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Western Cape Education Department
Directorate: Curriculum FET

Mechanical Technology Automotive

REVISION BOOKLET

TERM 1

Grade 12

This revision program is designed to assist you in revising the critical content and skills covered during the 1st term. The purpose is to prepare you to understand the key concepts and to provide you with an opportunity to establish the required standard and the application of the knowledge necessary to succeed in the NCS examination.

The revision program covers the following topics:

Structure of question paper

Generic Topics

- Safety
- Materials

Specific Topics

- Tools
- Engines

There are also lessons on various grade 12 topics on the WCED e-Portal
(<https://wcedportal.co.za/>)

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Structure of question paper

QUESTION	CONTENT	MARKS	TIME in minutes
	GENERIC		
1	Multiple-choice questions	6	6
2	Safety	10	10
3	Materials	14	14
	SPECIFIC		
4	Multiple-choice questions	14	10
5	Tools and Equipment	23	20
6	Engines	28	25
7	Forces	32	25
8	Maintenance	23	20
9	Systems and Control (Automatic Gearbox)	18	20
10	Systems and Control (Axles, Steering Geometry and Electronics)	32	30
TOTAL		200	180

Instructions and Information

1. Read ALL the questions carefully.
2. Answer ALL the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Start EACH question on a NEW page.
5. Show ALL calculations and units. Round off final answers to TWO decimal places.
6. Candidates may use non-programmable scientific calculators and drawing instruments.
7. The value of gravitational acceleration should be taken as 10 m/s.
8. All dimensions are in millimetres, unless stated otherwise in the question.
9. Write neatly and legibly.
10. A formula sheet is attached at the end of the question paper.

Final examination: At the end of each academic year every learner is required to write a final examination, which is compiled in such a way that it represents the entire theoretical content covered throughout the year. The final examination paper accounts for 50% of the learner's promotion mark and is externally set, marked and moderated.

Formal assessments should cater for a range of cognitive levels and learners' abilities as shown below:

Cognitive Levels	Percentage of Task
Lower order: knowledge	30%
Middle order: comprehension and application	50%
Higher order: analysis, evaluation and synthesis	20%

Below is a table of Bloom's taxonomy indicating the action verbs and also gives you the cognitive level of the learners' ability. Learners need to expect different levels of questioning.

MECHANICAL TECHNOLOGY - BLOOM'S TAXONOMY: GRADE 12		
Low	Knowledge: memorize and recall information: arrange, define, label, list, outline, repeat, order	30%
	Comprehension: (understanding) — interpret information in one's own words: describe, indicate, restate, review, summarize, classify	
Medium	Application: apply knowledge to new situations: apply, calculate, draw, explain, identify, illustrate, prepare, operate, practice, solve, sketch, use	50%
	Analysis: breakdown knowledge into parts and show relationship among parts: analyse, categorize, compare, distinguish, discuss, examine, investigate, and test	
High	Synthesis: bring together parts of knowledge to form a whole; build relationships for new situation: arrange, compose, formulate, organize, plan, assemble, construct	20 %
	Evaluation: make judgments on basis of criteria: appraise, assess, comment on, critically analyse, evaluate, conclude, interrogate, judge, predict, compare, and score	

Mechanical Technology (Automotive) Grade 12 Revision pack

Term 1

There are previous NSC examination question papers and marking guidelines available online or ask your teacher to give them to you, either electronically or give you a hard copy so that you can familiarise yourself with the layout and work through them.

They are November 2018 until November 2022

QUESTION 1:

Various options are provided as possible answers to the following questions. This question requires you to choose the **one, correct** answer and write only the letter (A–D) next to the question numbers (1.1 to 1.6) in the ANSWER BOOK, e.g. 1.6 C.

Do not leave any one of these questions unanswered. If you are unsure, take an “intelligent guess” of the most likely possible answer.

Examples:

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.6) in the ANSWER BOOK, e.g. 1.6 C.

