Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2022

MECHANICAL TECHNOLOGY: AUTOMOTIVE (EXEMPLAR)

MARKS: **200**

TIME: **3 hours**

This question paper consists of 16 pages, including a 1-page formula sheet.

INSTRUCTIONS AND INFORMATION

1. Write your NAME on the ANSWER BOOK.
2. Read ALL the questions carefully
3. Answer ALL the questions.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Start EACH question on a NEW page.
6. Show ALL calculations and units. Round off final answers to TWO decimal places.
7. You may use a non-programmable scientific calculator and drawing instruments.
8. The value of gravitational force should be taken as 10 $m.s^{-2}$.
9. All dimensions are in millimetres, unless stated otherwise in the question.
10. A formula sheet is attached to the question paper.
11. Write neatly and legibly.
12. Use the criteria below to assist you in managing your time.

QUESTION	CONTENT	MARKS	TIME
GENERIC			
1	Multiple-choice questions	20	17 minutes
2	Safety	20	18 minutes
3	Tools and Equipment	25	23 minutes
4	Maintenance	20	18 minutes
SPECIFIC			
5	Tools and Equipment	15	13 minutes
6	Engines	30	27 minutes
7	Systems and Control	30	27 minutes
8	Maintenance	15	14 minutes
9	Forces	20	18 minutes
10	Terminology	5	5 minutes
TOTAL		**200**	**180 minutes**

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC) (COMPULSORY)

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question numbers (1.1 to 1.20) in your ANSWER BOOK, for example 1.21 A.

1.1 Which of the following options is correct in terms of the Occupational Health and Safety Act (OHS Act No. 85 of 1993) as one of the national policies and procedures dealing with HIV/Aids?

A The Act emphasises the working relations of employees and employers.
B Elaborates how everybody has the right to fair labour practice.
C It states that all employers must make sure that the workplace is safe and that the employees are not at risk of becoming infected with HIV at work.
D It contains common guidelines on how employers, employees and trade unions should respond to HIV/Aids in the workplace. (1)

1.2 Which of the following is an example of an unsafe condition?

A Insufficient ventilation in the workshop
B Adjusting or lubricating a machine that is in motion
C Using machine without having required training
D Using hands or feet instead of available equipment. (1)

1.3 In order for a workshop to run successfully It is important for the workers to report the daily operations of the workshop which include …

A maintenance and requirements of machines or equipment to prevent production flow interruption.
B work progress.
C accident and causes.
D All of the above. (1)

1.4 Which ONE of the following safety procedures is applicable to the operation of a guillotine?

A Make sure the space between the tool rest and emery disc does not exceed 3 mm
B Do not attempt to cut material beyond the capacity of the machine
C Select the correct drill bit
D Use the machine table as an anvil. (1)

1.5 What safety measure is applicable to the use of the tool in FIGURE 1.5 below in terms of the Occupational Health and Safety Act?

FIGURE 1.5

A Check the pressure gauge regularly for adjustment of replacement before work commences.
B Remove guards before grinding.
C Make sure that there are no cracks on the disc before you start a job.
D It can be forced to grind thick material. (1)

1.6 Which of the following safety precaution must be carried out on a small workpiece before drilling operation can be done on a pedestal drilling machine?

A Clean the workpiece properly with a dry cloth.
B Hold the workpiece firmly by hand.
C Clamp the workpiece securely on the work table
D All of the above (1)

1.7 What is the colour code for acetylene cylinder?

A Maroon
B Red
C Blue
D Black (1)

1.8 Why is it important to use cutting fluid when cutting a hardened medium carbon steel with a power saw?

A In order to softened the steel
B In order to prolong the lifespan of the cutting tool as it cuts through the hardened steel
C In order to have a straight cut
D In order to change the texture of the chips (1)

1.9 What will be the tap drill size for an M12 x 2,5?

A 12,50 mm
B 12,00 mm
C 14,50 mm
D 9,50 mm (1)

