignition system delivered by a professional engineer. Prepare 10 questions concerning its operation you would like to know the answers to. Listen to the lecture. At the end of the lecture, ask the questions that haven't been answered by the lecturer.

Lesson 2. IGNITION SYSTEM MAITENANCE

Task 2.1a *As an automotive engineer, you should be able to provide car owners with the guidance on keeping their ignition system in the best condition.*

Listen to 4 descriptions that will help you explain why ignition system parts need to be regularly inspected. Match them with the pictures (a-d).

TIP! Follow the link to listen to the descriptions *https://tinyurl.com/4j6r7j9y* ***or use the QR-code:***

a) battery	b) spark plug	c) contact breaker	d) ignition coil
			

Speaker:	1.	2.	3.	4.

Task 2.1b *Listen again and restore the phrases that will help you develop the guidance:*

a) a mechanical + NOUN;
b) VERB / VERB + the ignition circuit;
c) VERB + rough running / misfiring;
d) VERB + the electrical energy into high voltage;
e) VERB + power;
f) VERB + something regularly / twice a year;
g) VERB + signs of weakness;
h) VERB + the chances of failure;
i) VERB + the spark;
j) VERB + rough;
k) VERB the vehicle vibrating.

Task 2.1c *As an automotive engineer, you should be able to develop the guidance for car owners on keeping their ignition system in the best condition.*

Develop the guidance. Use the information in the chart, your TD and the following phrases:

- It's generally best/a good idea to...
- One thing you should/have to do is to...
- The best/most important thing (to do) is to ...
- The main recommendation is/would be…

Maintenance Interval	Number of month or kilometers (miles), whichever comes first								
	Months	6	12	18	24	30	36	42	48
	*1000 km	12	24	36	48	60	72	84	96
	*1000 miles	7.5	15	22.5	30	37.5	45	52.5	60
IGNITION SYSTEM									
Battery[1]		I	I	I	I	I	I	I	I
Spark plugs		Replace every 120,000 km (75,000 miles)							
		C/T	C/T	C/T	C/T	C/T	C/T	C/T	C/T
Contact breaker		R/A	R/A	R/A	R/A	R/A	R/A	R/A	R/A
Coil		C	C	C	C	C	C	C	C
Cam face		L	L	L	L	L	L	L	L

Chart symbols:

[1] Inspect the battery electrolyte level, specific gravity and outer appearance. The sealed battery only requires an outer appearance inspection

I: Inspect; C: Clean; T: Test; R: Replace; A: Adjust; L: Lubricate

Lesson 3. SYMPTOMS AND CAUSES OF IGNITION COMPONENTS FAULTS

Task 3.1 *A qualified automotive engineer is able to explain the symptoms and causes of ignition system faults.*

Read the text below and use the information in the text and your TD to restore the phrases that will help you create an infographic for car owners to detect a faulty ignition coil:

a) ADJECTIVE + ignition coil (3 phrases);
b) ignition coil + NOUN (2 phrases);
c) VERB + less mileage;
d) VERB + in+ costly repairs / engine misfiring / vibration/ the stalling of the vehicle;
e) VERB + some power;
f) VERB + a malfunction.

SYMPTOMS OF A BAD IGNITION COIL

If a vehicle is behaving intermittently and is giving its driver some trouble in smooth driving, then it could indicate that the ignition coil of that vehicle has gone bad.

The failed or weak ignition coil symptoms may vary depending on the severity of the ignition coil failure. Here are some of the most common signs of a bad ignition coil.

#1 Backfiring

Backfiring caused by your vehicle can indicate the symptoms of the ignition coil failure in its early stages. It occurs when the unused fuel in the combustion cylinders of the engine leaves through the exhaust pipe.

If this problem is left unchecked, then it can result in costly repairs. The backfiring problem can usually be detected by the emission of black smoke through the exhaust pipe. The smell of gasoline in that smoke may also give away the ignition coil failure.

#2 High Fuel Consumption

Another sign of a faulty ignition coil is poor fuel economy. If your vehicle is getting noticeably less mileage than it was before, then it could mean that an ignition coil failure has occurred.

#3 Engine Misfiring

Engine misfiring will be seen in a vehicle whose ignition coils have failed. Trying to start the engine of such a vehicle will result in engine misfiring that sounds like a coughing, sputtering noise.

When driving at high speeds, jerking and spitting will be seen in the behavior of the vehicle. A vehicle with a failed ignition coil will also result in vibration when it is idling at a stop sign or lights.

#4 Stalling of the Vehicle

Ignition coil failure may also result in the stalling of the vehicle. This can occur because of the irregular sparks sent to the spark plugs by the faulty coil. Your car may shut off completely when brought to a stop.

#5 – Engine Jerking, Rough idling, Poor Power

Another symptom is rough idling of the engine, jerking, and hesitating while accelerating. It will feel like your vehicle is missing some power when driving.

#6 Check Engine Light On / DTC Code

Often, the check engine light will turn on in your dashboard. Most commonly, engine code P0351 (Ignition Coil – Primary/Secondary Circuit Malfunction) is what shows up when scanned using a car diagnostic tool. Scanning for the error code is probably the easiest way to troubleshoot a coil issue.

#7 – Engine Hard Starting

A hard-to-start engine is a symptom that will occur especially if your car uses a single coil. If the coil has a malfunction, it means the engine will be cranking without sparks inside the cylinders. At times, it may start but then die right away.

Task 3.2 *Follow the link https://tinyurl.com/2p9a2btv to view the "What are the signs of a defective ignition switch in a car?" infographic. Use it as an example to create the infographic to help car owners detect faulty ignition system components. Include the information about: 1) each ignition system element function; 2) the symptoms of its malfunction; 3) malfunction results; 4) your recommendations.*

You can use https://app.genial.ly/templates/infographics or any other tool to create your infographic.

Lesson 4. ASSESSMENT OF THE IGNITION SYSTEM

Task 4.1 *As an automotive engineer you will assess the ignition system performance and safety.*

Look over the list of adjectives (from your TD) that can help you describe its performance. Listen and put them in the table below according to their stress pattern:

TIP! Follow the link to listen to the list of the adjectives *https://tinyurl.com/mrx25eas* ***or use the QR-code:***

Reliable, accurate, powerful, effective, sophisticated, innovative, faulty, weak, failed.

O	Oo	Ooo	oOo	Oooo	oOoo	oOooo

Task 4.2 *Replace the definitions provided in bold with the appropriate adjectives from Task 4.1 or your TD.*

1. To meet the demands for improved emissions, fuel economy and power, the engineers aimed for increased efficiency through a combination of revised valve seats for better gas flow at low engine speeds, and a more **able to do something in an exact way without making a mistake** ignition system to enhance the combustion process.
2. PerTronix's Ignitor III is a **very well designed and very advanced, and often works in a complicated way** ignition system that increases spark energy dramatically and provides multiple sparks through the entire rpm range.
3. The AccuSpark electronic ignition module completely replaces the points and a condenser with a modern **something that can be trusted or depended on** ignition system.
4. The ultimate Engine Control System combines a **very effective and can do a lot** ignition system and an Air/Fuel ratio control system, to reduce engine emissions, increase efficiency and reduce maintenance.
5. A **not working properly, or not made correctly** ignition system can cause some engine problems: lack of power and torque, overheating, stalling, etc.
6. Replace your old and **not having much power** ignition system and improve ignition power with our Kit Easy Installation.
7. Developed by Alfa Romeo back in 1914, this **new, different, and better than those that existed before** ignition system promised improvements in terms of power and flexibility.

Task 4.3 *Look over the ignition systems pros and cons and compare them using the following phrases and the adjectives from Task 4.1 or your TD:*

more +adjective / adjective + -er than
_____is as + adjective + as _____
_____is not so / as + adjective + as _____
*Both **A** and **B** have _____*
*Unlike **A**, **B** has_____*
***A** (offers) _____, whereas **B** (offers) _____*
*Compared to **A**, **B** _____*
*As opposed to **A, B** _____*

	Breaker-Point Ignition	Electronic Ignition	Distributorless Ignition	Coil-On-Plug Ignition
Pros	**Easy maintenance:** the mechanical nature of these ignition systems, as well as the fact that these systems have been around the longest, render them relatively easy to diagnose and repair.	**Reliable:** they can generate a consistent, high voltage spark throughout the life of the engine, which means fewer engine misfires and reasonable emissions. **Less likely to break down:** they have fewer mechanical moving parts (breaker points and a condenser are removed), thus they are less likely to break down.	**Reliable:** they can generate consistent, high voltage throughout the engine's lifetime. **Precise spark timing:** spark timing can be precisely controlled, thus allowing for lower emissions. **Less likely to break down:** due to the lack of moving parts, as the system is now electronic.	**Engine efficiency:** they can generate consistent, high voltage and hotter, stronger spark that can efficiently burn the leaner air-fuel mixture in newer vehicles. **Precise spark timing:** this allows for optimal engine efficiency and lower emissions. **Less frequent repairs:** due to the lack of moving parts as spark plug wires are removed.
Cons	**Likely to breakdown:** they consist of a large number of mechanically moving parts, which increases the potential for wear and tear, malfunction and breakdowns. **Affect engine performance:** deterioration of these types of ignition system can decrease the maximum spark energy over time, causing frequent engine problems such as misfires and increased emissions.	**Costly maintenance**: the distributor is subject to wear and tear and requires replacement, adding to repair costs. **Timing**: spark timing is not exactly precise, resulting in sluggish acceleration and poor fuel economy.	**Maintenance**: it can be much harder to diagnose and more expensive to repair once a problem occurs than mechanical ignition systems. **More expensive parts:** distributorless systems require double platinum spark plugs to facilitate their firing mechanism.	**Repairs**: no moving parts means difficult troubleshooting and more expensive repairs.

