



**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2022

**MECHANICAL TECHNOLOGY: (AUTOMOTIVE)
MARKING GUIDELINE
(EXEMPLAR)**

MARKS: 200

This marking guideline consists of 12 pages.

SECTION A: COMPULSORY**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

- 1.1 C ✓
- 1.2 A ✓
- 1.3 D ✓
- 1.4 B ✓
- 1.5 C ✓
- 1.6 C ✓
- 1.7 A ✓
- 1.8 B ✓
- 1.9 D ✓
- 1.10 A ✓
- 1.11 C ✓
- 1.12 D ✓
- 1.13 D ✓
- 1.14 A ✓
- 1.15 C ✓
- 1.16 B ✓
- 1.17 B ✓
- 1.18 A ✓
- 1.19 C ✓
- 1.20 D ✓

(20 x 1) [20]

QUESTION 2: SAFETY**2.1 Accident**

An unplanned hazardous event ✓ caused by unsafe conditions or unsafe acts ✓

(2)

2.2 Unsafe act

- Adjusting machine that is in motion ✓
- Working at unsafe speed ✓
- Working without PPE ✓
- Working without authority
- Working without safety devices/rendering safety devices ineffective ✓
- Teasing fellow employee ✓
- Horse play ✓
- Running in the workshop while carrying sharp object ✓
- Using the wrong tools for the job ✓

(Any 3 x 1) (3)

2.3 Workshop safety rules.

- The workshop must be in a good working condition ✓
- The working area must be condoned off, ensuring maximum protection of other workers ✓
- Solid screens must be erected around workers who are welding, grinding or chipping ✓
- Workers must wear PPE ✓
- Any person assisting a worker operating a machine must also wear PPE ✓

(Any 3 x 1) (3)

2.4 Welding or flame cutting safety rules

- The operator must have been instructed on how to use the equipment safely ✓
- The workplace must have been effectively partitioned off ✓
- The operator must wear the correct PPE ✓
- The hose pipes must be fitted with flashback arrestor ✓ (Any 3 x 1) (3)

2.5 Safety precautions when handling gas cylinder

- Never stack cylinders on top of each other ✓
- Do not bang or work on the cylinder ✓
- Do not allow a cylinder to drop ✓
- Do not allow oil or grease to come in contact with oxygen fittings ✓
- All cylinders must conform with the standards set by South Africa Bureau of Standards (SABS) ✓ (Any 3 x 1) (3)

2.6 Flashback arrestor

To prevent the backward movement of gas into the cylinders, this can lead to a gas explosion. ✓✓ (2)

2.7 Safety precautions of a hydraulic press

- Ensure safe working pressure is not exceeded ✓
- Pressure gauge must be tested regularly and adjusted or replaced when it malfunctions ✓
- The platform on which the workpiece rest must be rigid ✓
- Platform must rest on supporting pins ✓
- Place object to be pressed in or out on a suitable jig ✓
- Relieve the cylinders of all pressure after use ✓
- Special tools should be used to prevent damage to soft materials ✓ (Any 3 x 1) (3)

2.8 Reason for wearing goggles when using a pedestal grinder

To prevent the eyes from sparks and sharp particles. ✓ (1)

[20]

QUESTION 3: TOOLS AND EQUIPMENT**3.1 Hand tool**

3.1.1 Tap wrench ✓ (1)

3.1.2 **Function**

To turn various sizes of taps into a drilled hole ✓✓ (2)

3.2 Types of taps

- Taper tap ✓
- Intermediate/second tap ✓
- Plug/bottoming tap ✓ (3)

3.3 3.3.1 Tool identification

- Manual guillotine ✓ (1)

3.3.2 Use of tool

- It is used to cut sheet of metals ✓✓ (2)

3.3.3 Labelling parts

- A – Adjusting nut ✓
- B – Pressure plate ✓
- C – Base ✓
- D – Spring loaded pedal ✓
- E – Extension bar ✓
- F – Cutting table ✓ (6)