1.10 Which ONE of the following tools is used to enlarge pop marks on a work-piece before drilling commences?

A Centre punch
B Scriber
C Vernier calliper
D Steel rule (1)

1.11 What is the function of the depth gauge on the drill press?

A Prevent damages to the cutting tool
B Guides the cutting into the hole
C Indicates the depth of the hole
D Pop marks on the workpiece before drilling (1)

1.12 What is the function of the screen of a pedestal grinder?

A Lubricates the grinding process
B Serves as a wheel dresser
C Aligns the grinding disc in order to prevent vibrations
D Protects the eyes from sparks and abrasive materials expelled from the grinding disc (1)

1.13 Which of the following is the cause of malfunction of a pedestal drilling machine?

A Lack of lubrication or incorrect lubrication
B Friction
C Overload
D All of the above. (1)

1.14 Why do we carry out wheel dressing as part of the maintenance procedure in pedestal grinding machines?

A To remove the dull outer layer of the wheel grinding surface in order to expose the sharp grains
B To align the wheel properly on the spindle
C To check if there are cracks on the grinding wheel
D To fix the cracks on the grinding wheel (1)

1.15 What is the purpose of the weight (balls) on a manual press?

A To indicate the compressive pressure of the tool
B To drill a hard material
C To maintain momentum and thrust for easier operation
D To reduce compressive stress on materials (1)

1.16 Which of the following is not one of the maintenance activities of a power saw?

A Inspect blade tension according to manufactural specifications
B Perform a diamond wheel dressing in order to restore cutting ability
C Change the saw blade as required
D Monitor the cutting fluids (1)

1.17 How does overload affect the performance of a horizontal band saw?

A Improves surface finish
B It results in a skew cut as well as binding or breaking the blade
C Results in smoother cut
D Straight cut can easily be achieved (1)

1.18 What is the function of a ring test in a grinding wheel?

A To check if the grinding wheel has cracks
B To confirm the need for a wheel dressing
C To test the cooling system of the electric motor
D All of the above. (1)

1.19 What is the function of the hand tools shown in FIGURE 1.19 below?

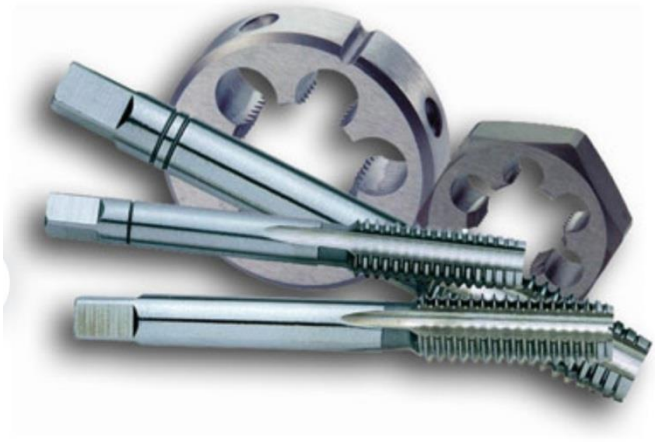


FIGURE 1.19

A Countersink a workpiece
B Open and locking bolts and nut
C Cut internal and external thread
D Drill a hole (1)

1.20 What is the unit of torque?

A Cm^3
B N/m^2
C N/m
D Nm (1)

[20]

QUESTION 2: SAFETY (GENERIC)

2.1 What do you understand by the term *accident* in the workshop? (2)

2.2 List any THREE unsafe acts you know in the workshop. (3)

2.3 Give THREE safety rules that must be adhered to in order to prevent an accident from taking place in the workshop. (3)

2.4 Give THREE safety measures that must be in place before welding or flame cutting can be undertaken. (3)

2.5 When handling oxi-acetylene gas welding cylinders, state THREE safety precautions you must take into consideration. (3)

