Province of the
EASTERN CAPE
EDUCATION

# NATIONAL SENIOR CERTIFICATE

## GRADE 11

## NOVEMBER 2020

# MECHANICAL TECHNOLOGY: AUTOMOTIVE (EXEMPLAR)

**MARKS:** **200**

**TIME:** **3 hours**

This question paper consists of 20 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 management.

| QUESTION | CONTENT | MARKS | TIME in minutes |
|---|---|---|---|
| | **GENERIC** | | |
| 1 | Multiple-choice questions | 25 | 22 |
| 2 | Safety | 30 | 27 |
| 3 | Tools and Equipment | 25 | 23 |
| 4 | Maintenance | 20 | 18 |
| | **SPECIFIC** | | |
| 5 | Tools and Equipment | 15 | 13 |
| 6 | Engines | 25 | 23 |
| 7 | Systems and Control | 15 | 13 |
| 8 | Maintenance | 15 | 13 |
| 9 | Forces | 25 | 23 |
| 10 | Terminology | 5 | 5 |
| | **TOTAL:** | **200** | **180** |

## 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 (1.1–1.25) in the ANSWER BOOK, for example 1.26 A.

1.1 The following are the policies and procedures that protect the rights of employees living with HIV/Aids in their corresponding places of work except …

A Code of Good Practice on HIV/Aids and Employment.
B Occupational Health and Safety Act (OHS Act No. 85 of 1993).
C Labour Relations Act
D Salary Adjustment Related Act. (1)

1.2 Which ONE of the following options is not part of the basic first aid measures?

A Examination
B Diagnosis
C Operation
D Treatment (1)

1.3 In terms of the occupational Health and Safety Act, what safety measure is applicable to a pedestal drilling machine?

A Clamp the workpiece to the work table before drilling.
B Remove the belt fixed guard before drilling.
C Use your fingers to remove chips.
D Force the drill into the workpiece. (1)

1.4 Welding or flame cutting operation may NOT be undertaken, unless the following is put in place:

A A workplace is effectively partitioned off
B An operator has been instructed on how to use the equipment safely
C The workshop must be overcrowded to keep it warm
D An operator uses protective equipment (1)

1.5 What is the function of a flashback arrestor?

A To prevent back feeding in any of the two cylinder hoses
B To cause flashback
C To improve the welding beam
D To increase the strength of the welded joint (1)

1.6 Which ONE of the following is NOT a safety precaution to observe when using an arc welding equipment?

A Wear fire resistant PPE to protect the welder against sparks
B Remove all combustible materials from the welding area and keep fire extinguisher handy at all times
C Weld without a welding helmet for better vision
D The electrical conductors must be well insulated (1)

1.7 What is the colour of an oxygen cylinder in an oxy-acetylene welding system?

A Orange
B Maroon
C Green
D Black (1)

1.8 In terms of the Occupational Health and Safety Act, what safety measure is applicable for the use of a pedestal grinder?

A You can force the workpiece on the emery disc if the workpiece is difficult to grind due to its thickness.
B Grind on the side of the wheel.
C The tool rest must not be more than 3 mm away from the grinding wheel surface.
D Remove the guards before grinding. (1)

1.9 Which of the following is not a safety precaution that must be followed before operating a surface grinder?

A Make sure all the guards are in place
B Do not stop the machine in an emergency situation
C Wear the correct PPE
D Understand the operating instructions applicable to the machine (1)