3.3.4 Specification

1,2 mm ✓ (1)

3.4 Uses of angle grinder

- Cutting ✓
- Grinding ✓
- Polishing ✓ (3)

3.5 Ways of adjusting the speed of pedestal drilling machine

- Speed adjusting levers ✓
- Changing drive pulleys ✓ (2)

3.6 3.6.1 Depth gauge

It gives accurate measurement of the intended hole to be drilled ✓
and ensured that you don't go beyond the indicated depth. ✓ (2)

3.6.2 Motor

It converts electrical energy to mechanical energy ✓ used by the
spindle for the different machine operations. ✓ (2)

[25]

QUESTION 4: MAINTENANCE (GENERIC)**4.1 Factors to consider when selecting drilling speed**

- Type of material ✓
- Diameter of drill bit ✓
- Material of which the drill bit is made ✓
- Firmness with which the work is clamped ✓
- Condition of the machine ✓
- Use of cutting fluid ✓
- Rates of feed ✓

(Any 3 x 1) (3)

4.2 Drill speed

$$S = \pi DN$$

$$S = \frac{500}{1\,000} \checkmark = 0,5 \text{ m/s } \checkmark$$

$$N = \frac{0,5}{\pi \times 0,012} \checkmark$$

$$= 13,26 \text{ r/sec } \checkmark$$

$$= 795,77 \text{ r/min } \checkmark$$

(5)

4.3 Effect of excessive friction

Soften and dull the cutting tip of the drill bit ✓

(1)

4.4 Cooling method during drilling process

- Using oil (squatting oil from oil can) ✓
- Use of cutting fluid ✓

(Any 1 x 1) (1)

4.5 Causes of malfunction in a pedestal drilling machine

- Lack of lubrication ✓
- Overloading ✓
- Friction ✓

(3)

4.6 Consequences of poor cooling system in a horizontal band saw

- Excessive friction ✓
- Overheat ✓
- Damage to blade ✓
- Poor cutting efficiency ✓

(Any 3 x 1) (3)

4.7 4.7.1 Guards

Ensure the guards are securely clamped ✓

(1)

4.7.2 Screens

The screens must be kept clean ✓

(1)

4.7.3 Tool rest

The gap between the grinding face and the tool rest must not exceed 3 mm. ✓

(1)

4.7.4 Grinding wheel

It must be checked for cracks and dressed when necessary. ✓

(1)

[20]

QUESTION 5: TOOLS AND EQUIPMENT (SPECIFIC)**5.1 5.1.1 Tool identification**

Micrometre ✓

(1)

5.1.2 Parts Labelling

A – Anvil ✓

B – Spindle ✓

C – Spindle lock ✓

D – Barrel ✓

E – Thimble ✓

F – Ratchet ✓

G – Frame ✓

(7)

5.1.3 Function of a micrometre

It is used for checking external measurements ✓

(1)

5.2 Dial indicator parts labelling

A – Indicator needle ✓

B – Rotation needle ✓

C – Lock screw ✓

D – Plunger ✓

(4)

5.3 Uses of dial indicator

- Determine run-out of flywheel ✓
- Determine if the crankshaft is bent ✓
- Set-up workpiece on a four-jaw chuck of a centre lathe ✓
- Determine if two pieces of equipment are the same size ✓
- To measure wears between valve stem and valve guide ✓
- To measure and adjust backlash on differentials ✓

(Any 2 x 1)

(2)

[15]

QUESTION 6: ENGINES (SPECIFIC)**6.1 Valve arrangements**

- I-valve arrangement ✓
- W-head arrangement ✓
- L-head arrangement ✓

(3)

6.2 Function of a cam follower

It converts the reciprocating movement of the cams on the camshaft ✓ into a reciprocating movement of the valves. ✓

(2)

