Province of the
EASTERN CAPE
EDUCATION

**NATIONAL SENIOR CERTIFICATE**

**GRADE 11**

**NOVEMBER 2019**

# MECHANICAL TECHNOLOGY: AUTOMOTIVE MARKING GUIDELINE

**MARKS: 200**

This marking guideline consists of 13 pages.

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

1.1 C ✓
1.2 B ✓
1.3 D ✓
1.4 C ✓
1.5 A ✓
1.6 B ✓
1.7 C ✓
1.8 A ✓
1.9 C ✓
1.10 B ✓
1.11 B ✓
1.12 D ✓
1.13 A ✓
1.14 A ✓
1.15 A ✓
1.16 B ✓
1.17 D ✓
1.18 C ✓
1.19 B ✓
1.20 B ✓ (20 x 1) **[20]**

## QUESTION 2: SAFETY (GENERIC)

2.1 **Gas welding (PPE)**

- Eye protection ✓
- Overall / leather apron ✓
- Safety boots ✓
- Gloves ✓ (Any 3 x 1) (3)

2.2 **Hydraulic Press**

- The predetermined pressure must not be exceeded ✓
- Pressure gauges must be tested regularly ✓
- The platform on which the work piece rests must be rigid and square ✓
- The platform must rest on the supporting pins ✓
- Place objects to be pressed in or out of the suitable jigs ✓
- Special tools and holding devices must be used to prevent damage to soft material ✓
- Ensure that the direction of pressure is always 90° to the platform ✓
- Relieve pressure after use by opening the return valve ✓ (Any 3 x 1) (3)

2.3 **Surface Grinder**

- Do not force the work piece into the wheel ✓
- Do not clean or adjust the machine while it is in motion
- Avoid large cuts ✓
- Use coolant ✓
- Know how to use the emergency stop ✓
- Keep an eye on the position of the work piece ✓
- Keep all tools clear of the work table ✓
- Do not leave the machine while it is in operation ✓
- Do not lean on the machine ✓ (Any 3 x 1) (3)

2.4 Switch off the machine. ✓ (1)

2.5 **Bench Grinder**

- Make sure that there are no cracks or chips on the disc ✓
- Make sure that the emery disc that is fitted is rated above the revolutions at which it is turned by the motor ✓
- Make sure that the space between the tool rest and the emery disc does not exceed 3 mm ✓
- Ensure that guards are in place ✓
- When switching on the machine, do not stand in front of it until it reaches its full speed ✓
- Do not force or bump the work piece against the emery disc . ✓
- Grind only on the front surface of the wheel, not the sides ✓
- All grinding machines must have a sign indicating the revolutions at which the spindle rotates ✓ (Any 3 x 1) (3)

2.6 To protect your eyes from flying sparks ✓ (1)

2.7 **Safety: Hand drill**

- Use a sharp drill of the right size for the type of material to be drilled ✓
- Remove the key from the chuck ✓
- Never leave the machine running unattended ✓
- Clamp the work piece securely on the vice or table ✓
- Never attempt to stop the machine with your hands if it slips ✓
- Do not force the drill on the work piece ✓
- Use a brush to remove chips from the drill ✓ (Any 3 x 1) (3)

2.8 **Handling of gas bottles/cylinders**

- Ensure the cylinders are stored in an upright position ✓
- The cylinders should be colour-coded ✓
- Full cylinders should be separated from empty ones ✓
- Keep away from direct sunlight ✓
- Keep protector cap on for protection ✓ (Any 3 x 1) (3)

2.9 **Band saw**

- Ensure there is no oil or grease around the machine ✓
- Ensure that all guides are in place before work commences ✓
- Ensure that the entire blade is guarded except at the point to cut ✓
- Ensure that the machine is switched off when changing blades or guides
- Wear eye protection ✓
- Ensure that the blade is fitted in the correct cutting direction ✓
- Round material must be clamped in a vice or holding device ✓
- Always use pusher against the work piece whenever possible ✓

(Any 3 x 1) (3)

2.10 Clamp the work piece in the vice or holding device ✓ (1)

**[24]**

## QUESTION 3: TOOLS AND EQUIPMENT (GENERIC)

3.1 **Function of tap and die set**

Tap is used to cut internal threads ✓ and die cuts external threads ✓ (2)

3.2 **Purpose of extension bar of guillotine**

Lengthens the work surface and supports longer material ✓✓ (2)