1.10 Identify the tools displayed in FIGURE 1.10 below.

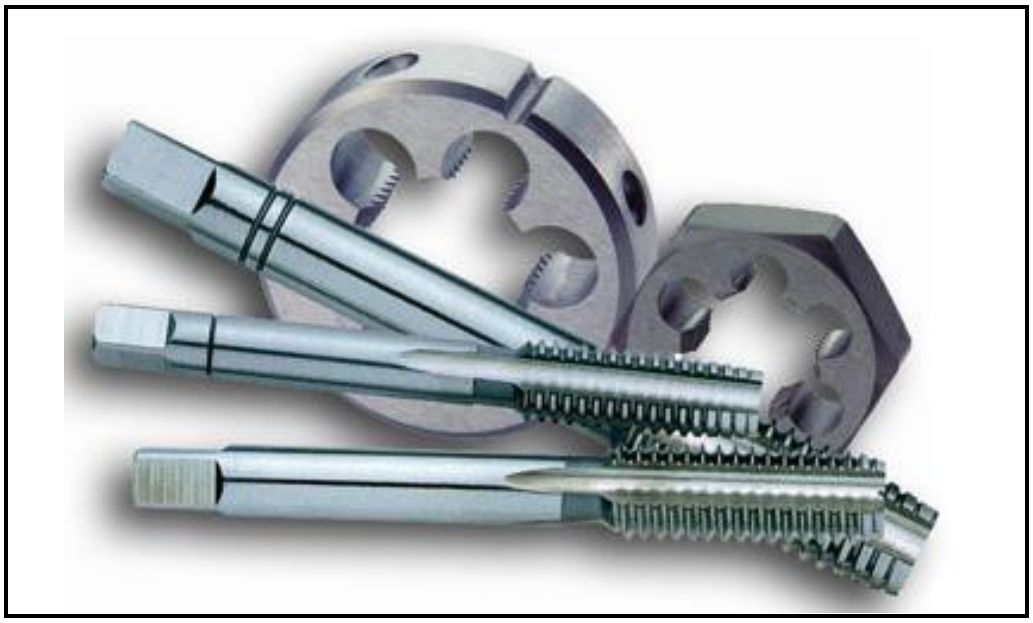


**FIGURE 1.10**

A Bolts and nuts
B Taps and dies
C Studs and nuts
D Callipers (1)

1.11 Which of the following information is not required by the SANS (South African National Standards) on labels of gas cylinders?

A Maximum permissible operating pressure in Pascal
B The cylinder content viscosity
C Manufacturer serial number
D Year of manufacture (1)

1.12 Which of the following is not among the three basic taps used in thread cutting?

A Taper taps or starting taps
B Intermediate taps or second taps
C Plug or bottoming taps
D Cutting or drilling taps (1)

1.13 What is the maximum thickness and width that can a manual guillotine accommodate?

A 2,1 mm thick and 1,8 m wide
B 3,5 mm thick and 6 m wide
C 1,2 mm thick and 1,2 m wide
D 2,2 mm thick and 2,2 m wide (1)

1.14 Identify the diagram in FIGURE 1.14 below.

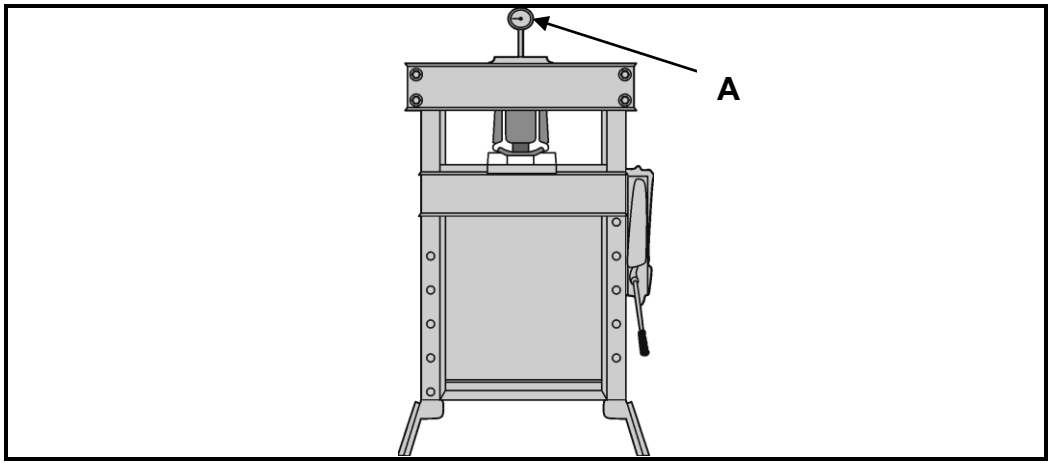



**FIGURE 1.14**

A Guillotine
B Pedestal drilling machine
C Hydraulic press
D Surface grinder (1)

1.15 What is the function of the part labelled **A** in FIGURE 1.14 on the previous page?

A To pump the fluid in the system
B It serves as a platform for the hydraulic press
C To control the electrical supply to the pump motor
D To display the working pressure of the system (1)