Task 4.4 *Work with a partner and prepare a 5-minute presentation about the top ignition coil manufacturers. Give your presentation to the group.*

TIP! You can follow the link https://tinyurl.com/yvuctfpa to find some useful information to make your presentation or use the QR-code:

UNIT 5. HISTORY OF THE IGNITION SYSTEM

Task 5.1 *Look over the list of the breakthrough inventions in the automotive industry. Listen and put them in the order you hear them.*

TIP! Follow the link *https://tinyurl.com/4w227xuj* ***to listen to the list of the breakthrough inventions or use the QR-code:***

A double-coil magneto with a fixed spark plug, the Simms-Bosch ignition magneto, a coil-on-plug ignition, an electronic ignition, a terminal connecter for spark plugs, a distributorless ignition, a self-cleaning spark plug, an electric spark plug, a battery and coil type ignition, a high-voltage magneto ignition system, a breaker-point ignition, a magneto ignition system, a self-starter for automobile engines, a double-insulated spark plug, an electrical ignition system.

Task 5.2 *Use you TD and carry out research on the Internet to help you match the breakthrough inventions with their developers.*

1. the first practically used electric spark plug	a) Charles Kettering
2. the first magneto ignition system	b) Jean Joseph Étienne Lenoir
3. high-voltage magneto ignition system	c) Albert Champion
4. the first automobile electrical ignition system	d) Gottlob Honold
5. a battery and coil type ignition	e) Nikolaus Otto
6. double-insulated spark plug	f) Cadillac engineers

Task 5.3 *Carry out research on the Internet to add some information to the timeline (https://tinyurl.com/37bztpeb). Present your timeline to your groupmates and describe the developments in the automotive industry you have added.*

UNIT 3 BRAKING SYSTEM

Introduction

Introductory tasks. *Follow the link https://tinyurl.com/4wjjyb98 to complete tasks 1-6 or use the QR-code:*

Follow the link https://tinyurl.com/vwyvdb9n to download the Term Dimensions file (see page 1) or use the QR-code:

Lesson 1. HYDRAULIC BRAKING SYSTEM OPERATION

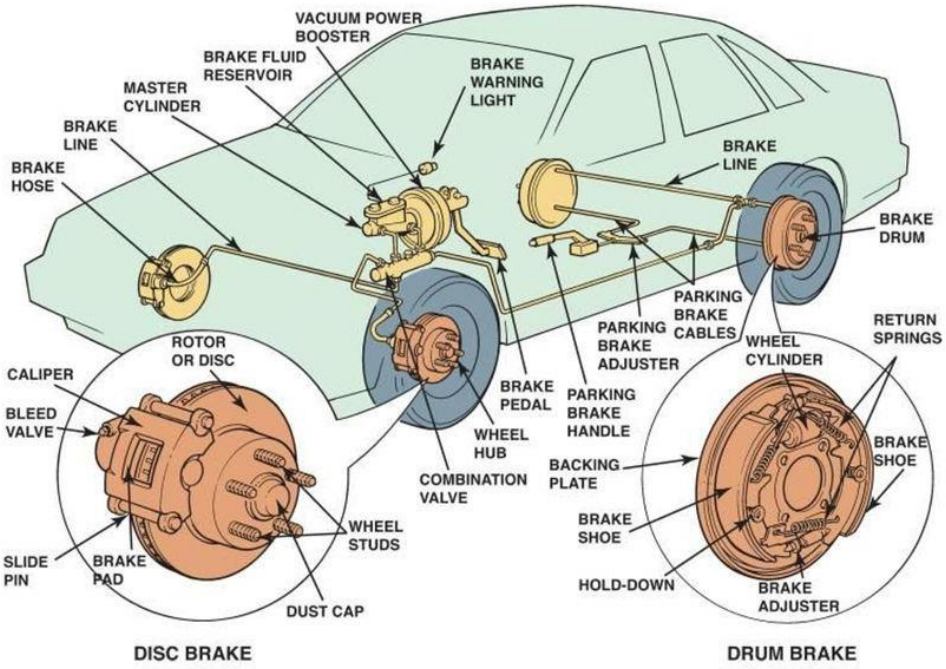
Task 1.1 *As an automotive engineer, you should know how a braking system operates. Read the text below and underline the terms that denote components of a braking system. Add the missing terms to your TD.*

TIP! Follow the link https://multidict.net/cs/10358 to read the "HYDRAULIC BRAKING SYSTEM OPERATION" text on Clilstore or use the QR-code:

HYDRAULIC BRAKING SYSTEM OPERATION

The main braking system of a car works by hydraulics. This means that when the driver presses the brake pedal, liquid pressure forces pistons to apply brakes on each wheel. Disc brakes are used on the front wheels of some cars and all wheels of sports and performance cars. Braking pressure forces brake pads against both sides of a steel disc. Drum brakes are fitted on the rear wheels of some cars and all wheels of older vehicles. Braking pressure forces shoes to expand outwards into contact with a drum. The important part of brake pads and shoes is the friction lining.

Brake pads are steel-backed blocks of friction material, which are pressed onto both sides of the disc. Pads should be changed when the friction material wears down to 2 or 3mm. The circular steel disc rotates with the wheel. Some are solid but many have ventilation holes.



Brake shoes are steel crescent shapes with a friction material lining. They are pressed inside a steel drum, which rotates with the wheel. The rotating action of the brake drum tends to pull one brake shoe harder into contact. This is known as self-servo action. It occurs on the brake shoe, which is after the wheel cylinder, in the direction of wheel rotation. This brake shoe is described as the leading shoe. The brake shoe before the wheel cylinder in the direction of wheel rotation is described as the trailing shoe.

The master cylinder piston is moved by the brake pedal. In its basic form, it is like a pump, which forces brake fluid through the pipes. Pressure in the pipes causes a small movement to operate either brake shoes or pads. The wheel cylinders work like a pump only in reverse.

The brake servo increases the force applied by the driver on the pedal. It makes the brakes more effective. Vacuum, from the engine inlet manifold, is used to work most brake servos.

Strong, high-quality pipes are used to connect the master cylinder to the wheel cylinders. Fluid connection, from the vehicle body to the wheels, has to be through flexible pipes to allow suspension and steering movement. As a safety precaution (because brakes are quite important!), braking systems are split into two sections. If one section fails, say through a pipe breaking, the other will continue to operate.

Task 1.2 *Use the information in the text (see Task 1.1) and your TD to restore the phrases that can help you describe the braking system components:*

a) brake + NOUN (x6);
b) NOUN + brakes (x2);
c) NOUN + cylinder (x2);
d) ADJECTIVE + shoe (x2);
e) ADJECTIVE + pipes (x2);
f) VERB + brake fluid through the pipes / shoes to expand / brake pads against a steel disk.

Task 1.3a *To explain how a braking system works, you need to know the terms, which denote the components involved in its operation.*

Look over the list of automotive terms. Circle the terms referring to braking system components.

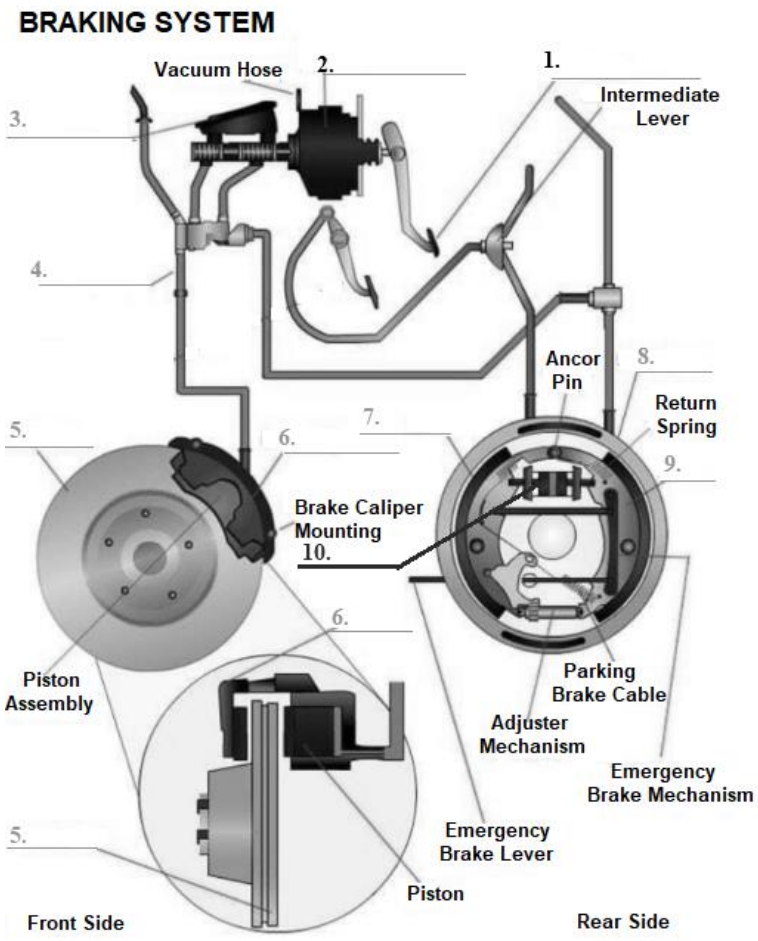
A master cylinder, a calliper, contact-breaker points, brake pads, a rotor, a rotor arm, brake shoes, a drum, a coil, a wheel cylinder, a piston, a distributor cap.

Task 1.3b *Put the following terms in the order you hear them:*

TIP! Follow the link to listen to the list of the terms *https://tinyurl.com/yckur4mt* ***or use the QR-code:***

A pedal, disc brakes, drum brakes, a brake booster, a push rod, a master cylinder, a disk rotor, a wheel cylinder, disk pads, brake shoes, brake lines, brake hoses, an emergency brake, anti-lock brakes.