3.3
A Pressure gauge ✓
B Handle ✓
C Hydraulic press cylinder ✓
D Supporting pin ✓
E Adjustment holes ✓
F Plunger ✓ (6)

3.4 **Functions of equipment**

3.4.1 Angle grinder - is used for cutting, grinding and polishing ✓✓ (2)

3.4.2 Rolling machine – used to roll sheet metal ✓✓ (2)

3.4.3 Press machine – press fit or remove parts from each other ✓✓ (2)

**[16]**

## QUESTION 4: MAINTENANCE (GENERIC)

4.1 **Maintenance of pedestal grinder**
**Guards** - always check that they are clamped ✓ before operation and have adequate clearance ✓ from the rotating grinding wheel (6 mm) (2)

4.2 **Reducing friction when cutting holes**
Apply cutting fluid ✓
Apply oil to the tip of the drill bit ✓ (2)

4.3 **Overloading**
is when the lubrication bearer of oil is squeezed out of the machine-bearing surfaces ✓✓ (2)

4.4 **Lack of lubrication in a gear system**
- Without lubrication friction between teeth contact surfaces becomes too great, resulting in loss of efficiency ✓
- Excessive noise ✓
- Overheating ✓
- Eventual mechanical failure ✓ (Any 2 x 1) (2)

**[8]**

## QUESTION 5: MATERIALS (GENERIC)

5.1 **Raw materials in the production of iron:**
- Iron ore ✓
- Fuel (coke) ✓
- Fluxing agent (lime stone) ✓
- Air ✓ (Any 3 x 1) (3)

5.2 **Blast furnace product**
Pig Iron ✓
(1)

5.3 **Electric arc furnace**
It is useful in the production of stainless steel, other high-alloy steels, ✓ or special steels requiring very close metallurgical control ✓of grain or other structural qualities ✓
(3)

5.4 **Functions of furnaces**

5.4.1 **Blast furnace:** it is used to covert iron ore to pig iron ✓✓ (2)

5.4.2 **Bessemer converter furnace**
It is used to convert molten pig iron to steel by the Bessemer process ✓✓ (2)

5.4.3 **Open hearth furnace**
It is used to convert scrap metal and other alloying elements into different kinds of steel ✓✓ (2)

5.5 5.5.1 Blast furnace ✓ (1)

5.5.2
A Small bell ✓
B Stack ✓
C Melting zone ✓
D Iron tap hole ✓
E Hot air supply hole from stove ✓
F Steel casing ✓
G Hopper / Load ✓ (7)

5.6 **Advantages of rotor plant**

- The molten metal is protected by a layer of slag ✓
- The oxidation of iron and other elements is minimised ✓
- The melting loss is lower than that of the cupola furnace ✓ (3)

5.7 **Properties of metals**

5.7.1 **Ductility** is the ability of a metal to change shape by stretching it along its length without breaking or drawing it into wire form ✓✓ (2)

5.7.2 **Brittleness** is the ability of a metal to break easily and fracture with little or no deformation ✓✓ (2)

5.7.3 **Plasticity** is the ability of a metal to change shape permanently; it is the reverse of elasticity ✓✓ (2)

5.7.4 **Toughness** is the ability of a metal to resist penetration, cracking, bending, breaking or stretching and remain intact after continual bending in opposite directions ✓ (2)

**[32]**

## QUESTION 6: TOOLS AND EQUIPMENT (SPECIFIC)

6.1 6.1.1 Telescopic gauge ✓ (1)

6.1.2 Provides a quick and accurate means of checking internal measurement ✓ (1)

6.1.3 The measurement is determined by a micrometer ✓ (1)

6.2 6.2.1 Micrometer ✓ (1)

6.2.2 5 + 0,5 + 0,30 ✓ = 5,80 mm ✓ (2)

6.3 **Application of torque wrench**
It is used to tighten:

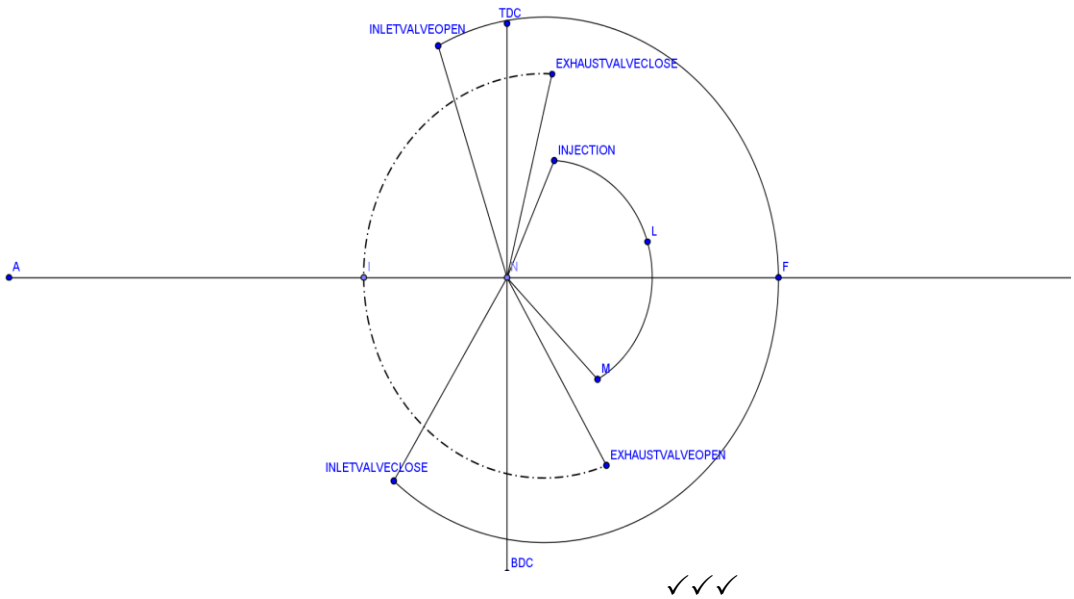
- Cylinder head bolts and nuts ✓
- Big-end bearings bolts and nuts ✓
- Locking nuts of front wheel bearing and rear axle assembly ✓
- Bolts and nuts on automatic gearbox ✓

(Any 3 x 1) (3)
**[9]**

## QUESTION 7: ENGINES (SPECIFIC)

7.1 **Function of a glow plug**
Heat up the cylinder ✓ in order to vaporize and ignite the injected fuel ✓ in cold start (when the engine is cold) ✓ (3)

7.2




✓✓✓ (3)

7.3 7.3.1 Inlet valve period

16 + 180 + 34 = 230° ✓ (1)

7.3.2 Exhaust valve period

36 + 180 + 12 = 228° ✓ (1)

7.3.3 Power period

180 – 36 = 144° ✓ (1)

7.3.4 Valve overlap

16 + 12 = 28° ✓ (1)

7.4 7.4.1 **Valve Lead**
A valve lead is when the valve opens before ✓ the piston reaches the TDC or BDC ✓ (2)

7.4.2 **Valve Lag**
A valve lag is when the valve closes after ✓ the piston has reached the TDC or BDC ✓

7.5 **Disadvantageous effect of excessive valve clearance**

- Noisy engine operation ✓
- Excessive wear in the valve mechanism components ✓
- Loss of power ✓

(Any 1 x 1) (1)
**[15]**

## QUESTION 8: SYSTEMS AND CONTROL (SPECIFIC)

8.1 Bevel gear ✓ (1)

8.2 **Functions of final drive**
- It provides a drive at right angles from the drive shaft to the side shafts of the axle assembly ✓
- It provides constant reduction between the speed of the drive wheel and the engine ✓ (2)

8.3 **Advantages of using hypoid gear assembly in final gear**
- Quiet in operation ✓
- It offers stronger drive ✓
- It ensures more efficient lubrication ✓
- It accommodates lower floor assembly ✓
- The pinion can be designed with larger and stronger teeth ✓

(Any 3 x 1) (3)

8.4 **Functions of differential**
- It allows the drive wheel to rotate at different speeds when the car navigates a sharp curve or corner ✓
- It enables even torque to be transmitted to the side shaft irrespective of the difference in the speed of rotation between the wheels ✓ (2)

8.5 8.5.1 Four-wheel drive ✓ (1)

8.5.2 A Half shaft ✓
B Front differential ✓
C Rear differential ✓
D Front drive shaft ✓
E Rear drive shaft ✓ (5)

8.5.3 **Purpose of four-wheel drive**
To enable better traction ✓ in unfavourable conditions ✓ (2)

8.6 8.6.1 **Function of the master cylinder**
It converts the applied force on the brake pedal into an effective pressure in the hydraulic brake lines ✓ (1)

8.6.2 **Function of the vacuum servo unit**
It improves the efficiency of the brake system by increasing the force on the drums or disc ✓ with relatively less applied force on the brake pedal ✓ (2)

8.7 **Factors that determine the braking distance of a car**

- Weather conditions ✓
- Road surface ✓
- Amount of brake pressure applied ✓
- Condition of the tyre ✓ (Any 1 x 1) (1)