1.1 What is the purpose of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) with regard to HIV/Aids awareness?

- A **The Act on safety states that all employers must make sure that the workplace is safe and that employees are not at risk of becoming infected with HIV at work.**
- B The Act contains common guidelines on how employers, employees and trade unions should respond to HIV in the workplace.
- C Employers may not demote or promote an employee based on his/her HIV status.
- D Employers cannot simply dismiss a person who has HIV. (1)

1.2 Which ONE of the following items of personal protective equipment (PPE) is applicable when arc welding is performed on a work piece?

- A Hard hat
 - B Welding goggles
 - C Welding helmet**
 - D Face shield
- (1)

1.3 Who is responsible for the provision of safety equipment in the workplace?

- A Employer**
 - B Employee
 - C Customer
 - D Foreman
- (1)

1.4 Which ONE of the following properties of solid steel will change if the steel is subjected to a heat treatment process?

- A Length
 - B Hardness**
 - C Size
 - D Shape
- (1)

1.5 The purpose of normalising steel is to ...

- A harden.
 - B temper.
 - C harden the core.
 - D relieve internal stresses.**
- (1)

1.6 If a sound test is applied to high-carbon steel, which ONE of the following sounds will help one to identify the metal?

- A Loud and clear sound**
 - B Dull sound
 - C Soft ringing sound
 - D Low ringing sound
- (1)

[6]

Safety (Generic) Question 2

In this section, work through the content the things you need to know the are the following:

HIV/AIDS Awareness

Knowledge of basic First Aid measures

Analyse the OHS Act and regulations where applicable to the following machines:

- Grinding machines (portable, bench and surface)
- Cutting (drilling machines, power saw, band saw)
- Shearing machines (manual and power driven)
- Press machines
- Joining (arc, gas)
- Handling and usage of gas cylinders

Knowledge and application of basic workshop layouts:

- Process layout
- Product layout

Referring to the OHS Act analyse the responsibilities of the:

- Employer
- Employee

In this question you need to know the safety regulation regarding the safe use of tools and equipment

Examples

QUESTION 2: SAFETY (GENERIC)

2.1 State ONE important safety rule that should be adhered to before any machine in the mechanical workshop is switched on. (1)

2.2 Give ONE reason why you need to clamp down a small work piece before any drilling is done. (1)

2.3 State TWO safety rules you should observe before a hydraulic press is used. (2)

2.4 Give TWO reasons why you have to use surgical gloves when treating a co-worker with open wounds. (2)

2.5 State TWO safety precautions that must be taken into consideration for the safe handling of portable electrical equipment. (2)

2.6 State ONE responsibility of an employer regarding safety in the work place. (1)

2.7 State ONE responsibility of an employee regarding safety in the work place. (1)
[10]

Model answers

2.1 Machine safety rule:

Know how to switch the machine off / stop. ✓ (1)

2.2 Drill press safety precautions:

- To prevent injuries. ✓
- To improve accuracy.
- To prevent work piece rotating/moving ✓ (Any 1 x 1) (1)

2.3 Hydraulic press safety rules:

- Make sure the press is in a good working condition. ✓
- Take notice of the pre-determined maximum pressure of the hydraulic press. ✓
- Make sure the area around the press is clean and free of oil, grease and water. ✓
- Ensure that the platform is rigid and square to the cylinder. ✓
- Ensure that suitable jigs and prescribed equipment is available. ✓ (Any 2 x 1) (2)

2.4 Reasons for wearing surgical gloves:

- To prevent HIV/AIDS or any blood related infections being transmitted. ✓
- To prevent contamination of the open wounds. ✓ (2)

2.5 Safe handling of portable electrical equipment:

- Ensure the electrical cord is in a good condition. ✓
- Ensure that plug is wired properly and / in a good condition. ✓
- Ensure all safety guards are in place. ✓
- Ensure that the attachments (drill bits, blades etc.) are fixed in the correct way. ✓
- Do not force the machine / equipment. ✓
- Operate according to manufacturer instructions. (Any 2 x 1) (2)