Task 1.3c *Label the unmarked braking system parts in the picture using the information in the text (see Task 1.1) and your TD:*



Task 1.4a *Watch a professional review and restore its script by filling in the gaps with the verbs (in the active or passive voice) describing the actions of the braking system parts.*

TIP! Follow the link to watch the review *https://tinyurl.com/2p99ths7* ***or use the QR-code:***

Simple and low maintenance, drum brakes use a cast iron drum which 1._____ with the axle. When the brakes 2._____ two inner shoes with pads act outwards to the inner face of the drum to stop the wheel rotating.

Disc brakes 3._____ using outer callipers and a steel rotor disc which 4._____ with the wheel. When the brakes 5._____ the calliper's pistons 6._____ firmly on the disc to stop the wheel. The callipers are fitted with brake pads designed to perform effectively under various conditions using a high friction material designed to 7._____ the intense heat generated by brake action.

Both brake types use a hydraulic system to operate using a network of brake lines filled with hydraulic fluid. Bringing a vehicle to a rapid stop, especially in an emergency calls for more force than the driver can apply. Brake boosters are provided to 8._____ the driver by amplifying the force applied to the brake pedal.

The brake system requires regular inspection and service according to the maintenance schedule found in the owner's manual supplement.

Task 1.4b *Add the verbs you inserted (Task 1.4a) to your TD. Connect them and the braking system components (from the blue segment of your TD) performing the actions these verbs describe.*

Task 1.5a *Replace the underlined verbs, which denote the actions of the engine parts, with their synonyms using the following list of words (sometimes two variants are possible):*

cover	store	transport	deliver
press	accommodate	turn	

1. A brake fluid reservoir is a container, usually made of clear plastic, which is joined to a master cylinder assembly. It holds the fluid needed for the brake system.
2. Brake hoses are tubes made of rubber or flexible braided steel that bridge the gap between steel brake lines from the master cylinder and the brakes at the wheels.

3. A brake line is specially designed non-flexible steel tubing (usually stainless) that delivers brake fluid under high pressure from the master cylinder to the flexible brake hose sections at each wheel.

4. A brake calliper, found only on disc brakes, houses pistons that use the force of hydraulic brake fluid to squeeze brake pads against the rotor.

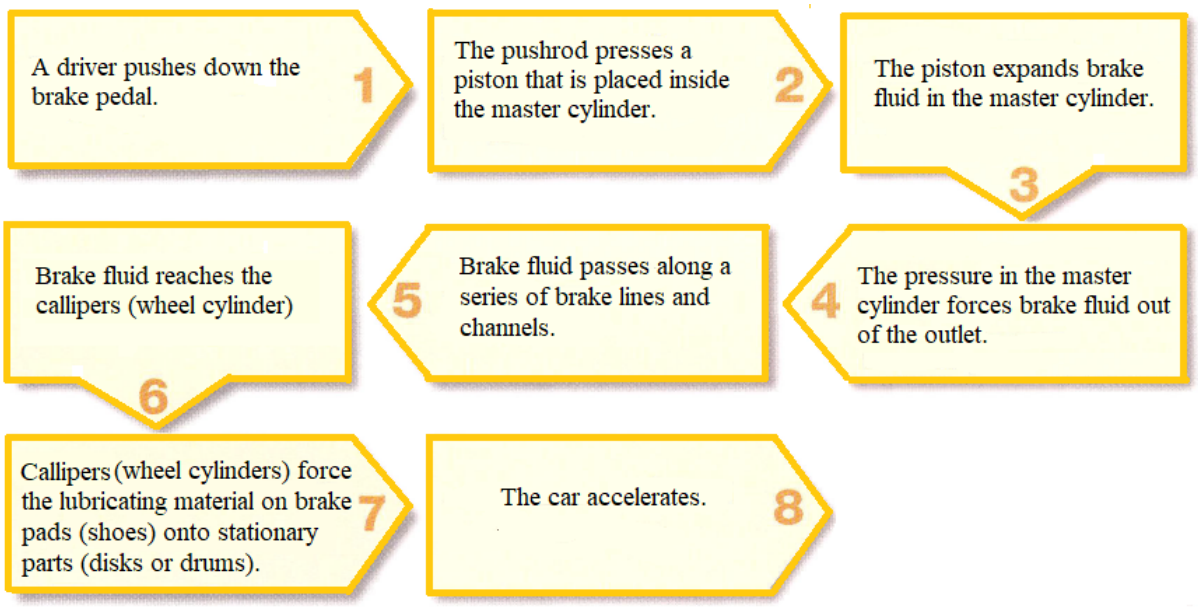
5. A drum is a ring-shaped outer housing that rotates with a vehicle's wheel and fits over all the internal components of a drum brake setup.

6. The brake master cylinder feeds brake fluid into the brake circuit to convert the pressure on the brake pedal to the hydraulic pressure.

7. The rotor is a circular metal disc that rotates with the wheel to provide a surface for brake pads to clamp against when stopping friction is required.

Task 1.5b *Add the verbs from the list (Task 1.5a) to the red segment of your TD. Connect them and the braking system components, performing the actions these verbs describe.*

Task 1.6 *Study the diagram. Use the information in the text (see Task 1.1) and your TD to identify 5 words that are used incorrectly.*



Task 1.7 *Student A: You are a professional engineer invited to deliver a lecture at a university. Study the braking system simulation and describe its operation to the students using the simulation.*

TIP! Follow the link to watch the simulation *https://tinyurl.com/mt3r9fej* ***or use the QR-code:***

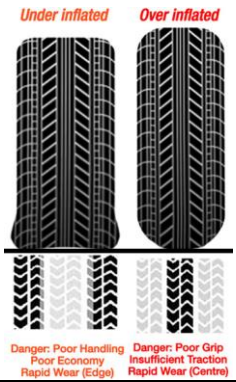
Student B: You are a student. You are going to listen to the lecture on the braking system delivered by a professional engineer. Prepare 10 questions concerning its operation you would like to know the answers to. Listen to the lecture. At the end of the lecture, ask the questions that haven't been answered by the lecturer.

Lesson 2. BRAKING SYSTEM MAITENANCE

Task 2.1a *As an automotive engineer, you should be able to provide car owners with the guidance on keeping their braking system in the best condition.*

Listen to 4 descriptions that will help you explain why braking system parts need to be regularly inspected. Match them with the pictures (a-d).

TIP! Follow the link to listen to the descriptions *https://tinyurl.com/yeywrs3c* ***or use the QR-code:***

a) brake lines and hoses	b) brake fluid	c) worn tyres	d) tyre pressure
			

Speaker:	1.	2.	3.	4.

Task 2.1b *Listen again and restore the phrases that will help you develop the guidance:*

a) VERB + brake shoes;
b) VERB + brake pads;
c) VERB + the proper operation of the brakes;
d) VERB + metal parts from corrosion;
e) NOUN + of hydraulic pressure;
f) VERB + braking / a car's fuel economy;

g) VERB + to losing control of a vehicle;
h) VERB + the ability to control vehicle;
i) VERB + the life of a tyre.

Task 2.1c *Use the information from the chart below, tasks 2.1a and 2.1b, and your TD to create the guidance giving essential tips on keeping the braking system in the best condition. Explain: 1) what braking system parts should be checked; 2) how often they should be checked and 3) why it's a good idea to check them. Use the following phrases:*

- It's generally best/a good idea to...
- One thing you should/have to do is to...
- The best/most important thing (to do) is to ...
- The best course of action is to …

Maintenance Interval	Number of month or kilometers (miles), whichever comes first								
	Months	6	12	18	24	30	36	42	48
	x1000 km	12	24	36	48	60	72	84	96
	x1000 miles	7.5	15	22.5	30	37.5	45	52.5	60
BRAKING SYSTEM									
Brake lines, hoses and connections		I	I	I	I	I	I	I	I
Brake lines	Bleed every 2-3 years								
Brake fluid level		I	I	I	I	I	I	I	I
Brake fluid	Replace every 40,000 km (25,000 miles)								
Disc brakes		I	I	I	I	I	I	I	I
Tire (Rotation)	Rotate every 8,000 km (5,000 miles)								
Tire inflation pressure and tire wear		I	I	I	I	I	I	I	I

Chart symbols:
I: Inspect

Lesson 3. SYMPTOMS AND CAUSES OF BRAKING COMPONENTS FAULTS

Task 3.1 *A qualified automotive engineer is able to explain the symptoms and causes of braking system faults.*

Read the text below and use the information in the text and your TD to restore the phrases that will help you create an infographic for car owners to detect defective brakes:

a) a common/ an internal + NOUN;
b) to fix / to experience + NOUN;
c) NOUN + feel soft;
d) VERB + the rotors / the brake pads / the master cylinder / the calliper;

e) VERB + the brake fluid level;
f) a frozen + NOUN;
g) warped + NOUN;
h) resurface / replace the +NOUN.

THREE WARNING SIGNS OF DEFECTIVE BRAKES

#1. There's no resistance on the pedal

A common problem many drivers experience is when the brakes feel soft or spongy, or the pedal has barely any resistance when engaged. If the pedal sinks right down to the floor without you having to push down much, this can be a sign that there is a leak in the braking system. A leak can be extremely hazardous and increase the risk of having a road accident.

The first thing you should do in this instance is to check the brake fluid levels under your bonnet. If you are unsure of how to do this, check your owner's manual or take your car to a local garage. If the brake fluid levels are correct and you can see no visible signs of a leak, it may be an internal problem.