1.16 Identify the gas welding accessory displayed in FIGURE 1.16 below.

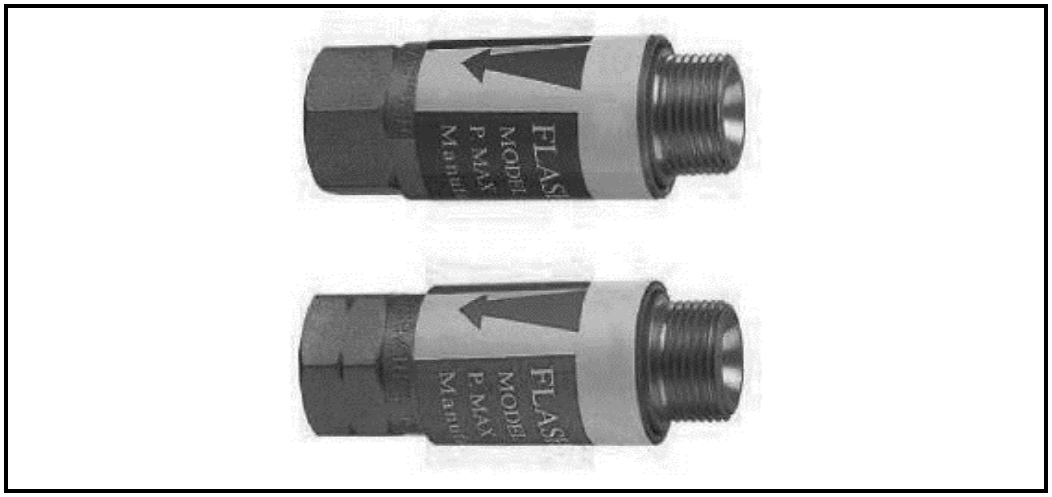


**FIGURE 1.16**

A Regulator
B Lock nut
C Flash back arrestor
D Welding nozzle (1)

1.17 What will be the tap drill size for an M14 x 2 screw thread?

A 85 mm
B 12 mm
C 10 mm
D 14 mm (1)

1.18 What is the function of a guillotine?

A To cut sheets of metal
B To grind off unwanted pieces of metal
C To drill a hole
D To chamfer the edge of a workpiece (1)

1.19 A hydraulic press employs the principle of amplifying the force within a closed system by using …

A fluid under pressure.
B an electric current.
C a screw thread to create linear motion.
D All of the above. (1)

1.20 What is the function of the machine tool shown in FIGURE 1.20 below?

**FIGURE 1.20**

A Grinding
B Cutting
C Polishing
D All of the above. (1)

1.21 Which ONE of the following is NOT among the causes of malfunction in machines?

A Lack of lubrication
B Regular and effective machine maintenance
C Overloading
D Friction (1)

1.22 What is the function of the screen on a pedestal grinder?

A To prevent the hands from going into the rotary part of the machine
B For effective visibility
C To protect your eyes from sparks and abrasive material that is expelled from the grinding machine
D For wheel dressing (1)

1.23 Which ONE of the following can be used to reduce friction between machine components?

A Antifreeze
B Thinners
C Water
D Grease (1)

1.24 Why do we lubricate the chuck of a pedestal drilling machine?

A For correct centring of the chuck
B To prevent the drill bit from breaking
C To prevent rust and ensure free motion
D To cool the machine (1)

1.25 The distance from a reference point on a screw thread to the next corresponding point is called …

A the major diameter.
B the thread angle.
C pitch.
D lead. (1)

**[25]**

## QUESTION 2: SAFETY (GENERIC)

2.1 List the FOUR examination procedures that must be followed when dealing with an injured employee in the workshop as a result of an accident. (4)

2.2 Give THREE recommendations to consider when giving first aid to an employee who was injured during a fire (hazard) in the workshop. (3)

