Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

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MECHANICAL TECHNOLOGY MEMORANDUM

MARKS: **200**

This memorandum consists of 13 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

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QUESTION 2: SAFETY

2.1
- Store full cylinders apart from empty ones. ✓
- Keep cylinders in a cool place. ✓
- Always store and use cylinders in an upright position. ✓
- Never stack cylinders on top of one another. ✓
- Do not bang or work on cylinders. ✓
- Cylinders must be chained to prevent them from falling. ✓
- Do not allow oil or grease to come into contact with oxygen fittings as oil and oxygen together are flammable. ✓ (Any 3 x 1) (3)

2.2
- Guards must be fitted correctly. ✓
- Ensure there is no oil or grease in front of the machine or the floor. ✓
- Check that the tool rest is no more than 3 mm from the wheel. ✓
- Step aside when starting the machine. ✓
- Dress uneven wheels with an emery wheel dresser. ✓
- Grind only on the face of the grinding wheel and never on the side. ✓
- Never force grinding so as to slow the machine down. ✓ (Any 2 x 1) (2)

2.3
- Wear personal protective clothing. ✓
- Wear correctly shaded welding helmet. ✓
- Wear rubber soled shoes. ✓
- Ensure that equipment and cables are in good condition. ✓
- Floors must be dry. ✓
- There should be adequate ventilation to remove harmful fumes. ✓
- All electrodes must be kept dry. ✓ (Any 3 x 1) (3)

2.4
- All guards must be in place. ✓
- No loose clothing. ✓
- No oil or grease on the floor in front of the machine. ✓
- Do not use hands to remove cuttings. ✓
- Never adjust the cutting tool while machine is running.
- Do not lean as a habit on the machine.
- Do not attempt to stop the chuck by placing your hand on the chuck while the machine is slowing down. (Any 2 x 1) (2)

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QUESTION 3: TOOLS AND EQUIPMENT

3.1 Horizontal milling machine ✓
Vertical milling machine ✓ (2 x 1) (2)

3.2 Clean the tool after using it. ✓
Store it safely after using it. ✓
Ensure that the sockets fit properly onto it. ✓ (Any 2 x 1) (2)

3.3
- Taper taps ✓
- Second or intermediate taps ✓
- Bottoming taps or plug taps ✓ (3)

3.4
- Clean after use. ✓
- Never force the drill. ✓
- Oil the machine regularly. ✓
- Check rack on side of pillar column for damage. ✓
- Release the table lock before adjusting. ✓ (Any 3 x 1) (3)

3.5 Oxygen ✓ and
Acetylene ✓ (2)
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QUESTION 4: MATERIALS

4.1 Changing the structure and grain of metals ✓ by applying heat. ✓ (2)

4.2
- Low carbon steel ✓
- Medium carbon steel ✓
- High carbon steel ✓ (Any 2 x 1) (2)

4.3
- Water ✓
- Oil ✓
- Brine
- Liquid salts
- Molten lead
- Soluble oil
- Air (Any 2 x 1) (2)

4.4 4.4.1 C ✓ (1)

4.4.2 B ✓ (1)

4.4.3 D ✓ (1)

4.4.4 A ✓ (1)

4.5
- Heating the metal slowly to a certain temperature to ensure a uniform temperature. ✓
- Soaking the metal. ✓
- Cooling the metal at a certain rate to room temperature. ✓ (3)
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QUESTION 5: TERMINOLOGY

5.1 Arbor cutters:

- Plain milling ✓
- Side milling ✓
- Staggered tooth
- Slitting (Any 2 x 1) (2)

Shank cutters

- End mills √
- Shell-end √
- T-slot
- Woodruff (Any 2 x 1) (2)

5.2 Divides the circumference of the work piece into any number of equal parts. ✓
Holds the work piece in the required position while cuts are being made. ✓ (2)

5.3 5.3.1 The surface may be produced by any manufacturing process. ✓ (1)

5.3.2 It indicates the amount of stock to be removed. ✓ (1)

5.4

- Rapid indexing ✓
- Simple indexing ✓ (2)

5.5 NOTE: $\frac{\theta}{2} = \frac{6^\circ}{2} = 3^\circ$ ✓

$\text{Tan } \theta = \frac{D-d}{2\,x\,L}$ ✓

$\text{Tan } 3^\circ = \frac{50-d}{2\,x\,120}$ ✓

$0{,}0524 = \frac{50-d}{240}$ ✓

$d = 0{,}0524 \times 240 - 50$ ✓

$d = 37{,}42$ mm ✓ (6)