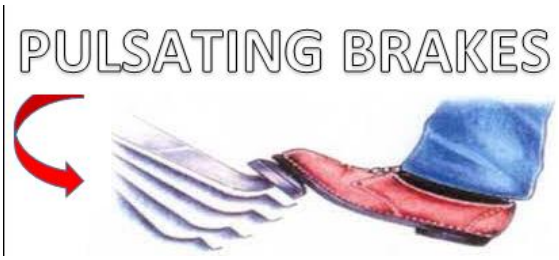
It's also a good idea to see if the master cylinder above the brake pedal is not leaking by checking if there is any fluid on the ground. If you find that the master cylinder is leaking, you will need to have it replaced.

#2. The vehicle pulls to one side

If you notice that your car pulls to the left or right when braking, it could indicate several different problems. For example, a common reason for this to happen is a frozen calliper. The calliper can become stuck due to rust, corrosion, after a car accident, or simply due to a lack of maintenance. This can result in uneven pressure on the pads, which can make the car pull to one side.

To fix this problem, you may be able to clean and lubricate the calliper mechanism yourself by buying a special maintenance kit. However, this can be tricky to do and if the problem is serious, it may be that it's not worth repairing. For this reason, the best course of action is to have the calliper replaced with a new one. Although this will cost you more, it can save you time and money in the long term.

#3. The brakes are pulsating



Brakes pulsation is usually caused by warped rotors. Rotors are constantly being heated up and cooling down when you drive, meaning that they can become easily worn and lose their shape over time. This can be made worse if you do a lot of long-distance driving.

The solution to this problem is to resurface or replace the rotors. You may also need to replace the brake pads or have them checked to make sure that they are fitted properly as they can also suffer from excessive wear and tear.

Task 3.2 *Follow the link https://tinyurl.com/dauwr3cf to view the "Is It Time to Change the Brake Pads of Your Car?" infographic. Use it as an example to create an infographic to help car owners detect defective braking system components (brake pads, brake rotors, callipers, a master cylinder). In your infographic use the phrases from Task 3.1, and your TD. Include the information about: 1) each braking system element function; 2) the symptoms of its malfunction; 3) malfunction results; 4) your recommendations.*

You can use https://app.genial.ly/templates/infographics or any other tool to create your infographic.

Lesson 4. ASSESSMENT OF THE BRAKING SYSTEM

Task 4.1 *As an automotive engineer, you will assess the braking system performance and safety.*

Look over the list of adjectives (from your TD) that can help you describe its performance. Listen and put them in the table below according to their stress pattern:

TIP! Follow the link https://tinyurl.com/yckvbw5s to listen to the list of the adjectives or use the QR-code:

Efficient, dependable, solid, predictable, powerful, meaty, smooth, compact, vibration-free.

O	oO	Oo	Ooo	oOo	oOoo

Task 4.2 *Replace the definitions provided in bold with the appropriate adjectives from Task 1 or your TD.*

1. These rotors were designed utilizing the latest developments in iron formulation technology using our blend ferrous alloy to bring you the strongest, lightweight, most **you can have confidence in it** rotor available in the market place.
2. Every vehicle should be equipped with long-lasting, durable, and **work well without wasting time, money, or energy** brake pads.
3. **Hard or firm, with a fixed shape, and not a liquid or gas** brake rotors are made from a single piece of material, usually, cast iron.
4. There are so many other cars on the market with more **behaving in a way that you expect** brakes.
5. A powerful car such as the BMW 325e requires a **very effective and can do a lot** brake booster**.**

6. To keep the car in top shape during all your Formula Series races, the cars are fitted with some serious tires, and **large or having a lot of flesh** brakes***.***

7. Those who live in areas that use salt and brine on the roads should install **able to protect the material from corrosion** brake components.

8. StopTech sells quiet and **without vibration** pads that can work on any truck.

9. The 2021 Volvo XC60 Recharge comes with responsive and **with no sudden movements** brakes.

10. 75-Series master cylinders kits are designed for applications where space limitations require a **using very little space** master cylinder***.***

Task 4.3 *Look over the pros and cons of ceramic and metallic pads. In pairs, compare these types of brake pads using the following phrases and the adjectives from Task 4.1 or your TD:*

more +adjective / adjective + -er than
_____is as + adjective + as _____
_____is not so / as + adjective + as _____
*Both **A** and **B** have _____*
*Unlike **A**, **B** has_____*
***A** (offers) _____, whereas **B** (offers) _____*
*Compared to **A**, **B** _____*
*As opposed to **A, B** _____*

CERAMIC BRAKE PADS	*METALLIC BRAKE PADS*
PROS	
1. keep the performance of your car very strong, even after you've made a large number of hard stops; 2. very resilient and do not break down when you use them repeatedly; 3. produce significantly less dust than other types of brake pads; 4. quiet; 5. durable.	1. significantly less expensive; 2. less likely to cause damage to the rotors; 3. work very effectively, with an effective grip even during cold weather; 4. will give you high-quality performance; 5. both durable and cost-effective.
CONS	
1. very expensive (you can typically expect to pay an additional 50% for ceramic brake pads); 2. make for more wear and tear on rotors than the metallic ones do.	1. heavy (this can have a minor impact on how much fuel your car uses while you are driving). 2. do not last as long as the ceramic ones do. 3. give rise to dust that is more likely to stick to the wheels of your car than the dust generated by ceramic brake pads; 4. loud, which can impact your driving experience.

Task 4.4 *Work with a partner and prepare a 5-minute presentation about the best currently available car brakes. Give you presentation to the group.*

TIP! You can follow the link https://tinyurl.com/mwhmk2fw to find some useful information to make you presentation or use the QR-code:

Lesson 5. HISTORY OF THE BRAKING SYSTEM

Task 5.1 *Look over the list of the breakthrough inventions in the automotive industry. Listen and put them in the order you hear them.*

TIP! Follow the link https://tinyurl.com/2p9c5jvy to listen to the list of the breakthrough inventions or use the QR-code:

A power brake booster, a twin piston master cylinder, an anti-lock brake system (ABS), brake pads, disk brakes, drum brakes, drum linings, hydraulic brakes.

Task 5.2 *Use you TD to help you match the breakthrough inventions in the automotive industry with their developers.*

1. drum brakes	a) Herbert Frood
2. disk brakes	b) Malcom Locheed
3. brake pads and drum linings	c) William Lanchester
4. hydraulic brakes	d) Albert Dewandre
5. a power brake booster	e) Cadillac engineers
6. a twin piston master cylinder	f) Mario Palazzetti
7. ABS system	g) Louis Renault

Task 5.3 *Carry out research on the Internet to add some information to the timeline (https://tinyurl.com/4wjjyb98). Present your timeline to your groupmates and describe the developments in the automotive industry you have added.*

UNIT 4. STEERING SYSTEM

Introduction

Introductory Tasks. *Follow the link https://tinyurl.com/mwjnuwea to complete tasks 1-6 or use the QR-code:*

Follow the link https://tinyurl.com/vwyvdb9n to download the Term Dimensions file or use the QR-code:

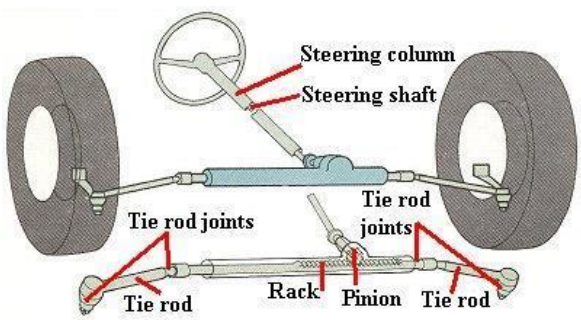
Lesson 1. STEERING SYSTEM DESIGN AND OPERATION

Task 1.1 *As an automotive engineer, you should know how a steering system operates. Read the text below and underline the terms that denote components of a steering system. Add the missing terms to your TD.*

TIP! Follow the link https://multidict.net/cs/10379 to read the "STEERING SYSTEM DESIGN AND OPERATION" text on Clilstore or use the QR-code:

STEERING SYSTEM DESIGN AND OPERATION

In order to transmit the steering movements of the driver to the wheels, several components are required. The steering movement is transmitted by a steering wheel, a steering shaft, a gear and linkages to the front wheels. The rotational movement of the steering wheel is transmitted via the steering shaft to the steering pinion in the steering gear. The steering shaft is supported in the steering column, which is fixed to the vehicle body.



The steering gear translates (reduces) the steering force applied by the driver. It also converts the rotational movement of the steering wheel into push or pull movements of the tie rods. The converted movement is transmitted to the linkage, which in turn moves the wheels in the desired steering direction. Tie rods are required to transmit the steering movement from the steering gear to the front wheels. Different tie rods are used depending on the type of the front axle.

In rack and pinion steering, the steering rack housing generally contains a helically toothed pinion, which meshes with the rack. By turning the steering wheel and hence the pinion, the rack is displaced transversely to the direction of travel. A spring-loaded pressure pad presses the rack against the pinion. For this reason, the steering gear always functions without backlash. At the same time, the sliding friction between the pressure pad and the rack acts as a damper to absorb road shocks. Advantages of rack and pinion steering include the shallow construction, a very direct steering, good steering return and the low cost of manufacture.

When a driver rotates the steering wheel, the shaft rotates along with it. This, in turn, rotates the pinion which is on top of the rack. The rotation of the pinion makes the rack move linearly, moving the tie rod. The tie rod connected to the steering arm then causes the wheel to turn.

Task 1.2 *Use the information in the text (Task 1.1) and your TD to restore the phrases that can help you describe the steering system components:*

a) steering + NOUN (5 phrases);
b) the steering / rotation / converted movement+ VERB;
c) VERB + the steering wheel / the pinion.

Task 1.3a *To explain how a steering system works, you need to know the terms, which denote the components involved in its operation.*

Look over the list of automotive terms. Circle the terms referring to steering system components.