2.3 State any THREE unsafe conditions in a workshop. (3)

2.4 List any THREE responsibilities of an employee in a workshop. (3)

2.5 State THREE safety precautions that must be observed when using a power saw. (3)

2.6 Give any THREE safety precautions that must be observed when handling gas cylinders. (3)

2.7 Give THREE reasons why it is important to wear a welding helmet during arc welding. (3)

2.8 What safety precaution must be observed at the end of a machine operation in a workshop? (1)

2.9 The diagram in FIGURE 2.9 below describes the internal part of a flashback arrestor. Label parts **A** to **D**. (4)

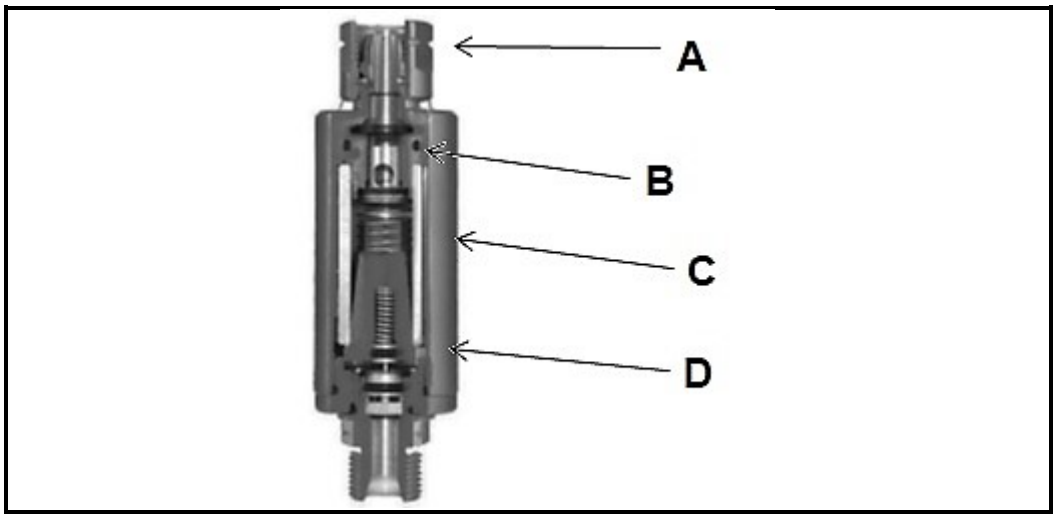



**FIGURE 2.9**

2.10 State THREE safety precautions to observe before using a bending press. (3)

**[30]**

## QUESTION 3: TOOLS AND EQUIPMENT (GENERIC)

3.1 The diagram in FIGURE 3.1 below is a machine tool commonly used in a workshop. Answer the questions that follow.

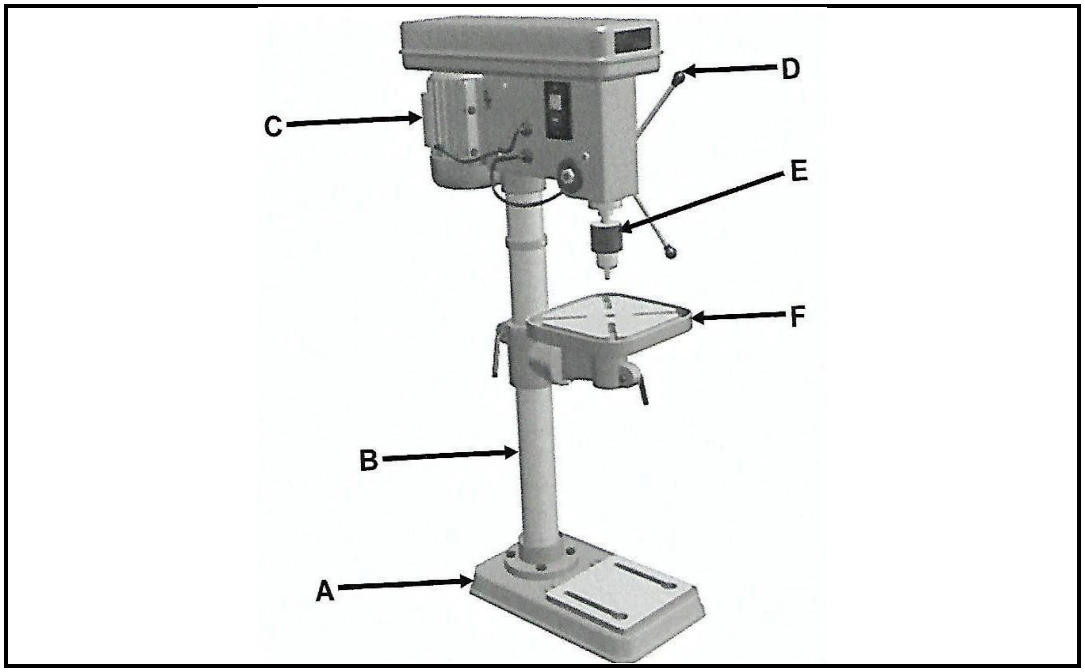



**FIGURE 3.1**

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

3.1.2 Label parts **A** to **F**. (6)

3.1.3 Give any THREE operations that can be done with the machine in FIGURE 3.1 above. (3)

3.2 What is the difference between a power saw and a band saw in terms of working operation? (2)

3.3 What is the difference between a tap and a die in terms of their applications? (2)

3.4 FIGURE 3.4 below is a commonly used tool in workshop operations. Answer the following questions.


**FIGURE 3.4**

3.4.1 Identify the machine tool in FIGURE 3.4 above. (1)

3.4.2 Label parts **A** to **E**. (5)