2.6 Responsibility of employer:

- Provide and maintain working systems, work area, equipment and tools in a safe condition. ✓
 - Eliminate or reduce any potential hazard. ✓
 - Produce, handle, store and transport goods safely. ✓
 - Ensure that every person employed complies with the requirements of this OHS Act. ✓
 - Enforce measures if necessary in the interest of health and safety. ✓
 - Appoint a person who is trained and who have the authority to ensure that the employee takes precautionary measures. ✓
 - Inform employees of the hazards to his health and safety attached to any duty or work situation. ✓
- (Any 1 x 1) (1)

2.7 Responsibility of employee:

- Pay attention to their own and other people's health and safety. ✓
 - Co-operate with the employer regarding the OHS Act. ✓
 - Carry out a lawful order given to them. ✓
 - Report any situation that is unsafe or unhealthy. ✓
 - Report all incidents and accidents. ✓
 - Not to interfere with any safety equipment or misuse such equipment. ✓
 - Obey all safety rules. ✓
- (Any 1 x 1) (1)

[10]

Materials (Generic). Question 3

In this section, work through the content. The things you need to know the are the following:

- How to identify the different engineering materials by the different tests (Sound, bending, filing, machining and spark tests)
- Examiners will always include one of the tests or they will give you the following table and ask you to make a distinction between materials.

Different Type of Tests	Material			
	Cast iron	Cast Steel	Mild steel	HSS
Sound	Very dull sound.	High ringing sound.	Medium metallic sound.	Lower ring sound similar to mild steel.
Bend	Cannot bend. It will snap, break or fracture easily.	It tends to crack as it is brittle.	Bend easily.	It tends to crack as it is brittle.
Filing	It files easily.	Very difficult.	Files easily.	Very difficult.
Machining	Cuts easily, black, crumbly chips.	Hard to cut, cuttings break in sharp chips.	Turns easily curly chips.	Turns difficultly

- Heat treatment processes to enhance the properties of engineering materials.

Learners must be know how to draw the iron –carbon equilibrium diagram and know the labels. This drawing is a favorite question and has been asked frequently.

Types of heat treatment (Hardening, Tempering, Case-hardening, Annealing and Normalising)

Learners must know these types of heat treatment, their purposes and how the process is done. The examiner normally includes one or two of these processes in Question 3.

Multiple-choice Questions (Specific) QUESTION 4:

Various options are provided as possible answers to the following questions. This question requires you to choose the **one, correct** answer and write only the letter (A–D) next to the question numbers (4.1 to 4.14) in the ANSWER BOOK, e.g. 4.7 C.

Do not leave any one of these questions unanswered. If you are unsure, take an “intelligent guess” of the most likely possible answer.

This type of questions are the same as those in question 1, but it covers all the **specific topics**. How to handle these questions:

- They could contain sketches, leave out missing words or even simple calculations.
- To correctly answer these questions you need to know the facts.
- Each question is worth one mark so do not stress and take too long to answer the question as you have about 10 minutes to complete this question.
- Carefully read the question and the possible answers, think about it, before making your choice of the correct answer.
- Do not write all the numbers and correct letters down. **Use the template** in the answer book and make a cross in the correct block. This will save some time.

Examples of types of questions to expect

4.1 The purpose of conducting a compression test for an internal combustion engine is to test the pressure in the ...

- A **cylinder.**
 - B oil pump.
 - C fuel pump.
 - D radiator.
- (1)

4.2 Which ONE of the following equipment is used to test the exhaust gases of an internal combustion engine?

- A Torsion analyser
 - B Pressure analyser
 - C **Gas analyser**
 - D Combustion analyser
- (1)

4.3 The function of the crankshaft in an internal combustion engine is to convert the reciprocating motion of the piston into a ... motion.

- A linear
- B horizontal
- C vertical
- D rotary** (1)

4.4 Which ONE of the following firing orders is applicable to a V6 internal combustion engine?

- A 1-5-3-6-2-4
- B 1-4-2-5-3-6**
- C 1-4-2-6-3-5
- D 1-5-6-3-4-2 (1)

4.5 What will be the mechanical efficiency of an engine if the brake power of the engine is 65 kW and the indicated power is 80 kW?