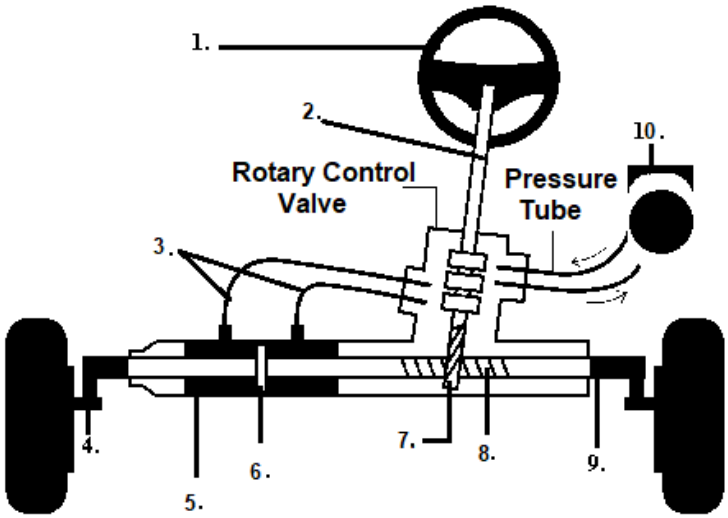
A steering wheel, a master cylinder, a steering shaft, a steering gear, a rack & pinion gear, a calliper, tie rods, tie rod ends, a bellow, contact-breaker points, steering knuckles, ball joints, brake pads, a fluid reservoir, power steering hoses, a hydraulic piston, a power steering pump, a coil.

Task 1.3b *Put the following terms in the order you hear them:*

TIP! Follow the link** https://tinyurl.com/yckjtjp8 **to listen to the list of the terms or use the QR-code:

A steering wheel, a steering shaft, a steering gear, a rack & pinion gear, a tie rod, a tie rod end, a bellow, a steering knuckle, a ball joint, a fluid reservoir, a power steering hose, a hydraulic piston, a power steering pump.

Task 1.3c *Label the unmarked steering system parts in the picture using the information in the text (see Task 1.1) and your TD:*



Task 1.4a *Watch a professional review and restore its script by filling in the gaps with the verbs (in the active or passive voice) describing the actions of the steering system parts.*

TIP! Follow the link to watch the review *https://tinyurl.com/23bkbc9a* ***or use the QR-code:***

The driver's input from the steering wheel 1._____ to the steering rack and pinion via the steering shaft. The rotation 2. _____ to horizontal movement by the steering rack and pinion. Most vehicles 3. _____ hydraulic fluid pressurized by a power steering pump to provide assistance to the driver in turning the wheels. A small valve in the steering rack 4. _____ the pressurized fluid according to which direction the driver is trying to turn the wheel. Tie rods and tie rod ends 5. _____ the steering rack and pinion to the wheels on the vehicle. As the steering rack and pinion 6. _____ left and right, the angle of the wheels changes. Some steering components can be adjusted to ensure that all four wheels are aligned correctly. Regular alignment checks help to prevent premature tire wear.

Task 1.4b *Add the verbs you inserted (Task 1.4a) to your TD. Connect them and the steering system components (from the blue segment of your TD) performing the actions these verbs describe.*

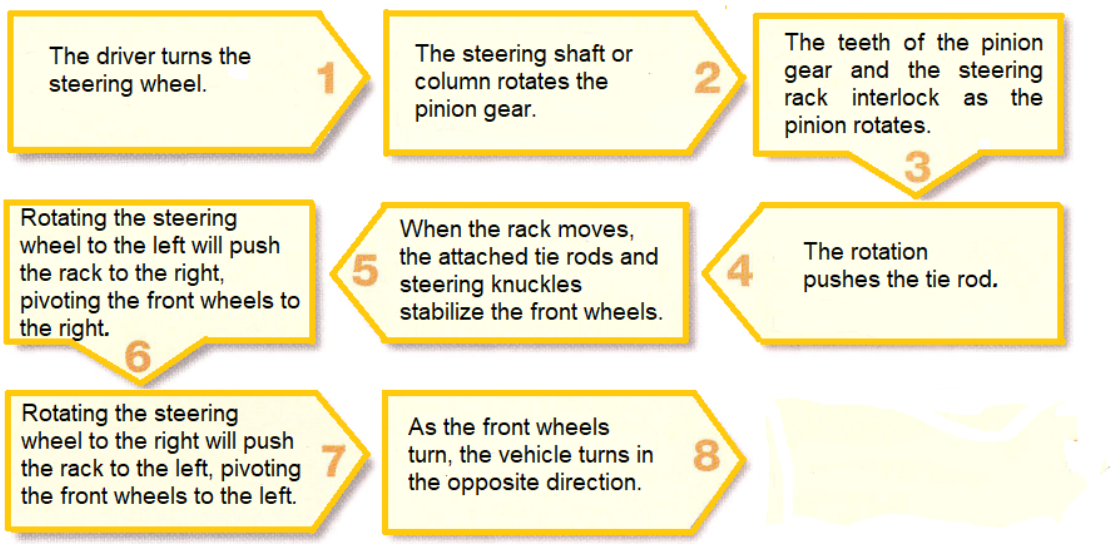
Task 1.5a *Replace the underlined verbs, which denote the actions of the engine parts, with their synonyms using the following list of words:*

compress	attach	transport	enable
equip	influence	hold	secure

1. A steering arm is connected to the car frame via a roller bearing.
2. A tie rod is fitted with rod ends or ball joints to allow for turning and suspension motion.
3. Power steering hoses carry the fluid from the pump to the power steering rack.
4. Steering rack bellows protect the steering rack and the inner tie rod ends from dirt, moisture and other contaminants.
5. The power-steering pump pressurizes the hydraulic fluid that helps the driver turn the steering wheel.
6. Tie rod ends push and pull tires, they directly affect stability of control, safety, and tire use life.
7. The steering knuckle is the pivot point of the steering system, which allows the wheels to turn.
8. The steering gearbox contains the gears that transmit the driver's steering inputs to the steering linkage that turns the wheels, it multiplies the driver's steering changes so that the front wheels move more than the steering wheel.

Task 1.5b *Add the verbs from the list (Task 1.5a) to the red segment of your TD. Connect them and the steering system components, performing the actions these verbs describe.*

Task 1.6 *Study the diagram. Use the information in the text (see Task 1.1) and your TD to identify 5 words that are used incorrectly.*



Task 1.7 *Student A: You are a professional engineer invited to deliver a lecture at a university. Study the steering system simulation and describe its operation to the students using the simulation.*

TIP! Follow the link to watch the simulation *https://tinyurl.com/yc343yu5* ***or use the QR-code:***

Student B: You are a student. You are going to listen to the lecture on the steering system delivered by a professional engineer. Prepare 10 questions concerning its operation you would like to know the answers to. Listen to the lecture. At the end of the lecture, ask the questions that haven't been answered by the lecturer.

Lesson 2. STEERING SYSTEM MAITENANCE

Task 2.1a *As an automotive engineer, you should be able to provide car owners with the guidance on keeping their steering system in the best condition.*

Listen to 4 descriptions that will help you explain why steering system parts need to be regularly inspected. Match them with the pictures (a-d).

TIP! Follow the link to listen to the descriptions *https://tinyurl.com/2p8fu8f6* ***or use the QR-code:***

a) power steering hose	b) power steering fluid	c) power steering filter	d) tie rods
			

Speaker:	1.	2.	3.	4.

Task 2.1b *Listen again and restore the phrases that will help you develop the guidance:*

a) VERB + a hydraulic link;
b) VERB + the amount of effort required;
c) VERB + the moving parts;
d) VERB + any metal particles;
e) VERB + catches any small impurities / minute fluid contaminants;

f) VERB + as the pivot point;
g) VERB + the steering pump to the rack-and-pinion
h) steering +NOUNx5.

Task 2.1c *Use the information from the chart below, tasks 2.1a and 2.1b, and your TD to create the guidance giving essential tips on keeping the steering system in the best condition. Explain: 1) what steering system parts should be checked; 2) how often they should be checked and 3) why it's a good idea to check them. Use the following phrases:*

- It's generally best/a good idea to...
- One thing you should/have to do is to...
- The best/most important thing (to do) is to ...
- The main recommendation is/would be…

Maintenance Interval	Number of month or kilometers (miles), whichever comes first								
	Months	6	12	18	24	30	36	42	48
	x1000 km	12	24	36	48	60	72	84	96
	x1000 miles	7.5	15	22.5	30	37.5	45	52.5	60
STEERING SYSTEM									
Power steering fluid	Replace every 48,000 km (30,000 miles)								
Fluid reservoir		D		D		D		D	
In-line filter		R		R		R		R	
Guidelines for tie rods	Lubricate every 40,000 km (25,000 miles)								
Hydraulic hoses and connections	I	I	I	I	I	I	I	I	

Chart symbols: D: Drain; R: Replace; I: Inspect

Lesson 3. SYMPTOMS AND CAUSES OF STEERING COMPONENTS FAULTS

Task 3.1 *A qualified automotive engineer is able to explain the symptoms and causes of steering system faults.*

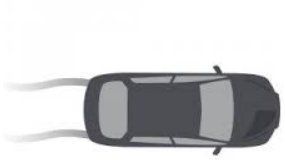
Read the text below and use the information in the text and your TD to restore the phrases that will help you create an infographic for car owners to detect defective brakes:

a) steering + NOUN (x 4 phrases);
b) power steering +NOUN (x 3 phrases);
c) a worn / faulty + NOUN;
d) a loose / worn + NOUN;
e) screeching / grinding + NOUN;
f) to fix / to indicate a +NOUN.

WARNING SIGNS OF STEERING PROBLEMS

Unlike some mechanical problems, steering problems generally give you plenty of warning signs that something is wrong, and they persist until the problem is fixed or the system fails.