3.4.3 Give ONE operation that can be done with the machine tool illustrated in FIGURE 3.4 above. (1)

3.5 What is the function of the following equipment?

3.5.1 Roller machine (2)

3.5.2 Fly press (2)

**[25]**

## QUESTION 4: MAINTENANCE (GENERIC)

4.1 Give FOUR guidelines that must be followed when maintaining a pedestal drilling machine. (4)

4.2 Define *friction.* (2)

4.3 Friction generates excessive heat during drilling. Give ONE way that can be used to reduce friction during the drilling process. (1)

4.4 List FOUR factors that must be considered when selecting the drilling speed of a pedestal drilling machine. (4)

4.5 The drilling speed of aluminium is 90 m/min. Calculate the speed of the machine spindle in revolutions per second for drilling a hole with a diameter of 10 mm. (4)

4.6 Describe in point form the process required in dressing a grinding wheel using diamond cutters. (5)

**[20]**

## QUESTION 5: TOOLS AND EQUIPMENT (SPECIFIC)

5.1

**FIGURE 5.1**

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

5.1.2 Give THREE important applications of the tool in FIGURE 5.1 above in a motor vehicle. (3)

5.2 Give the vernia caliper reading shown in FIGURE 5.2 below.

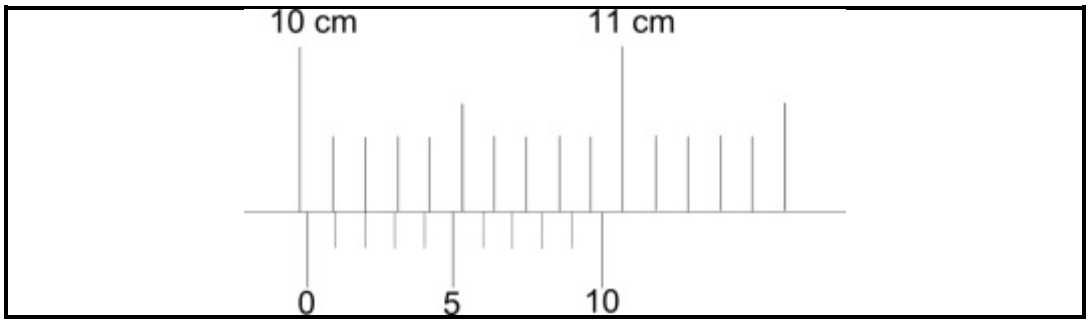



**FIGURE 5.2** (1)

5.3 Give TWO functions of an outside micrometer. (2)

5.4 When using an outside micrometer, give FOUR measures you must consider in order to have accurate readings. (4)

5.5 FIGURE 5.5 below is a precision measuring tool commonly applicable in automotive industries. Use it to answer the questions that follow.