5.6 Sin θ = $\frac{Distance\ across\ the\ flat\ side\ (X)}{40}$

X = Sin θ x 40

X = Sin 60° x 40 ✓

X = 0,866 x 40 ✓

X = 34,64 mm ✓ (Distance across the flat side)

Depth of cut (x) = $\frac{40 - X}{2}$ ✓

x = $\frac{40 - 34,64}{2}$ ✓

x = 2,68 mm ✓ (Depth of cut of the biggest hexagon) (6)

5.7 Indexing = $\frac{40}{N}$ ✓

= $\frac{40}{20}$ ✓

Indexing = 2 Full turns ✓ (3)

5.8 5.8.1 Force ✓ (1)

5.8.2 Pa. ✓ (1)

5.8.3 Watt ✓ (1)

5.9 Bow's notation:

It is the method which can be used to simplify problem solving ✓ where three or more forces are applied to a body in a system of forces. ✓ (2)

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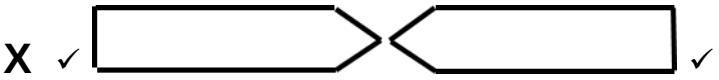
QUESTION 6: JOINING METHODS

6.1 6.1.1 Square butt joint:

(2)

6.1.2 Double-V-butt joint:



(2)

6.1.3 Single-J-butt joint:

(2)

6.2 Welding positions:

- Flat position. ✓
- Horizontal position. ✓
- Vertical position. ✓
- Oblique position. ✓
- Overhead position
- All round position (Any 4 x 1) (4)

6.3 Rightward gas welding:

- Rightward gas welding or backhand gas welding is usually used for welding material 4 mm thick and thicker. ✓
- Here the rod follows the flame, ✓ which tends to anneal the welded joint as the welding progresses. ✓
- The rod is held at 30° – 40° with the base metal and the flame at 40° – 50°. ✓ (4)

6.4 Shut down procedure:

- Shut off the acetylene and oxygen stop valves. ✓
- Shut off the gas mains.(cylinder valves) ✓
- Purge the system. ✓
- Reset regulators to zero outlet pressure. ✓
- Close the torch valves. ✓ (5)

6.5 Welding symbol elements:

- Reference line ✓
- Arrow ✓
- Weld symbol ✓
- Supplementary symbol(s) ✓
- Dimension(s) ✓
- Tail ✓
- Specification, process or other reference(s) (Any 6 x 1) (6)

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QUESTION 7: FORCES

7.1 Resultant:

If a system of forces acts on a body and a single force can be found ✓ that has the same effect as the system, that single force is known as the resultant. ✓ (2)

7.2 Types of forces:
Resultant ✓
Equilibrium ✓
Equilibrant ✓ (3)

7.3 Given:

Load = 12 kN = 12 x 10^3 N
Stress = ?

Cross sectional area = $\frac{\pi D^2}{4}$

= $\frac{\pi 25^2}{4}$ ✓

= $\frac{\pi .625}{4}$ ✓

= 490,9 mm^2 ✓

Stress = $\frac{12\ x\ 10^3}{4{,}909\ x\ 10^{-4}}$ ✓

= 24 444 897 Pa ✓

Stress = 24,445 MPa ✓ (6)

7.4 Stress = $\frac{Load}{Cross\ sectional\ area}$

= $\frac{10 \times 10^3}{400}$ ✓✓

= $\frac{10 \times 10^3}{\frac{400}{10^6}}$ ✓✓

= 25 000 000 Pa ✓

= 25 MPa ✓ (6)

7.5 7.5.1 RL: (RR x 8) = (4 x 3) + (5 x 5) ✓
= 12 + 25 ✓
= 37 ✓
RR = 4,625 N ✓ (4)

AND

RR: (RL x 8) = (5 x 3) +(4 x 5) ✓
= 15 + 20 ✓
= 35 ✓
RL = 4,375 N ✓ (4)

7.5.2 Bending moments:

BM_A = (4,375 x 3) ✓ = 13,125 N ✓
BM_B = (4,375 x 5) – (4 x 2) ✓
= 21,875 – 8 ✓
= 13,875 N ✓ (5)
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QUESTION 8: MAINTENANCE

8.1 Reasons for doing wheel alignment.
- To ensure maximum tyre life. ✓
- Optimal road holding. ✓
- To reduce excessive tyre wear.
- To reduce steering or tracking problems. (Any 2 x 1) (2)