Ignoring these signs could result in an accident, so if your steering is exhibiting any of the following symptoms, take it to a mechanic for inspection and repair:



#1. The vehicle wanders or pulls to one side. This often indicates a problem with a worn steering gear. Premature steering gear wear can be caused by a lack of lubrication from power steering fluid, so you should also check for any power steering leaks when replacing a worn steering gear.

#2. Excessive play in the steering wheel can also point to a worn or faulty steering gear. If you have to turn the steering wheel more than an inch before the wheels begin to turn, then you can be fairly certain there is a problem with the steering gear.

#3. Grinding noise when turning the steering wheel. This is another indication of a steering gear problem.

#4. Screeching noise when you turn the wheel. This is often caused by a loose or worn power steering belt. This is the belt that connects the power steering pump to the engine. The screeching noise could also be a symptom of low power steering fluid levels, as mentioned before.

#5. Foaming or discoloured power steering fluid. This indicates that air or water has got into the system and the fluid is not lubricating the components properly.

Staying alert for any of the warning signs mentioned above, you will have a much better chance of finding and fixing a steering problem before it becomes costly and dangerous.

Task 3.2 *Follow the link https://tinyurl.com/mpcft4ht to view the "How to identify the power steering fluid requirements in Mercedes" infographic. Use it as an example to create the infographic to help car owners detect faulty ignition system components. Include the information about: 1) each steering system element function; 2) the symptoms of its malfunction; 3) the causes of its malfunction; 4) your recommendations.*

You can use https://app.genial.ly/templates/infographics or any other tool to create your infographic.

Lesson 4. ASSESSMENT OF THE STEERING SYSTEM

Task 4.1 *As an automotive engineer, you will assess the steering system performance and safety.*

Look over the list of adjectives (from your TD) that can help you describe steering system performance. Listen and put them in the table below according to their stress pattern:

TIP! Follow the link to listen to the list of the adjectives *https://tinyurl.com/28pr5hft* ***or use the QR-code:***

Conventional, responsive, reliable, sturdy, durable, smooth, consistent, excellent, adaptive, state-of-the-art, innovative, advanced.

O	Oo	oO	Ooo	oOo	oOoo	Oooo	oooO
							1.

Task 4.2 *Replace the definitions provided in bold with the appropriate adjectives from Task 4.1 or your TD.*

1. A self-driving car needs a **strong, well-made, and not easily broken** steering system.
2. A **happening or operating successfully, without any problems** steering system can make for a safe and easy driving experience.
3. Adaptive steering is a technologically **very modern** steering system that uses sensor input from different sources to essentially “adapt” the steering to the driver and the road conditions.
4. As the name suggests, an **having an ability to change to suit changing conditions** steering system adjusts the steering ratio of a vehicle to adapt to changing conditions.
5. Champion Full Synthetic Racing Power Steering Fluid reduces temperature and delivers **always behaving in the same way** steering response.
6. Ford will also offer a Performance Package, which will include upgraded brake pads, 20-inch wheels, an even tighter and more **reacting quickly** electronic steering system.
7. Hyundai Mobis has succeeded in developing a **using the most modern and recently developed methods, materials, or knowledge** steering system that keeps the steering wheel safe in any situation during autonomous driving.
8. The **new, different, and better than those that existed before** steering system from Nabtesco @ Adcos will open up entirely new possibilities in the development of pioneering transport concepts for the commercial vehicle sector.
9. The **used for a long time and is considered the usual type** steering system has the following components: a steering gearbox, a pitman

arm, a steering column, a steering wheel, an idler arm, a track rod, a steering knuckle, and tie rods.

10. The **extremely good or of very high quality** steering system allows you to drive without much effort on different types of road surfaces.

11. This Tie Rod Kit will completely eliminate factory weak points and give you a solid and **can be trusted or depended on** steering system**.**

12. To sustain a **staying in good condition for a long time** steering system, gearboxes are made of tough and sturdy material.

Task 4.3 *Look over the pros and cons of rack-and-pinion steering and recirculating-ball steering below and compare them using the following phrases and the adjectives from Task 4.1 or your TD:*

more +adjective / adjective + -er than
_____is as + adjective + as _____
_____is not so / as + adjective + as _____
Both X and Y have _____
Unlike X, Y has_____
X (offers) _____, whereas Y (offers) _____
Compared to X, Y _____
As opposed to X, Y _____

Rack-and-Pinion Steering	***Recirculating-Ball Steering***
PROS	
1. its simplicity: it has only two moving parts; 2. the positive engagement of the system gives a very tight and responsive feel to the steering; 3. has only four wear points in the linkage: the inner ball joints and outer tie rod ends; 4. quite light; 5. offers extra clearance for headers and it is easier to package it into the car.	1. offers more steering travel; 2. less expensive, perfect for someone on a budget; 3. it is easy to install it as an upgrade.
CONS	
1. due to the limitations on the number of teeth that can be cut into the rack, there is typically less steering travel available; 2. it is hard to retrofit an older car with it; 3. quite expensive.	1. consists of many wearable moving parts; 2. less efficient; 3. quite heavy.

Task 4.4 *Work with a partner and prepare a 5-minute presentation. Compare hydraulic and electric power steering. Give you presentation to the group.*

TIP! You can follow the link https://tinyurl.com/2msvd8ue to find some useful information to make you presentation or use the QR-code:

Lesson 5. HISTORY OF THE STEERING SYSTEM

Task 5.1 *Look over the list of the breakthrough inventions in the automotive industry. Listen and put them in the order you hear them.*

TIP! Follow the link *https://tinyurl.com/4u6xacfb* ***to listen to the list of the list of the breakthrough inventions or use the QR-code:***

The first stub axle steering system, a steering wheel, the original tilt wheel, the first power steering system, the first rack and pinion gearbox, rod end bearings, a recirculating ball and nut steering gear, a variable rack, multifunction steering wheels.

Task 5.2 *Use you TD to help you match the breakthrough inventions in the automotive industry with their developers.*

1. the original tilt wheel	a) Alfred Vacheron
2. the first power steering system	b) Rudolf Ackermann
3. recirculating ball and nut steering gear	c) BMW engineers
4. the first stub axle steering system	d) Arthur Ernest Bishop
5. the first rack and pinion gearbox	e) Francis W. Davis
6. the variable rack	f) Edward James Lobdell
7. the earliest known use of a steering wheel	g) General Motors engineers

Task 5.3 *Carry out research on the Internet to add some information to the timeline (https://tinyurl.com/mwjnuwea). Present your timeline to your groupmates and describe the developments in the automotive industry you have added.*

UNIT 5. SUSPENSION SYSTEM

Introduction

Introductory Tasks. *Follow the link https://tinyurl.com/2p94jazk to complete tasks 1-6 or use the QR-code:*

Follow the link https://tinyurl.com/vwyvdb9n to download the Term Dimensions file or use the QR-code:

Lesson 1. SUSPENSION SYSTEM DESIGN AND OPERATION

Task 1.1 *As an automotive engineer, you should know how a suspension system operates. Read the text below and underline the terms that denote components of a suspension system. Add the missing terms to your TD.*

TIP! Follow the link https://multidict.net/cs/10389 to read the "SUSPENSION SYSTEM DESIGN AND OPERATION" text on Clilstore or use the QR-code:

SUSPENSION SYSTEM DESIGN AND OPERATION

The key components of a suspension system are springs, dampers, and stabilizer bars.

The components of the suspension system, while important separately, must operate as a whole for the system to meet all of the requirements during normal driving conditions.

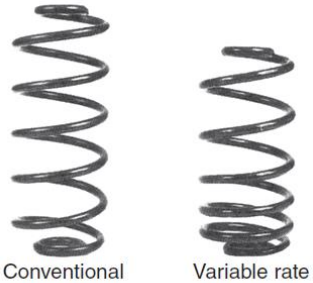


Fig. 1 Two types of coil springs

The springs in the suspension have two important functions. Springs support the vehicle weight and absorb the bumps and movements that occur when driving. There are four types of springs used in suspension systems.

Used on most front and many rear suspensions, coil springs are large pieces of round steel formed into a coil (Fig. 1). The spring absorbs energy as the coils are

forced closer together. This is called compression. The stored energy is released when the coil extends back out. The energy continues to dissipate as the spring bounces. Eventually, the energy is exhausted and the spring stops bouncing. Coil springs are compact and do not need maintenance. When the spring becomes fatigued or weak, the ride height will drop, and the spring will need to be replaced.

Leaf springs are long curved pieces of flattened steel and are used on the rear of many vehicles (Fig.2). Leaf springs are typically mounted to the rear axle and the frame. A leaf spring is a long, flat piece of spring steel, shaped into a semicircle. The spring is attached to the frame through a shackle or bracket assembly that permits changes in the effective length of the spring as it is compressed. To carry heavier loads, additional leaves can be stacked below the master leaf. Increasing the number of leaves increases load-carrying capacity but makes the ride stiffer.

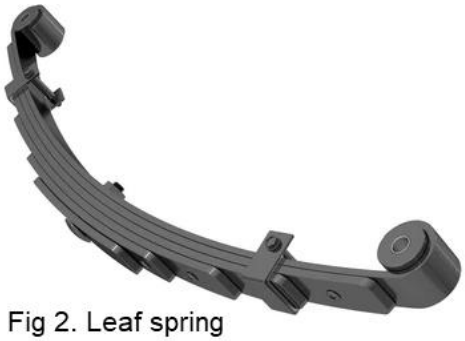


Fig 2. Leaf spring

Shock absorbers are actually dampers, meaning that they reduce or make something less intense. The springs do the shock absorbing while the shocks dampen the spring oscillations. Without the dampers, vehicles would continue to bounce for a long time after every bump, dip, and change in body movement. The most common type of damper is the direct double-acting hydraulic unit. This means that they are used to directly act on the motion; double-acting means that they work in both compression and extension modes, and hydraulic means that fluid is used to perform work. Dampers are typically mounted near the springs, with the lower end mounted on a lower control arm or axle.