- A 81,25%**
- B 1,25%
- C 1,25 °C
- D 81,25 °C (1)

4.6 Which ONE of the following safety procedures must be adhered to when a cylinder leakage tester is used on an internal combustion engine?

- A Use water to remove dust around the spark plug area.
- B Do not exceed the prescribed pressure in the cylinder.**
- C Make sure the high-tension leads to the spark plugs are connected.
- D Exceed the prescribed pressure in the cylinder. (1)

Tools (Specific) Question 5

In this section, work through the content the things you need to know the are the following:

Identification and application of diagnostic equipment:

- Compression tester
- Cylinder leakage tester
- Gas analyser (all crankcase gases)
- Computerised diagnostic scanner
- Wheel balancer
- Wheel alignment equipment (bubble gauge and turn tables)

You need know the purpose and set-up procedure of all the diagnostic equipment. This question normally starts with a sketch of of on of the tools or equipment, where you are asked to identify, label and asked to state its purpose, e.g.

5.1

FIGURE 5.1 below shows a cylinder leakage tester. Answer the questions that follow.

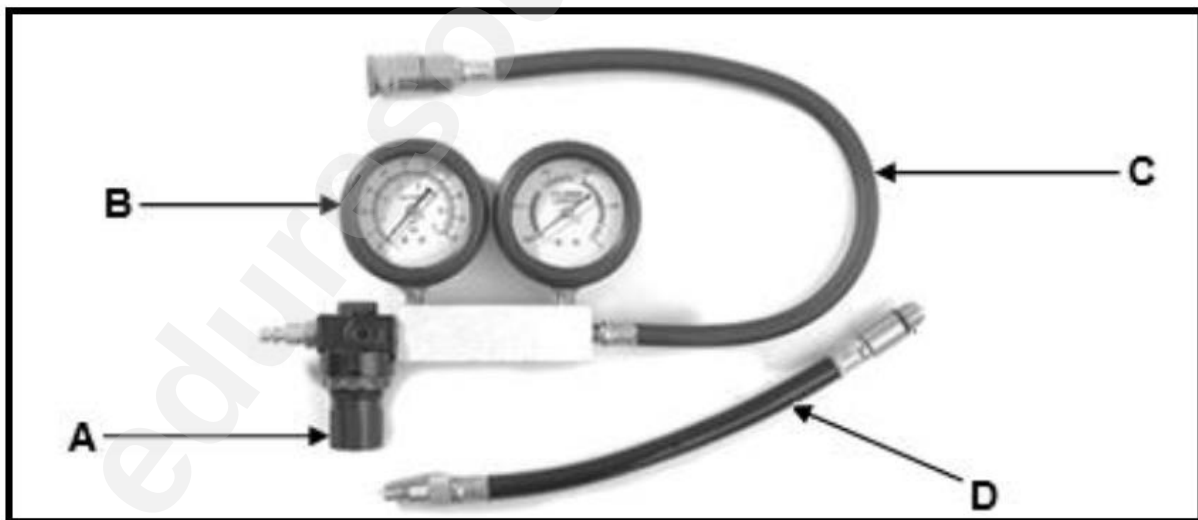


FIGURE 5.1

- 5.1.1 Label A–D. (4)
- 5.1.2 What is the purpose of the cylinder leakage tester? (2)
- 5.1.3 State, in the correct sequence, the set-up procedure of the cylinder leakage tester on an internal combustion engine. (6)

Model answers**5.1 Cylinder leakage tester:****5.1.1 Labels:**

A – Pressure control valve ✓

B – Pressure gauge ✓

C – Compressor hose / Air hose ✓

D – Spark plug connector / adapter ✓

(4)

5.1.2 Purpose of cylinder leakage tester:

- To determine the percentage ✓ gas leakage from a cylinder. ✓
- To determine the location ✓ of gas leaks from a cylinder. ✓

(Any 1 x 2) (2)