8.2 Implications of unbalanced revolving parts:
- Causes excessive wear. ✓
- Causes vibration. ✓ (2)

8.3
- Types of balancing:
- Static balancing ✓
- Dynamic balancing. ✓ (2)

8.4 8.4.1 Fluid friction:
Objects moving through liquid or gas experience fluid friction or drag. ✓✓ (2)

8.4.2 Rolling friction:
Rolling friction works against the motion of a rolling object e.g. a cricket ball on the outfield of a cricket ground as it moves away from the batsman. ✓✓ (2)

8.4.3 Sliding friction:
Sliding friction is the force that resists the motion ✓ of an object as it moves along a surface. ✓ (2)

8.5 Ackerman principle
- To avoid having the tyres slip sideways when cornering. ✓
- To reduce tyre wear. ✓ (2)

8.6 Meaning of calamites:
Disasters. ✓ (1)

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QUESTION 9: SYSTEMS AND CONTROL

9.1 Factors of grip of belt drives:

- The area of contact ✓
- The tension ✓
- The coefficient of friction ✓ (3)

9.2 Advantages of belt drives:

- It is cheaper than gear drives. ✓
- It is quieter than gear drives. ✓ (2)

9.3 Disadvantages of gear drives:

- A great deal of wear and tear is caused by friction. ✓
- Gears are difficult and expensive to manufacture. ✓
- Large amounts of power are needed to overcome friction between them. (2)

9.4 Function of valves in hydraulic system:

- Regulating pressure in a circuit. ✓
- Directing hydraulic fluid into a specific direction. ✓
- Determine the amount of fluid that will flow in the circuit. (2)

9.5 Speed of the driven shaft:

π x D_A x N_A = π x D_B x N_B

π x 250 x 700 = π x 120 x N_B ✓

$N_B = \frac{\pi \times 250\ 750}{\pi \times 120}$ ✓✓

N_B = 1 458,3 rpm ✓ (4)

9.6 Pressure in hydraulic fluid:

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

A = $\frac{\pi 320^2}{4}$

A = 80 424 mm^2 √

Pressure = $\frac{F}{A}$ ✓

P = $\frac{15\ 000}{80\ 424}$ ✓

P = 187,5 kPa ✓ (5)

9.7 Calculation of output speed:

$$\frac{N_O}{N_T} = \frac{T_A \times T_C}{T_B \times T_D}$$

$$\frac{N_O}{840} = \frac{35 \times 43}{86 \times 70} \checkmark$$

$$\frac{N_O}{840} = \frac{1\,505}{6\,020}$$

N_0 = 0,25 x 840 ✓

Output speed = 210 rpm ✓ (3)

9.8 Applications of screw threads:

- To hold parts together. ✓
- To transmit motion. ✓
- To transmit power. ✓
- To adjust parts with reference to one another. ✓ (4)

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QUESTION 10: PUMPS

10.1 Parts of reciprocating pumps:

- Inlet valve. / Intake valve. / Admission valve (Any 1) ✓
- Outlet valve. / Discharge valve. / Exhaust valve (Any 1) ✓
- Plunger / Piston. (Any 1) ✓ (3)

10.2 Advantages of gear pumps:

- Very efficient. ✓
- Can develop high pressure. ✓
- No reciprocating parts that can cause vibration. ✓
- Drive is always positive.
- No valves or springs. (Any 3 x 1) (3)

10.3 Disadvantages of vane pump:

- Wear on the vanes are high. ✓
- The pump cannot develop high pressure. ✓
- They can cause pulsation. ✓ (3)

10.4 Causes of "water hammer"

- The valve or stop cock in the pipeline can suddenly close. ✓
- During the delivery stroke, the water moves up the delivery pipe. ✓ (2)

10.5 Definition of "water hammer"

- Water hammer is a loud hammering in the pipeline, which is called the "knock" sound. ✓✓ (2)

10.6 Causes of pump slip:

- Worn external packing. ✓
- Worn internal packing. ✓
- A strainer exposed above the fluid level. ✓
- A faulty foot valve. ✓
- Faulty or loose flanges or joints. ✓
- A weak or faulty seat or spring of a valve. (Any 5 x 1) (5)

10.7 Types of relief valves:

- A plunger pressure relieve valve. ✓
- A ball pressure relieve valve. ✓ (2)

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TOTAL: 200