Fig.3 Rear Damper

Control arms are used to control wheel movement. Used on both front and rear suspensions, they are commonly referred to by their position, such as the upper and lower control arms.

Stabilizer bars, also called sway bars or anti-roll bars, reduce body roll (Fig. 4). These steel bars attach to the lower control arms or axle assembly and the body or frame. When the vehicle body starts to lift while cornering, the bar tries to move with the body. Because the outer ends of the stabilizer bar are connected to the control arms or axle, and the control arms cannot move upward, it forces the stabilizer bar to pull the body back down, limiting body roll.


Fig.4 Stabilizer bar

Task 1.2 *Use the information from the text (see Task 1.1) and your TD to restore the phrases that can help you describe the suspension system components:*

a) a NOUN + spring (x2 phrases);
b) VERB + the vehicle weight;
c) VERB + the bumps / energy;
d) VERB + maintenance;
e) VERB + the spring oscillations;
f) front / rear +NOUN;
g) VERB + wheel movement;
h) VERB + body roll (x2 phrases).

Task 1.3a *To explain how a suspension system works, you need to know the terms, which denote the components involved in its operation.*

Look over the list of automotive terms. Circle the terms referring to suspension system components.

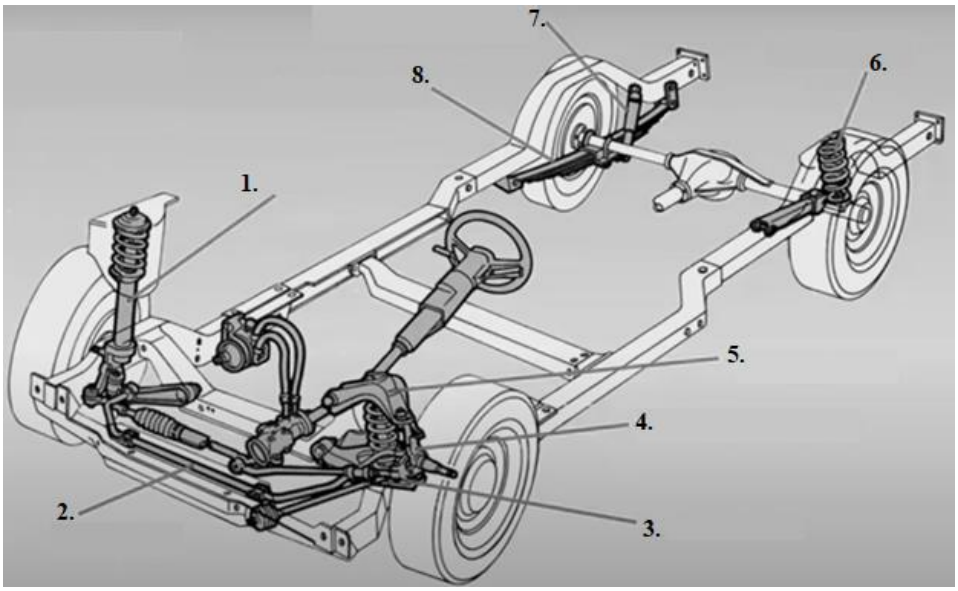
A stabilizer, a master cylinder, a coil spring, a steering knuckle, a calliper, contact-breaker points, a control arm, an intake valve, ball joints, brake pads, a strut, a torsion bar, a fluid reservoir, a hydraulic piston, a leaf coil, a shock absorber.

Task 1.3b *Put the following terms in the order you hear them:*

TIP! Follow the link to listen to the list of the terms *https://tinyurl.com/2p8rv5m3* ***or use the QR-code:***

A stabilizer, ball joints, a steering knuckle, a control arm, a coil spring, a shock absorber, a leaf spring, a strut, bushings, a torsion bar, an air spring.

Task 1.3c *Label the unmarked suspension system parts in the picture using the information in the text (see Task 1.1) and your TD:*



Task 1.4a *Watch a professional review and restore its script by filling in the gaps with the verbs (in the active or passive voice) describing the actions of the suspension system parts.*

TIP! Follow the link to watch the review *https://tinyurl.com/4aveya9t* ***or use the QR-code:***

The suspension 1._____the frame of a vehicle to the wheels. It 2._____ to the handling characteristics of the vehicle and the comfort of the passengers. The springs and struts or shock absorbers 3._____ bumps on the road and 4. _____ the body of the vehicle stable under braking and acceleration. Control arms, control arm bushings, and ball joints 5. _____ the wheels to 6. _____up and down. The wheel bearing, hub and knuckle assembly 7._____the wheel to the control arm. Suspension setups can differ greatly between cars, but the most commonly used suspension geometry is a Macpherson strut setup. The strut is an integrated damper or shock absorber and spring assembly. The top of the strut is bolted to the frame of the vehicle, with the bottom of the strut attached to the top of the steering knuckle. The lower end of the steering knuckle is attached to a lower control arm, and the control arm 8. _____ up and down as the strut 9._____ and 10**.**_____. As manufacturers constantly work to improve ride and handling characteristics suspension systems become more complex. Many vehicles now use multiple suspension links instead of a single lower control arm.

Task 1.4b *Add the verbs you inserted (Task 1.4a) to your TD. Connect them and the suspension system components (from the blue segment of your TD) performing the actions these verbs describe.*

Task 1.5a *Replace the underlined verbs, which denote the actions of the engine parts, with their synonyms using the following list of words (Sometimes 2 variants are possible):*

reduce	provide	maintain	raise
decrease	join	enable	dampen

1. The main job of a car suspension system is to ensure that there is maximum friction between the tyres and the surface of the road, to give steering stability with good handling, and to ensure the comfort of the passengers.
2. Springs absorb the various shocks generated from road friction with car wheels. They also help increase the wheels' traction on the road.
3. A shock absorber dampens up and down movements or oscillations caused by springs that absorb various shocks or vibrations from the road surface.

4. Dampers slow down and reduce the magnitude of vibratory motion by turning kinetic energy into heat energy to be dissipated through hydraulic fluid.

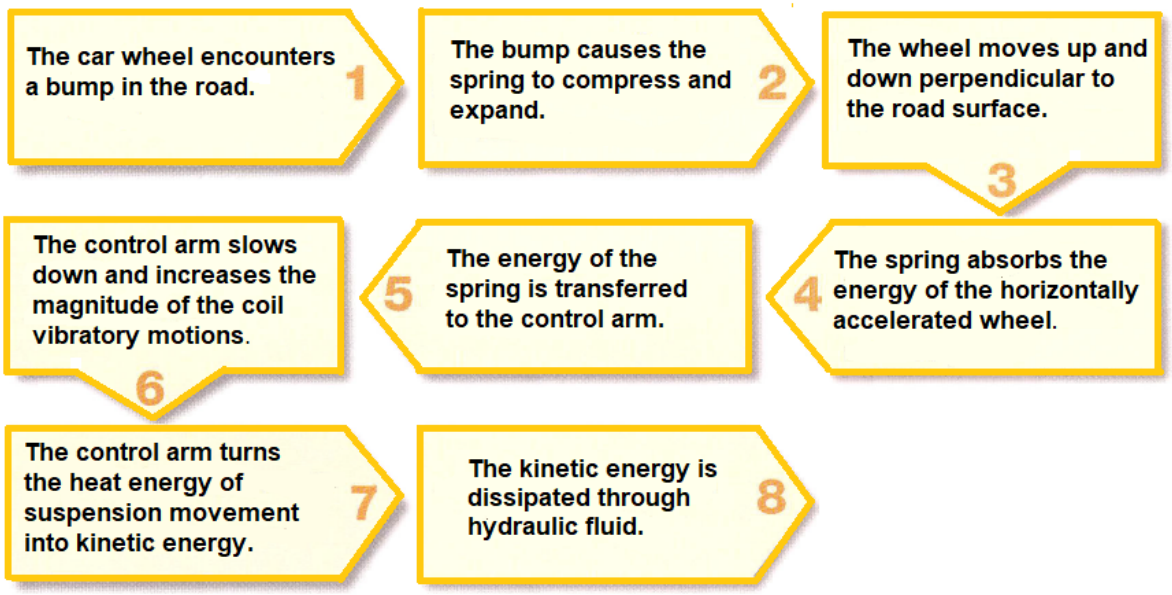
5. The stabilizer bar is a car suspension component that keeps body balance when the car turns.

6. Control arms connect the steering knuckle to the car body.

7. A strut assembly allows the tyre and wheel to move upwards and downwards.

Task 1.5b *Add the verbs from the list (Task 1.5a) to the red segment of your TD. Connect them and the suspension system components, performing the actions these verbs describe.*

Task 1.6 *Study the diagram. Use the information in the text (see Task 1.1) and your TD to identify 8 words that are used incorrectly.*



Task 1.7 *Student A: You are a professional engineer invited to deliver a lecture at a university. Study the suspension system simulation and describe its operation to the students using the simulation.*

TIP! Follow the link to watch the simulation *https://tinyurl.com/4z789a7d* ***or use the QR-code:***

Student B: You are a student. You are going to listen to the lecture on the suspension system delivered by a professional engineer. Prepare 10 questions concerning its operation you would like to know the answers to. Listen to the lecture. At the end of the lecture, ask the questions that haven't been answered by the lecturer.

Lesson 2. SUSPENSION SYSTEM MAITENANCE

Task 2.1a *As an automotive engineer, you should be able to provide car owners with the guidance on keeping their suspension system in the best condition.*

Listen to 4 descriptions that will help you explain why suspension system parts need to be regularly inspected. Match them with the pictures (a-d).

TIP! Follow the link to listen to the descriptions *https://tinyurl.com/2p8fu8f6* ***or use the QR-code:***

a) wheel bearing	b) wheel alignment	c) shock absorbers	d) ball joints
			

Speaker:	1.	2.	3.	4.