**FIGURE 5.5**

5.5.1 Identify the precision measuring tool in FIGURE 5.5. (1)

5.5.2 Give any THREE functions of the tool in FIGURE 5.5 above. (3)

**[15]**

## QUESTION 6: ENGINES (SPECIFIC)

6.1 What do you understand by the term *indirect injection* in a compression ignition engine? (3)

6.2 Give THREE advantages of using indirect injection over the use of direct injection in a compression ignition engine. (3)

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

6.4 In point form, highlight the working principles of a solenoid injector in a compression ignition engine. (4)

6.5 Give any TWO functions of a camshaft in an internal combustion engine. (2)

6.6 Give TWO advantages of using an overhead valve arrangement in an internal combustion engine. (2)

6.7 List TWO other methods of valve arrangements. (2)

6.8 What do you understand by *continuous variable valve timing (CVVT)*? (4)

6.9 What is *valve lead* in an internal combustion engine? (2)

**[25]**

## QUESTION 7: SYSTEMS AND CONTROL (SPECIFIC)

7.1 FIGURE 7.1 below shows part of a vehicle transmission system. Answer the questions that follow.

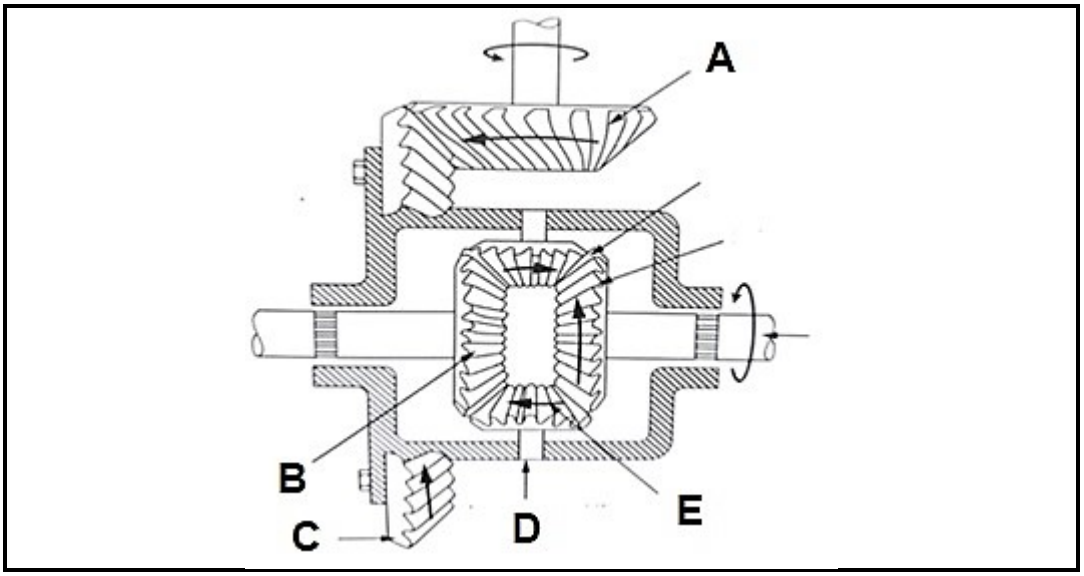



**FIGURE 7.1**

7.1.1 Identify the part of a vehicle transmission system in FIGURE 7.1 above. (1)

7.1.2 Label parts **A** to **E**. (5)

7.2 Give THREE advantages of power steering in a vehicle. (3)

7.3 Give ONE advantage of four-wheel-drive over two-wheel-drive. (1)

7.4 What do you understand by the term *wheel slip* of a car in motion? (2)

7.5 How many differentials are there in a four-wheel-drive vehicle? (1)

7.6 The diagram in FIGURE 7.5 below shows a spark plug commonly used in SI (spark ignition) engines.

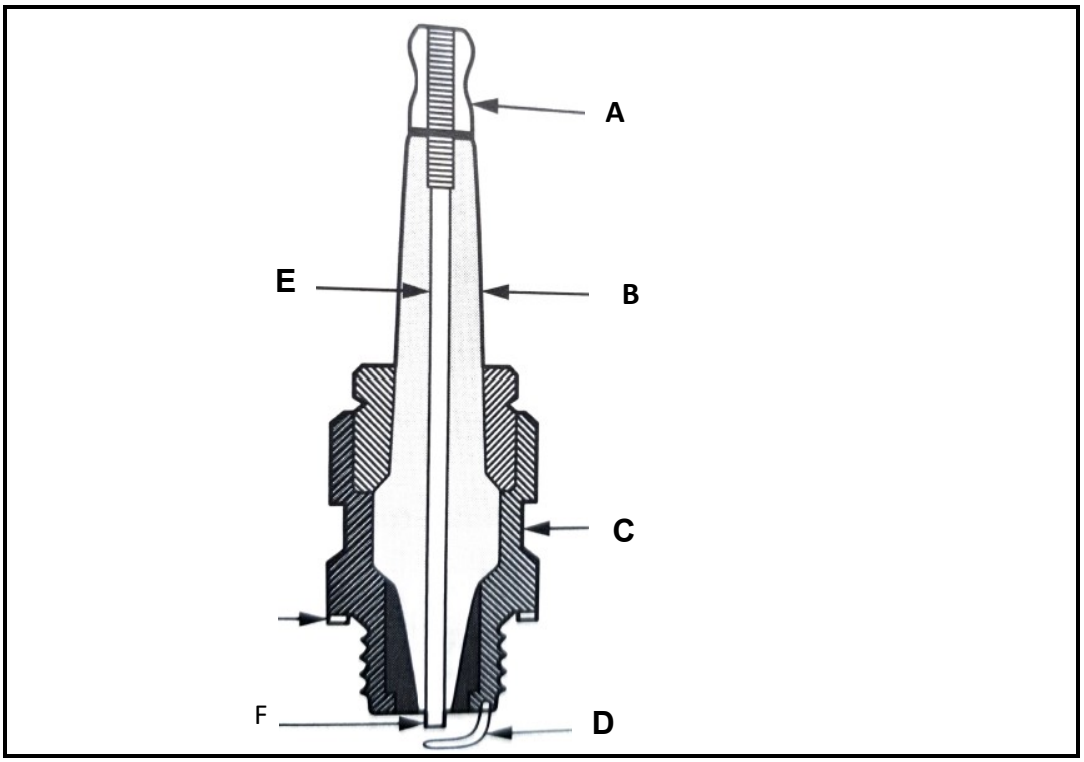


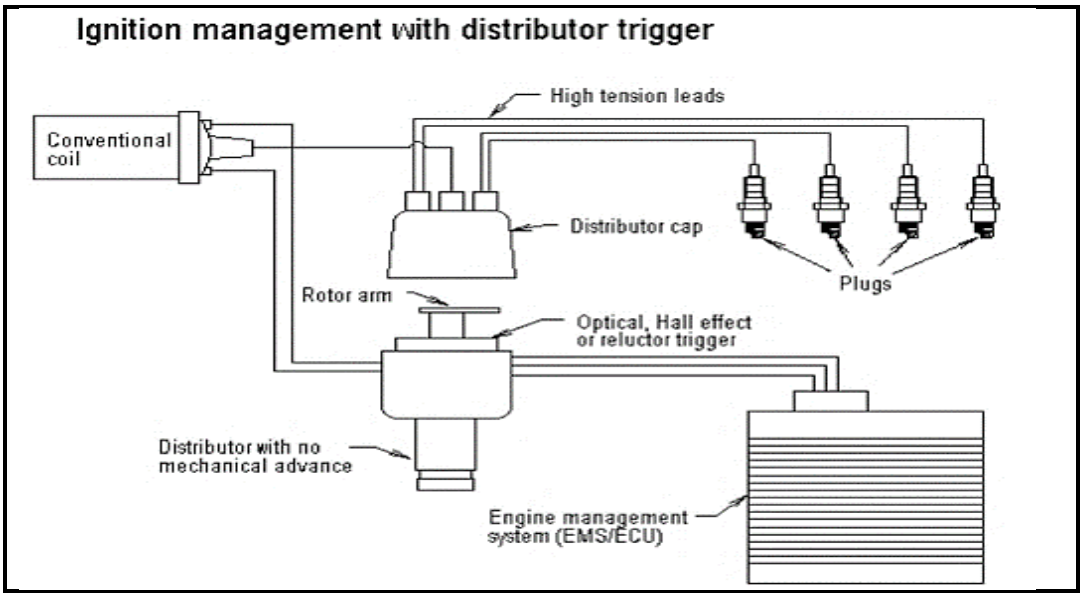

**FIGURE 7.6**

7.6.1 Label parts **A** to **F**. (6)

7.6.2 What is the function of a spark plug in a spark ignition engine? (2)

7.7 What is the firing order of a six cylinder V-engine? (1)

7.8 How many cylinders does the engine FIGURE 7.8 below have?




(1)