5.1.3 Procedure for cylinder leakage test:

- Turn the crank shaft until both valves on cylinder no. 1 are closed (piston no. 1 is on power stroke). ✓
- Remove the spark plug and connect the spark plug adaptor (tester) to the spark plug hole. ✓
- Use a spanner to lock the crankshaft pulley so that it cannot turn. ✓
- Release air into the cylinder according to the prescribed pressure. ✓
- The reading will indicate the percentage gas leakage. ✓
- A hissing sound at various points indicates the location of the leak. ✓

(6)

Engines (Specific) Question 6

In this section, work through the content the things you need to know the are the following:

Crankshafts:

- Balancing of crankshafts
- Vibration damper (function and assembly)
- Cylinder layouts
- Crank arrangements
- Firing orders

Describe the operating principles and construction of:

- Turbochargers
- Superchargers

Learners need to know **all the sketches** and be able to label them. Labeling of sketches can be sure marks. The examiner will not ask you to do the drawing. If he does, ensure that you also label all sketches. He will most likely give you the sketch and ask you to label it. There will also be one or two questions related to the sketch that is given.

Learners need to know the different types of superchargers, i.e. the construction and basic operation of all of them. They also must be able to define the different terminology and know the advantage and disadvantages of Turbo- and Superchargers.

Examples:

6.2 Identify the cylinder layouts as illustrated in FIGURES 6.2.1 and 6.2.2 below.

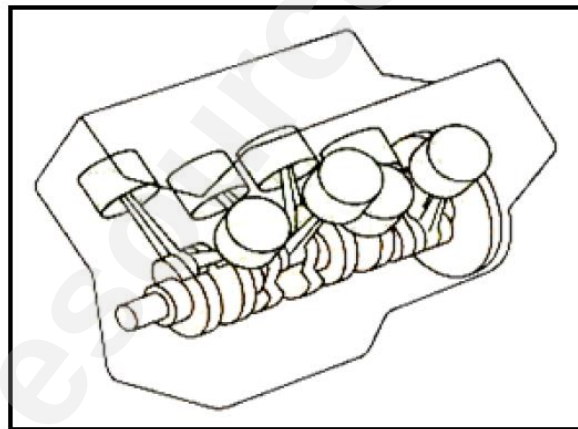


FIGURE 6.2.1

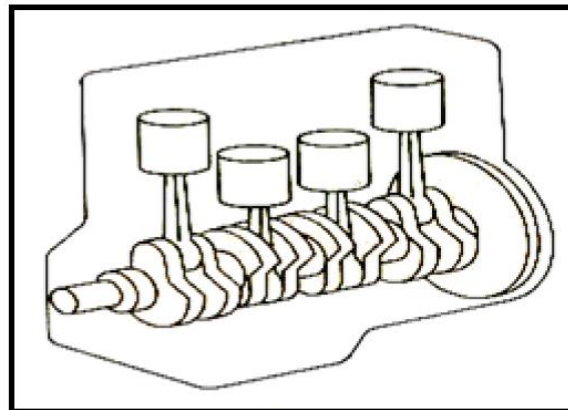


FIGURE 6.2.2

6.3 Explain how you will determine the firing order of a four-cylinder petrol engine if it is not marked on the crankshaft pulley and the manual is not available. (5)