2.6 Why is it very important to install flashback arrestors as a safety precaution on the hose pipes of an oxi-acetylene gas welding system? (2)

2.7 Give THREE safety precautions that must be observed when using a hydraulic press. (3)

2.8 Why is it important to wear goggles when grinding a workpiece on a pedestal grinder? (1)

[20]

QUESTION 3: TOOLS (GENERIC)

3.1 FIGURE 3.1 below is a common tool used in thread cutting.

FIGURE 3.1

3.1.1 Identify the tool in FIGURE 3.1 above. (1)

3.1.2 What is the function of the tool in FIGURE 3.1 above? (2)

3.2 List the THREE types of taps commonly used in the workshop. (3)

3.3 Study the diagram in FIGURE 3.3 below and answer the questions that follow.

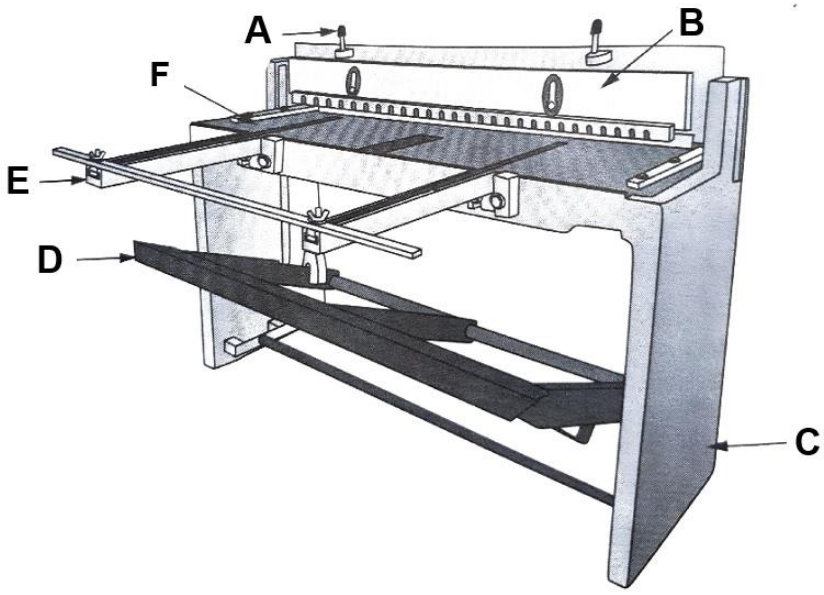


FIGURE 3.3

3.3.1 Identify the diagram in FIGURE 3.3 above. (1)

3.3.2 What is the tool in FIGURE 3.3 used for in the workshop? (2)

3.3.3 Label parts **A**–**F** in FIGURE 3.3 above. (6)

3.3.4 What is the maximum thickness of materials the tool in FIGURE 3.3 above can accommodate? (1)

3.4 What are the THREE main uses of an angle grinder? (3)

3.5 Give TWO possible ways you can use to adjust the speed of a pedestal drilling machine depending on manufactural specifications. (2)

3.6 What is the function of each of the following components of a pedestal drilling machine?

3.6.1 Depth gauge (2)

3.6.2 Motor (2)

[25]

QUESTION 4: MAINTENANCE (GENERIC)

4.1 List THREE factors that needs to be taken into account when selecting a drill speed on a pedestal drilling machine. (3)

4.2 A 12 mm hole must be drilled into a piece of metal. The cutting speed given is 500 mm per second. Calculate the required drill speed of the drill in revolutions per minute. (5)

4.3 What will be the effect of excessive friction when drilling a hole on a pedestal drilling machine? (1)

4.4 How can you reduce the effect of excessive friction during the course of drilling a hole on a pedestal drill? (1)

4.5 What are the THREE causes of malfunction in a pedestal drilling machine? (3)

4.6 Give THREE consequences of a poor cooling system caused by blocked nozzles in a horizontal band saw. (3)

4.7 How will you carry out maintenance practice on the following pedestal grinder components?

4.7.1 Guards (1)

4.7.2 Screen (1)

4.7.3 Tool rest (1)

4.7.4 Grinding wheel (1)

[20]