6.3 Advantages of a hydraulic cam follower

- Quiet in operation ✓
- Valve clearance adjustment is not required ✓
- Self-adjusting at variable temperatures ✓
- Smooth idling of engine ✓
- Zero valve clearance is maintained ✓

(Any 3 x 1) (3)

6.4 Purpose of valve clearance

- It allows for the expansion in the valve mechanism ✓ so that the valve will be properly closed ✓ and kept closed by the valve spring at all temperatures ✓

(3)

6.5 Disadvantages of excessive valve clearance

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

(2)

6.6 Advantages of belt drive in engine timing

- It is quiet in operation ✓
- Does not require lubrication ✓
- Belts are inexpensive ✓

(Any 2 x 1) (2)

6.7 Function of an injector in a CI engine

It breaks down the quantity of fuel from the injection pump ✓ and atomise it so that it will readily mix with the air in the combustion chamber ✓ and to inject the fuel under high pressure into the combustion chamber during the power stroke ✓

(3)

6.8 Advantages of using Piezo injectors

- Faster rate of fuel delivery ✓
- More precise fuel measurement ✓
- Highly reliable ✓
- Reduced emission ✓

(Any 3 x 1) (3)

6.9 Operating principle of a CVVT

It is installed in the intake camshaft of an engine, controlled by the oil control valve. ✓ It changes the opening and closing time of the intake valve in relation to engine load and speed ✓ thereby adjusting it to the optimum value. ✓

(3)

- 6.10 6.10.1 **Valve lead**
When it opens before ✓ the piston reaches TDC or BDC ✓ (2)
- 6.10.2 **Valve lag**
When it closes after ✓ the piston has reached TDC of BDC ✓ (2)
- 6.10.3 **Valve overlap**
It is the degree of the crankshaft rotation ✓ where both the intake and exhaust valves of one cylinder remain open ✓ (2)
- [30]**

QUESTION 7: SYSTEMS AND CONTROL (SPECIFIC)

- 7.1 **Brake pedal free play**
It is needed to prevent binding and overheating of the brakes ✓ (1)
- 7.2 **Factors that influence the stopping distance of a car**
- Weather conditions ✓
 - Road surface ✓
 - Brake pressure applied ✓ (3)
- 7.3 **Advantages of ABS in a motor vehicle**
- Prevents loss of directional stability while braking ✓
 - Steering control retained even at heavy braking ✓
 - It provides optimum braking at varying weather condition ✓ (Any 2 x 1) (2)
- 7.4 **Purpose of power steering**
Provides assistance with the steering of the vehicle ✓ (1)
- 7.5 **Advantages of power steering**
- Less effort required to turn steering ✓
 - More favourable gear ratio is achieved in the steering box ✓
 - It dampens road shocks to the steering wheel ✓
 - Enables easy vehicle parking ✓ (Any 2 x 1) (2)
- 7.6 **Functions of a shock absorber**
- They control the up and down movement of a vehicle body on the spring for the comfort of the passengers. ✓
 - They keep the wheels in full contact with the road for driving control and safety. ✓ (2)
- 7.7 **Effect of weak/worn shock absorber**
- Reduces comfort while driving ✓
 - Loss of stability and driver control ✓
 - Short lifespan of tyres, wheel bearing and steering linkages ✓
 - Bouncing motion of wheels and vehicle body ✓ (Any 3 x 1) (3)

7.8 Function of vacuum servo unit

Improves the efficiency of the brake system ✓ by increasing the force on the drum or disc with relatively less force applied to the brake pedal. ✓ (2)

7.9 Simple testing of servo unit

- With the engine switched off, apply the brakes several times ✓
- Keep the brake pedal well applied while you start the engine ✓
- If the servo unit is efficient, the brake pedal should drop slightly ✓ (3)

7.10 7.10.1 Function of an ignition coil

Converts battery voltage ✓ into enough high voltage that can produce sparks of sufficient intensity across spark plug gap. ✓ (2)

7.10.2 Function of a distributor

It directs high voltage from the ignition coil ✓ to the various spark plugs in a predetermined firing order. ✓ (2)