Task 2.1b *Listen again and restore the phrases that will help you develop the guidance:*

a) VERB + an excessive bouncing;
b) VERB + pivoting movement;
c) VERB + in causing a loss of control of the vehicle;
d) VERB + unnecessary wear;
e) VERB + driving stability;
f) VERB + tyre life;
g) VERB + handling performance;
h) VERB + the wheel and the axle;
i) VERB + severe consequences.

Task 2.1c *Use the information from the chart below, tasks 2.1a and 2.1b, and your TD to create the guidance giving essential tips on keeping the suspension system in the best condition. Explain: 1) what suspension system parts should be checked; 2) how often they should be checked and 3) why it's a good idea to check them. Use the following phrases:*

- It's generally best/a good idea to...
- One thing you should/have to do is ...

- The best/most important thing (to do) is to ...
- The main recommendation is/would be…

Maintenance Interval	Number of month or kilometers (miles), whichever comes first								
	Months	6	12	18	24	30	36	42	48
	x1000 km	12	24	36	48	60	72	84	96
	x1000 miles	7.5	15	22.5	30	37.5	45	52.5	60
SUSPENSION SYSTEM									
Shock absorbers or struts	Replace 50,000 and 100,000 miles								
Ball joints					I				I
Wheel bearing axial play					I				I
Wheels	Align every 6,000-10,000 miles								
Tyre tread depth	Check every 1,000 miles								

Chart symbol: I: Inspect

Lesson 3. SYMPTOMS AND CAUSES OF SUSPENSION FAILURE

Task 3.1 *A qualified automotive engineer is able to explain the symptoms and causes of suspension system faults.*

Read the text below and use the information in the text and your TD to restore the phrases that will help you create an infographic for car owners to detect suspension failure:

a) VERB + driving comfort;
b) VERB + traction;
c) VERB + to one side;
d) VERB + evenly;
e) NOUN + of wear or damage;
f) over- or underinflated + NOUN;
g) VERB + more than three times;
h) a + NOUN + with your shock absorbers;
i) VERB + for leaks of the fluid;
j) a knocking / creaking / squealing + NOUN;
k) VERB + over bumps.

WARNING SIGNS OF SUSPENSION FAILURE

Your suspension system works hard to ensure driving comfort by smoothing out the bumps in the road and providing traction by keeping the wheels on the ground as much as possible. But how can you tell if something is wrong with your suspension? Here are some common signs of suspension problems.

#1. Pulling to one side when driving

If you notice your car is pulling to one side or the other while you're driving, the problem lies with your tyres, your shock absorbers or your brakes. Tyres need to be precisely aligned to ensure a smooth ride. Take a look at your tyre

treads to see if they are wearing evenly, and check that the tyres are correctly inflated, as over- or under-inflated tyres can impact your stability while driving. If the problem continues after you have checked your tyres, take a look at your suspension system. Try to spot some signs of wear or damage on your shock absorbers, ball joints or control arms.

#2. Feeling every bump

One of the main roles of the suspension system is to smooth out the bumps on the road. If you start to feel every bump on the road, it's a clear sign that there is a problem with your shock absorbers or struts, that needs to be checked. An easy check is the bounce test. Simply push your entire weight down on your car's bonnet. Release and count the number of times the car bounces. If it bounces more than three times, then there is a problem with your shock absorbers or struts. An alternative test depends on whether your car has shock absorbers or struts. If your car has shock absorbers, look for leaks of the fluid that helps dampen the bouncing. And if your car has struts, listen for a knocking sound when you drive over bumps.

#3. One corner sits low

If you notice that one corner of your car seems to be a lot lower than the others, there's a good chance you have a worn or damaged spring. You may also notice a clunking noise as you drive over bumps or a deep pothole. To check this, first, ensure your tyres are correctly and equally inflated. If one corner still seems to sag, push your entire weight down on the boot of the car and listen to how the suspension reacts. A creaking or squealing sound will confirm that you need to get your suspension checked.

Task 3.2 *Follow the link https://tinyurl.com/kffbrr5h to view the "Signs that indicate the ball joints of my Audi are bad" infographic. Use it as an example to create the infographic to help car owners detect faulty ignition system components. Include the information about: 1) each suspension system element function; 2) the symptoms of its malfunction; 3) the causes of its malfunction; 4) your recommendations.*

You can use https://app.genial.ly/templates/infographics or any other tool to create your infographic.

Lesson 4. ASSESSMENT OF THE SUSPENSION SYSTEM

Task 4.1 *As an automotive engineer, you will assess the suspension system performance and safety.*

Look over the list of adjectives (from your TD) that can help you describe suspension system performance. Listen and put them in the table below according to their stress pattern:

TIP! Follow the link to listen to the list of the adjectives *https://tinyurl.com/5n863p22* ***or use the QR-code:***

Unique, advanced, reliable, sophisticated, adaptive, innovative, ingenious, standard, powerful, complex (the 1st syllable is stressed).

Oo	oO	Ooo	oOo	oOoo	Oooo	oOooo

Task 4.2 *Replace the definitions provided in bold with the appropriate adjectives from Task 4.1 or your TD.*

1. The company has revealed details about the model's **using new methods or idea** suspension system that will make the ride extremely smooth.
2. A **usual rather than special** suspension system uses springs, shocks, and control arms to mitigate imperfections in the road.
3. Eibach Sportline is an extremely **very effective and can do a lot** suspension system that was specially designed for enthusiastic motorsport fans who are looking for racing car performance for the road and with minimal loss of comfort and maximum driving quality.
4. This model has precisely-engineered aerodynamics, sporty exterior trim, and a **unusually good and special** suspension system that offers enhanced performance.
5. An **very modern** suspension system refers to a system that is useful for adjusting and managing the vertical movement of the automobile by tuning the vehicle's height and dampeners to the road conditions.
6. BMW offers a seductive V12 engine, while the S8 has the most **made in a complicated way and therefore able to do complicated tasks** suspension system Audi has ever designed for a production car.
7. The **having an ability to change to suit changing conditions** suspension system can even help improve safety, according to Audi: if the system detects an impending side impact at speeds above 15.5 mph, it will automatically raise the body on the side of the impact by up to 3.1 inches.

8. A **can be trusted or depended on** suspension system will offer improved fuel efficiency, less maintenance and well not damage your tyres.

9. The road car has an **skilfully made or planned and involving new ideas and methods** suspension system that uses a torsion bar and a coil spring in series to provide correct ride rates for normal use.

10. Nowadays cars have a **consisting of many different parts and often difficult to understand** suspension system that is either pneumatic (air type) or hydraulic (fluid type) or a combination of the two.

Task 4.3 *Look over the pros and cons of different suspension types and compare them using the following phrases and the adjectives from Task 4.1 or your TD:*

more +adjective / adjective + -er than
_____is as + adjective + as _____
_____is not so / as + adjective + as _____
*Both **A** and **B** have _____*
*Unlike **A**, **B** has_____*
***A** (offers) _____, whereas **B** (offers) _____*
*Compared to **A**, **B** _____*
*As opposed to **A, B** _____*

SOLID AXLES/BEAM AXLES used extensively on pickup trucks and 4×4 vehicles	
PROS	*CONS*
• solid axles are immensely strong and can handle the high weight and high engine torque; • simple and straightforward to repair	• not optimized for handling; • traction can be compromised when cornering; • the ride can be rough
DOUBLE-WISHBONE suitable for everything from regular passenger cars to racing vehicles	
PROS	*CONS*
• independent suspension system that could be optimized for handling; • the double-wishbone design allows for optimum adjustability and tire contact	• takes up a considerable amount of space; • multiple adjustments and multiple wear points add time and cost to repairs
MACPHERSON STRUT independent system where a lower control arm is connected to a combined damper assembly where the top pivot point of the damper is used to control motion at the top	
PROS	*CONS*
• a compact design and relatively few parts make this an efficient and cost-effective option	• limited adjustability and torque-steer in some more powerful front-wheel-drive applications
MULTI-LINK mostly found on European and higher-end vehicles	
PROS	*CONS*
• designed to maximize handling and ride comfort	• performance comes with added complexity and costs to maintain and repair; • the hardest to diagnose problems and the most challenging ones to fix

Task 4.4 *Work with a partner and prepare a 5-minute presentation about the best currently available suspension systems. Give you presentation to the group.*

TIP! You can follow the link to find some useful information to make you presentation *https://tinyurl.com/yndb5pct* ***or use the QR-code:***

Lesson 5. HISTORY OF THE SUSPENSION SYSTEM

Task 5.1 *Look over the list of the breakthrough inventions in the automotive industry. Listen and put them in the order you hear them.*

TIP! Follow the link to listen to the list of the list of the breakthrough inventions *https://tinyurl.com/2p8fyd88* ***or use the QR-code:***

The first shock absorber, the first stabilizer bar, the torsion bar suspension, the independent front suspension, the strut suspension, the double wishbone suspension, the multi-link suspension, the air suspension, the trailing arm suspension, the rigid axle suspension.

Task 5.2 *Use you TD to help you match the breakthrough inventions in the automotive industry with their developers.*

1. the first shock absorber	a) Stephen Coleman
2. the first stabilizer bar	b) Vincenzo Lancia
3. the torsion bar suspension	c) Earle MacPherson
4. the independent front suspension	d) Ferdinand Porsche
5. the strut suspension	e) Maurice Houdaille
6. the double wishbone suspension	f) Meredes-Benz engineers
7. the multi-link suspension	g) Packard Motor Car Company engineers

Task 5.3 *Carry out research on the Internet to add some information to the timeline (https://tinyurl.com/2p94jazk). Present your timeline to your groupmates and describe the developments in the automotive industry you have added.*

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