QUESTION 5: TOOL AND EQUIPMENT (SPECIFIC)

5.1 The diagram in FIGURE 5.1 below is a precision measuring tool, use it to answer the questions that follow.

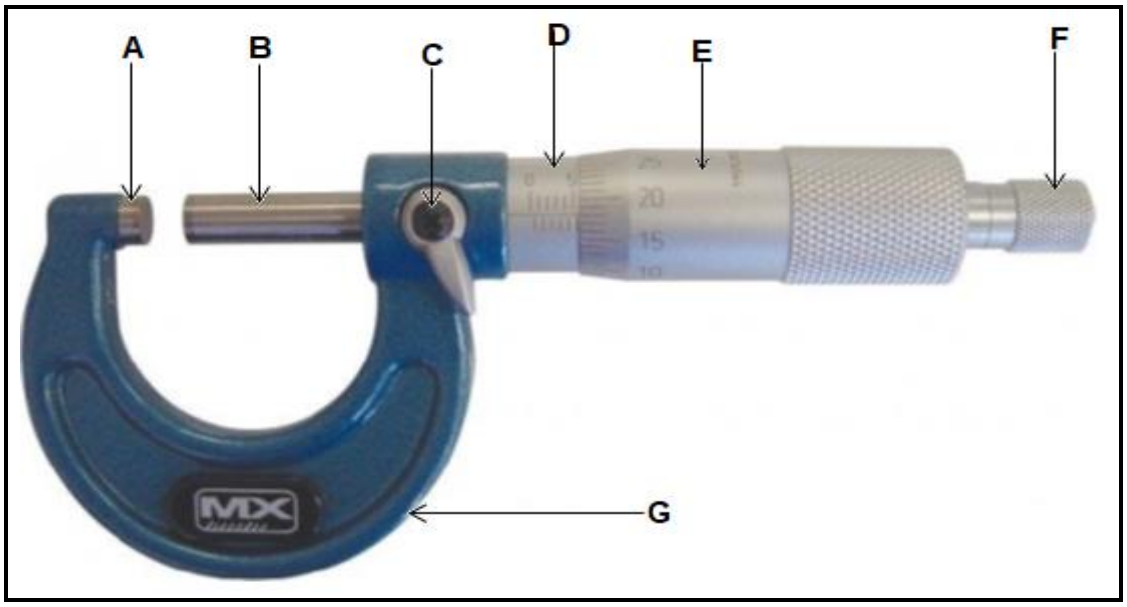


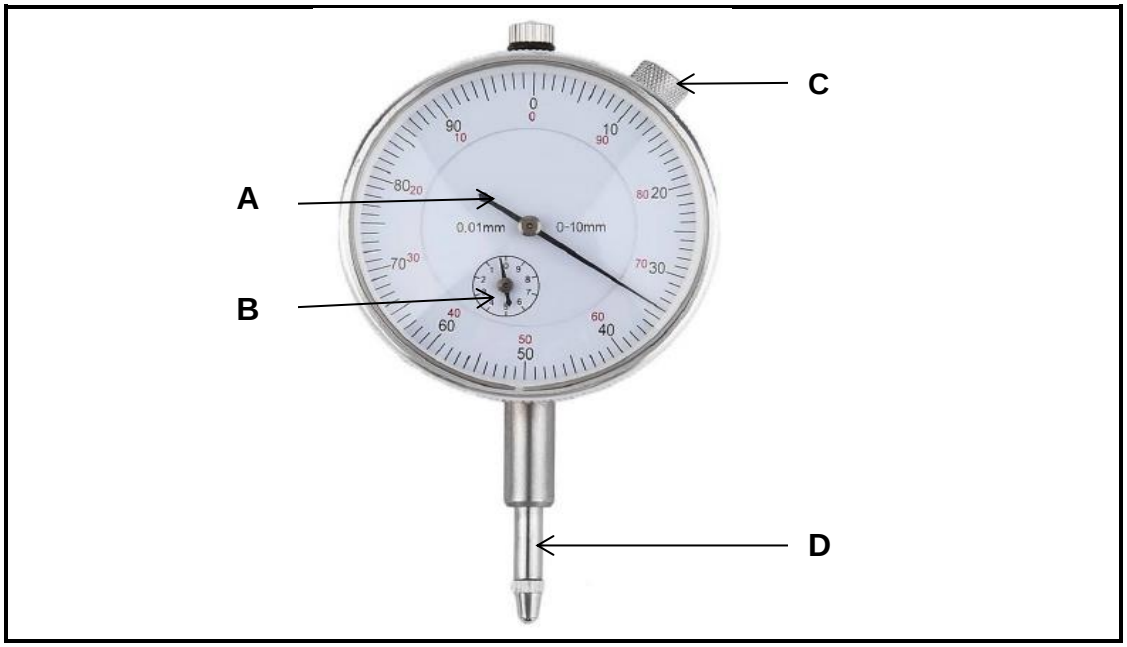
FIGURE 5.1

5.1.1 Identify the precision tool indicated in FIGURE 5.1 above. (1)

5.1.2 Label parts **A**–**G** in the FIGURE 5.1 above. (7)

5.1.3 What is the function of the tool in FIGURE 5.1 above? (1)

5.2 The tool in FIGURE 5.2 below is a dial indicator, label parts **A**–**D**.



(4)

FIGURE 5.2

5.3 Give TWO uses of a dial indicator. (2)

[15]

QUESTION 6: ENGINES (SPECIFIC)

6.1 In a compression ignition engine, there are three ways the valve assemblies are arranged depending on the manufactural specifications. Give the THREE methods of these valve arrangements. (3)