7.10.3 Function of an ignition switch

Regulates the current flow ✓ in the primary circuit of the car engine electronic control unit ✓ (2)

7.11 Firing order of a six-cylinder V-engine

1-4-2-6-3-5 ✓ (1)

7.12 Factors that determine firing order

- Position of the crank on the crankshaft ✓
- Arrangement of the cams of the camshaft ✓ (2)

7.13 Purpose of predetermined firing order

- Smoother engine performance because torsion of crankshaft is not concentrated on a specific section. ✓
- The heat caused by power stroke is evenly distributed and prevents local overheating or cooling. ✓ (2)

[30]

QUESTION 8: MAINTENANCE (SPECIFIC)**8.1 8.1.1 Oil pump Identification**

Vane pump ✓

(1)

8.1.2 Part labelling

1. Vane ✓
2. Rotor ✓
3. Pump housing ✓
4. Outlet port ✓
5. Working chamber ✓
6. Inlet port ✓

(6)

8.1.3 Advantages of oil pump (vane pump)

- Smooth operation ✓
- Very efficient at low speed ✓
- Fewer reciprocating parts with less displacement ✓ (Any 2 x 1) (2)

8.1.4 Other types of oil pump

- Gear pump ✓
- Rotor pump ✓ (2)

8.2 Function of a seal

Prevents the leakage of water, oil, or grease ✓ and also prevents dust or water from penetrating engine parts from the outside. ✓ (2)

8.3 Parts of a car where seals are used

- Fuel pumps
- Crankshafts
- Gearboxes
- Differentials (Any 2 x 1) (2)

[15]

QUESTION 9: FORCES (SPECIFIC)**9.1 Compression ratio calculation**

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

$$\text{Swept volume} = \frac{\pi 8,0^2}{4} \times 9,5 \checkmark$$

$$= 477,52 \text{ cm}^3 \checkmark$$

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

$$= \frac{477,52 + 80}{80} \checkmark$$

$$= 7 : 1 \checkmark$$

(6)

9.2 Torque

$$\text{Torque} = F \times r \checkmark$$

$$= 220 \times 0,6 \checkmark$$

$$= 132 \text{ Nm} \checkmark$$

(3)

9.3 Indicated power

It is a measure to determine the power developed \checkmark by the burning of fuel within the cylinder of an engine \checkmark

(2)

9.4 Indicated power calculation

$$P = 600\,000 \text{ Pa} \checkmark$$

$$L = 90 \text{ mm} = \frac{90}{1\,000} = 0,09 \text{ m} \checkmark$$

$$D = 100 \text{ mm} = \frac{100}{1\,000} = 0,1 \text{ m} \checkmark$$

$$N = 4\,080 \text{ rpm} = \frac{4\,080}{60 \times 2} = 34 \text{ r/s} \checkmark$$

$$n = 4$$

$$\text{Area} = \frac{\pi D^2}{4} \checkmark$$

$$= \frac{\pi \times 0,1^2}{4} = 7,854 \times 10^{-3} \text{ m}^2 \checkmark$$

$$\text{Indicated power} = PLANn \checkmark$$

$$= 600\,000 \times 0,09 \times 7,85 \times 10^{-3} \times 34 \times 4 \checkmark$$

$$= 57\,679,78 \text{ W}$$

$$= 57,68 \text{ kW} \checkmark$$

(9)

[20]

QUESTION 10: TERMINOLOGY (SPECIFIC)**10.1 Job card**

Replace the following:

- Engine oil filter ✓
- Transmission oil filter ✓
- Fuel filter
- Air filter ✓
- Cam belt ✓
- And change the engine oil and transmission oil ✓ (Any 3 x 1) (3)

10.2 Flow control

Proper planning is required to ensure smooth flow of work in order to make the best use of the available time and to minimize loss of time owing to delays between tasks. ✓✓

(2)
[5]

TOTAL: 200