8.8 **Working principles of a starter solenoid**

A solenoid consists of an iron core placed inside an electric coil. ✓ When electric current passes through the coil, a magnetic field develops around the coil ✓ which pulls the core into the coil ✓ (3)

8.9 **Starter solenoid drive mechanism**

- Bendix drive ✓
- Mechanical engaged drive ✓ (2)

8.10 In a cold spark-plug, the distance between the tip of the insulator at the firing point and the steel housing is relatively short. ✓ While in hot spark plug, the distance between the tip of the insulator at the firing point and the steel housing is relatively long. ✓ (2)

**[27]**

## QUESTION 9: MAINTENANCE (SPECIFIC)

9.1 **Purpose of oil pump**
To pump oil under pressure to a different part of the engine ✓ in order to prevent friction ✓ (2)

9.2 9.2.1 Vane pump (1)

9.2.2 A Outlet port ✓
B Rotor ✓
C Vane ✓ (3)

9.2.3 **Advantage of vane pump**
- It is characterised by smooth operation due to its rotary motion ✓
- The only reciprocating movement (vanes) is brief and slow and does not cause any vibrating effect on the system ✓
- The pump is very efficient at low speed ✓ (Any 2 x 1) (2)

9.3 9.3.1 **Function of oil seal**
It prevents the leakage of oil or grease ✓ (1)

9.3.2 **Function of gasket**
Gaskets are placed between two surfaces ✓ to prevent leakage of gas, water, oil and petrol ✓ (2)
**[11]**

## QUESTION 10: FORCES (SPECIFIC)

10.1

$$Swept\ volume = \frac{\prod D^2}{4} \times L \checkmark$$

$$Swept\ volume = \frac{\prod 9.6^2}{4} \times 72 \checkmark$$

= 521,153cm$^3$ ✓

$$Compression\ ratio = \frac{SV + CV}{CV} \checkmark$$

$$= \frac{521.153+74}{74} \checkmark$$

= 8 : 1✓ (6)

10.2 **Mean effective pressure**
It is the average pressure exerted on the piston ✓ during each power stroke ✓ (2)

10.3 **Types of mean effective pressure (MEP)**
- Indicated mean effective pressure ✓
- Brake mean effective pressure ✓ (2)

10.4 **Indicated power**
It is a measure to determine the power developed by the burning fuel within the cylinder of an engine ✓✓ (2)

10.5 P = 1 800 000 ✓

$L = 80mm = \frac{80}{1000}$ = 0,08m ✓

$D = 102mm = \frac{102}{1000}$ = 0,102m ✓

$N = 4300mm = \frac{4300}{60 \times 2}$ = 35,83r/s ✓

n=4

Area= $\frac{\prod D^2}{4}$ ✓

$= \frac{\prod X0.102^2}{4}$ = 8.17×10$^{-3}$ m$^2$ ✓

Indicated power = PLANn ✓

= 1800000 x 0.08 x 8.17 x 10$^{-3}$ x 35.83 x 4 ✓

= 168639.58W ✓ (9)

10.6 10.6.1 **Swept volume** is the volume the piston covers ✓ as it moves from BDC to TDC or from TDC to BDC ✓ (2)

10.6.2 **Clearance volume** is the volume of the space above the crown ✓ of the piston in the combustion chamber when the piston is at TDC ✓ (2)

10.6.3 **Torque** is a twisting effect ✓ applied on an object that tends to make the object to turn about its axis of rotation ✓ (2)

10.7 Torque = F x r ✓
=395 x 0,45 ✓
=177,75Nm ✓ (3)
**[30]**

## QUESTION 11: TERMINOLOGY (SPECIFIC)

11.1 11.1.1 **Capital**
It is the money needed for the establishment of the business which may be in the form of a loan. The capital is used to rent or buy the premises as well as for the running of the business. ✓✓ (2)

11.1.2 **Tools and equipment**
The most common equipment needed in the workshop includes a car lift, trolley jack, engine testing equipment, etc. but the availability of equipment depends on the job description. ✓✓ (2)

11.1.3 **Flow control**
Proper planning is required to ensure a smooth flow of work in order to make the best use of the available time and minimise loss of time owing to delays between tasks. ✓✓ (2)

11.1.4 **Quality control**
Upon the completion of work, the workshop foreman takes the vehicle for a test drive to ensure that everything on the job card has been done properly. ✓✓ (2)
**[8]**

**TOTAL: 200**