6.2 What is the function of a cam follower? (2)

6.3 Give THREE advantages of a hydraulic cam follower. (3)

6.4 What is the purpose of valve clearance? (3)

6.5 Give TWO disadvantages of excessive valve clearance. (2)

6.6 Give TWO advantages of using belt drive for the purpose of timing the relative movement between the crankshaft and the camshaft of a 4-stroke engine. (2)

6.7 What is the function of an injector in a compression ignition (CI) engine? (3)

6.8 Give THREE advantages of using Piezo injectors in a compression ignition (CI) engine. (3)

6.9 Briefly describe the operating principle of a continuously variable valve timing (CVVT). (3)

6.10 Describe each of the following terms in valve timing:

6.10.1 Valve lead (2)

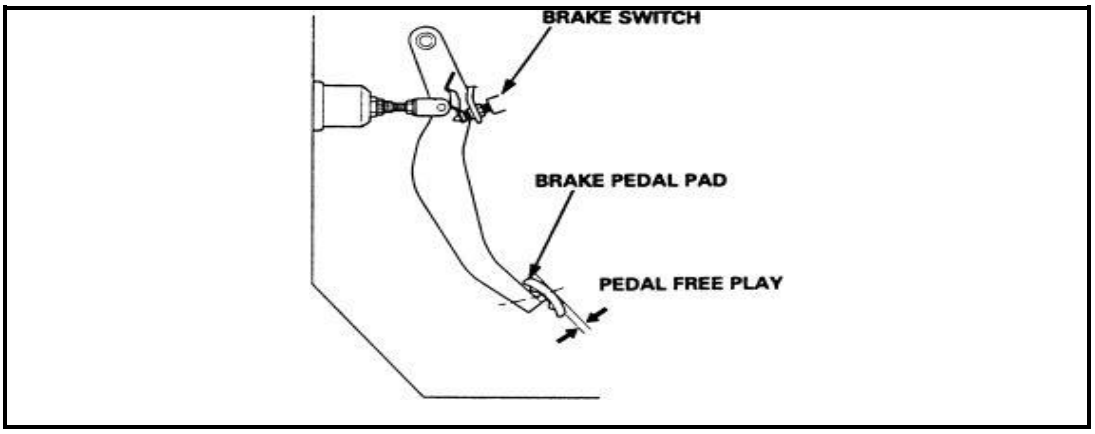
6.10.2 Valve lag (2)