6.4 State the firing order of the following types of engines:

6.4.1 Four-cylinder in-line engine (1)

6.4.2 V6-cylinder engine (1)

6.5 A turbocharger is shown in FIGURE 6.5 below. Answer the questions that follow.

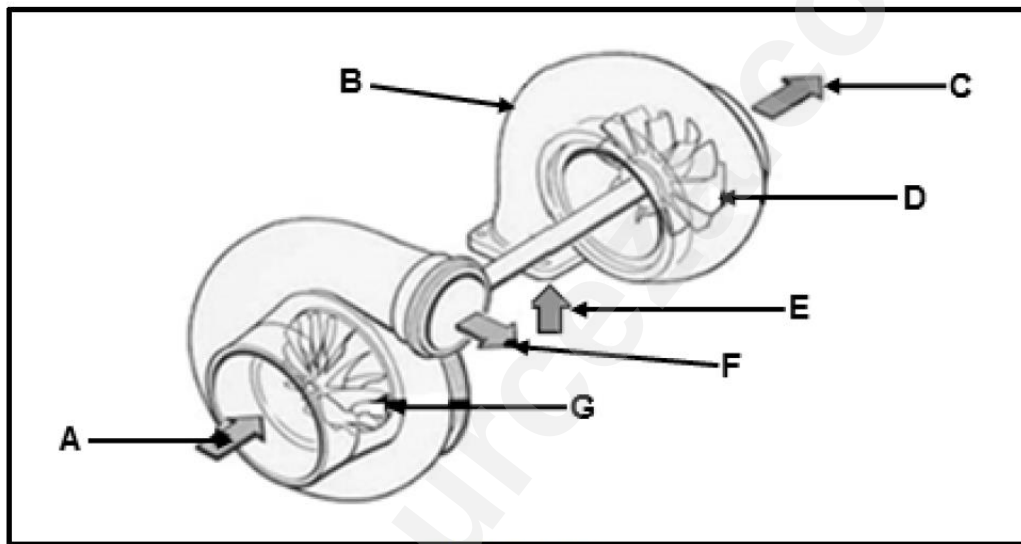


FIGURE 6.5

6.5.1 Label parts A–G. (7)

6.5.2 State TWO advantages of the turbocharger. (2)

Model Answers

6.2 Cylinder layouts:

6.2.1 V - engine layout ✓ (1)

6.2.2 In line (straight) engine layout ✓ (1)

6.3 Firing order in an engine:

- By removing the tappet cover and determining which are intake valves and which are exhaust valves ✓
- Rotating the engine in the direction in which it turns. ✓
- Watch the order in which one set of valves, inlet or exhaust operates ✓
- This will give the order in which the inlet stroke or exhaust stroke occurs ✓
- The power strokes occur in the same order. ✓

6.4 Firing order of engines:

6.4.1 Four cylinder in-line engine:

- 1,3,4,2; or ✓
- 1,2,4,3 ✓

(Any 1 x 1) (1)

6.4.2 V6-cylinder engine:

- 1,4,2,5,3,6 ✓
- 1,2,3,4,5,6 ✓
- 1,6,5,4,3,2 ✓
- 1,4,5,6,3,2 ✓

(Any 1 x 1) (1)

6.5.1 Turbocharger:

A – Compressor air inlet ✓

B – Turbine housing ✓

C – Turbine exhaust gas outlet ✓

D – Turbine wheel ✓

E – Turbine exhaust gas inlet ✓

F – Compressed air outlet ✓

G – Compressor wheel ✓

(7)

6.5.2 Turbocharger advantages:

- More power / speed / boost is obtained from an engine with the same capacity ✓
- There is no power loss as the turbocharger is driven by exhaust gasses ✓
- Improved fuel consumption ✓
- The effect of height above sea level is eliminated ✓
- Generally, cheaper than superchargers ✓

Any (2 x 1) (2)

General comments on the answering of questions

- (A) Learners must always start each question on a new page as indicated in the instructions.
- (B) Attempt to do the easier questions first and work your way up to the more difficult ones.
- (C) Some questions have sub-questions. Keep them together. **Do not mix them.**
- (D) Draw a line across the page once you have completed each question
- (E) Learners have difficulty expressing themselves when responding to describe/explain type of questions. It is important for learners to explain or describe concepts in a logical sequence, e.g. Explain the operation of the turbocharger.
- (F) Learners should be careful not giving general responses that are incorrect instead of specific responses, e.g. learners responded by indicating that workers should wear PPE, instead of a specific item, like a safety goggles.
- (G) In a question that counts two marks, learners only provided one response instead of two. Learners must be able to derive the number of facts that they should state from the mark allocation of the question.
- (H) Learners should not only rely on activities that are in the textbooks but alternative questions on all cognitive levels for all the topics should be developed by themselves.
- (I) It is important that all topics should be covered sufficiently by learners in order to prepare themselves for any type of questions on a specific topic.
- (J) It is important that labels should always be indicated on all drawings.
- (K) Learners have difficulty explaining practical applications theoretically.

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