**FIGURE 7.8**

7.9 What is the function of a distributor in the ignition system of a spark ignition (SI) engine? (2)

**[25]**

## QUESTION 8: MAINTENANCE (SPECIFIC)

8.1 What type of oil pump is shown in FIGURE 8.1 below?

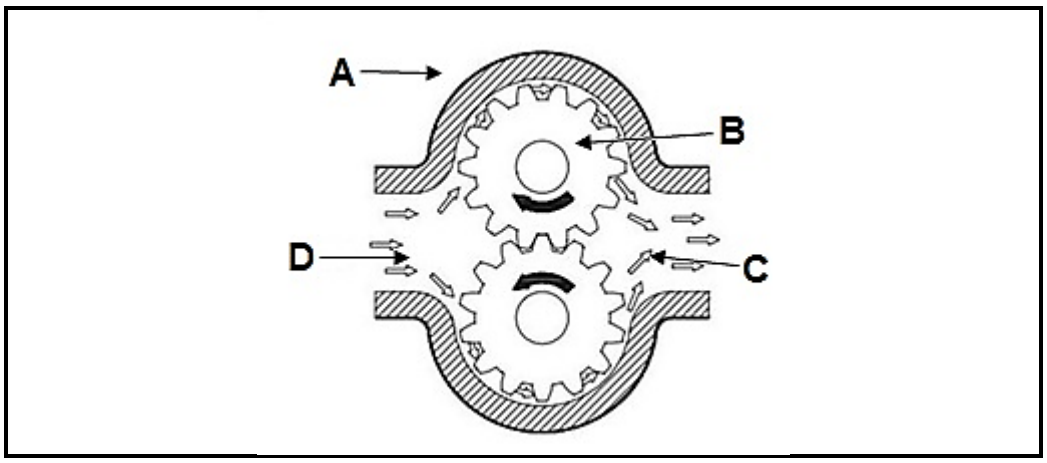



**FIGURE 8.1** (1)

8.2 Label parts **A** to **D** in FIGURE 8.1 above. (4)

8.3 Name TWO other types of oil pumps. (2)

8.4 Explain the function of a gasket in a vehicle. (2)

8.5 Name TWO places where a gasket can be applied in a vehicle. (2)

8.6 Name TWO types of lubrication used in vehicle components. (2)

8.7 What is the function of an oil seal? (2)
**[15]**

## QUESTION 9: FORCES (SPECIFIC)

9.1 A spark ignition (SI) engine has a cylinder diameter of 90 mm, a stroke length of 65 mm and a clearance volume of 69 $cm^3$. Calculate the compression ratio of the engine. (5)

9.2 What do you understand by the term *torque*? (2)

9.3 Briefly explain how torque can be created by an engine from the linear movement of the piston in that engine. (3)

9.4 Calculate the torque applied to a bolt by a torque wrench with a length of 500 mm from the point of grip, when a force of 300 N is applied. (3)

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

**[15]**

## QUESTION 10: TERMINOLOGY (SPECIFIC)

| | | |
|---|---|---|
| Name: Stanley | Date: 02 Nov 2020 | Cash |
| Job no. : 6048 | | Account |
| | Account number: | |
| Code: | | |
| Cellphone number: | | |
| Reg. nr.:FHC825EC | **Spares and materials used** | |
| Make: Honda | | |
| Model: CRV 2000 | Upper control arms | |
| Odometer: 129312 | Lower ball joints | |
| Engine no.: | Rear wheel bearings | |
| Chassis no.: | Thyroid ends and alignment | |
| Colour: Blue | | |
| Parts: | Order no.: | |
| Requisition no.: | | |
| Signature: ……..…….. | | |

You are requested to work on the suspension system of a vehicle. Use the job card given above to answer the questions below.

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

10.2 Explain the term *quality 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 $D = diameter\ of\ bore$
$l = clearance$

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

$$N = \frac{s}{\pi D}$$ where $\boldsymbol{s}$ = drilling speed
And $\boldsymbol{N}$ = speed of machine spindle