6.10.3 Valve overlap (2)

[30]

QUESTION 7: SYSTEMS AND CONTROL (SPECIFIC)

7.1 Why must a brake pedal have free play as shown in FIGURE 7.1 below?



(1)

FIGURE 7.1

7.2 State THREE factors that influences the stopping distance of a car when brakes is applied. (3)

7.3 Give TWO advantages of using ABS in a motor vehicle. (2)

7.4 What is the purpose of a power steering system? (1)

7.5 Give TWO advantages of using power steering in a motor vehicle. (2)

7.6 State TWO functions of a shock absorber. (2)

7.7 Give THREE effects of weak/worn shock absorbers on a motor vehicle. (3)

7.8 What is the function of a vacuum servo unit? (2)

7.9 In point form, explain the simple test of a servo unit. (3)

7.10 Briefly explain the function of each of the following ignition system components.

7.10.1 Ignition coil (2)

7.10.2 distributor (2)

7.10.3 Ignition switch (2)

7.11 What is the firing order of a Six-cylinder V-engine? (1)

7.12 State TWO factors that determine the firing order of a spark ignition engine. (2)

7.13 State the purpose of a predetermined firing order of an engine. (2)

[30]

QUESTION 8: MAINTENANCE (SPECIFIC)

8.1 The diagram in FIGURE 8.1 below is an engine oil pump. Use it to answer the questions that follow.

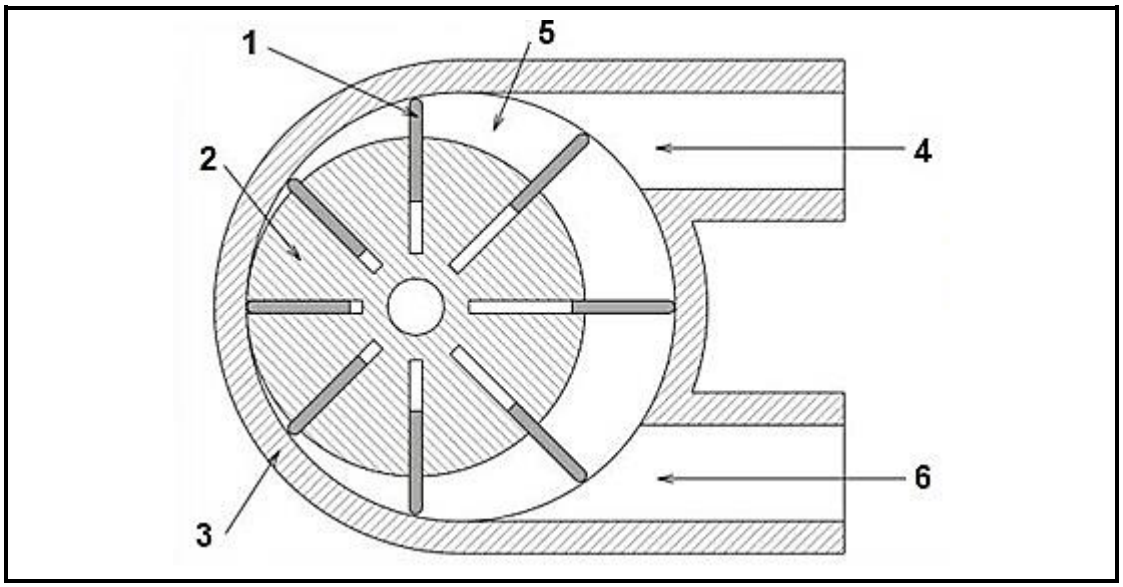


FIGURE 8.1

8.1.1 Identify the type of oil pump in FIGURE 8.1 above. (1)

8.1.2 Label the parts **1**–**6** in the FIGURE 8.1 above. (6)

8.1.3 Give TWO advantages of using the oil pump in the FIGURE 8.1 above in motor vehicle. (2)

8.1.4 Name TWO other types of oil pumps commonly used in a motor vehicle. (2)

8.2 Explain the function of a seal. (2)

8.3 List TWO places or components of a car where seals are used. (2)

[15]

QUESTION 9: FORCES (SPECIFIC)

9.1 A spark ignition (SI) engine has a cylinder diameter of 80 mm, a stroke length of 95 mm and a clearance volume of 80 cm^3. Calculate the compression ratio of the engine. (6)

9.2 Calculate the torque applied to a bolt by a torque wrench with a length of 600 mm from the point of grip, when a force of 220 N is applied. (3)

9.3 Briefly explain what is meant by the term '*indicated power'*. (2)

9.4 The following data was recorded during a test carried out on a four-stroke, four-cylinder petrol engine:

Mean effective pressure on the piston:	600 kPa
Length of stroke:	90 mm
Cylinder bore:	100 mm
Revolution per minute:	4080 rpm
Number of cylinder:	4

Calculate the indicated power in kW. (9)
[20]

QUESTION 10: TERMINOLOGY (SPECIFIC)

10.1 You are requested to carry out a full servicing of a motor vehicle, use the job card below to answer the questions that follow.

Name: Mark	Date: 05 Nov 2021	Cash
Job No. : 8042		Account
	Account number:	
Code:		
Cell number:		
Reg No.: FCR802EC	**Spares and materials used**	
Make: Honda		
Model: CRV 2000 Automatic	Oil filter, fuel filter and air filter	
Odometer: 114312	Cam belt	
Engine No.:	Engine oil and transmission oil	
Chasis No.:	Transmission oil filter	
Colour: White		
Parts:	Order no.:	
Requisition No.:		
Signature: ……..……..		

Write down at least THREE things you will have to attend to in the job card. (3)

10.2 Explain the term *flow control*. (2)
[5]

TOTAL: 200

FORMULA SHEET FOR MECHANICAL TECHNOLOGY (AUTOMOTIVE)

$Force = m \times a$ where $m = mass$
$a = acceleration$

$Work = force \times distance (F \times d)$

$$Power = \frac{force \times distance}{time}$$

$Torque = force \times radius$

$Indicated\ power = P \times L \times A \times N \times n$
where $P = mean\ effective\ pressure$
$L = length\ of\ stroke$
$A = area\ of\ piston\ crown$
$N = number\ of\ power\ strokes\ per\ second$
$n = number\ of\ cylinders$

$Brake\ power = 2\pi N \times T$
where $N = revolutions\ per\ second$
$T = torque$

$Brake\ power (Prony\ brake) = F \times 2 \times \pi \times R \times N$
where $F = force$
$R = length\ of\ brake\ arm$
$N = revolutions\ per\ second$

$$Mechanical\ efficiency = \frac{brake\ power}{indicated\ power} \times 100$$

$$Compression\ ratio = \frac{swept\ volume + clearance\ volume}{clearance\ volume}$$

$$where\ swept\ volume = \frac{\pi \times D^2}{4} \times L$$
where $L = length\ of\ stroke$
$D = diameter\ of\ bore$

$$Clearance\ volume = \frac{\pi \times D^2}{4} \times l$$
where $D = diameter\ of\ bore$
$l = clearance$

$$Gear\ ratio = \frac{product\ of\ the\ number\ of\ teeth\ of\ the\ driven\ gears}{product\ of\ the\ number\ of\ teeth\ of\ the\ driver\ gears}$$