Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2015

MECHANICAL TECHNOLOGY MEMORANDUM

MARKS: **200**

This memorandum consists of 10 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

QUESTION 2: SAFETY

2.1 2.1.1 True ✓ (1)
2.1.2 True ✓ (1)
2.1.3 False ✓ (1)
2.1.4 False ✓ (1)

2.2
- Ensure that there is no oil or grease on the floor. ✓
- Check that the tool rest is not more than 3 mm away from the grinding wheel surface. ✓
- If the wheel is running unevenly dress it with an emery-wheel dresser. ✓
- Grind only on the face of a straight grinding wheel and never on the side of the wheel. ✓
- Use the various wheels only for their intended purpose.
- Never force grind so that you cause the motor to slow or stop.

(Any 4 x 1) (4)

2.3
- All machinery must be fitted with an efficient stopping and starting device. ✓
- Never start a machine while another person is repairing, cleaning, oiling or adjusting or even dangerously close to it. ✓
- Machines with foot-operated pedals should have an automatic locking device to stop. (Any 2 x 1) (2)

[10]

QUESTION 3: TOOLS AND EQUIPMENT

3.1
- Should be used in the correct order (taper tap first). ✓
- A tap must be entered squarely in the tap wrench. ✓
- The correct size tapping drill must be used. ✓
- A tap is at a right angle to the stock once cutting has started.
- The tap is turned forwards a part-turn and then turned backward about half a turn to break off the chippings. (Any 3 x 1) (3)

3.2 Cutting fluid or cutting paste ✓ (1)

3.3 To compare the threads on a bolt to the teeth cut on the gauge or
To assess the pitch of the bolt. ✓ (1)

3.4
- Always select correct blade. ✓
- Always clean cuttings out of slots and guides to prevent blades from becoming clogged. ✓
- Always adjust down pressure in order not to overload.
- Check that the filler tank is in a serviceable state. (Any 2 x 1) (2)

3.5 Changes the welding current from AC to DC. ✓ (1)

3.6
- It prevents bolts and nuts from loosening. ✓
- It prevents bolts or studs from breaking. ✓
- It prevents castings from warping. (Any 2 x 1) (2)

3.7 To cut material by means of an electrical method. ✓ (1)

3.8 Always keep blades sharp and in good condition. ✓
Ensure guards are in place and operational. (Any 1 x 1) (1)

[12]

QUESTION 4: MATERIALS

4.1 Open-hearth furnace ✓ (1)

4.2 4.2.1 Refers to the material's ability to absorb forces and flex in different directions ✓and return to its original shape when the load is removed. ✓ (2)

4.2.2 Refers to the material's ability to change shape by stretching it along its length, ✓ or to be drawn into wire form. ✓ (2)

4.2.3 Refers to the material's behaviour when fractures occur ✓with little or no deformation e.g. glass. ✓ (2)

4.2.4 Refers to the materials ability to be reshaped in all directions ✓ without cracking e.g. lead. ✓ (2)

4.2.5 Refers to the material's ability to change shape permanently. ✓ (1)

4.3
- Water and salt. ✓
- Tap water. ✓
- Fused or liquid salts. ✓
- Molten lead.
- Soluble oil.
- Oil or air.

(Any 3 x 1) (3)

[13]

QUESTION 5: TERMINOLOGY

5.1 Set the indexing for 6(six) divisions(six flat sides)
Calculate the distance x across the flat sides.

Sin Θ = $\frac{x}{100}$ ✓

X = Sin 60° x 100 ✓

X = 0,866 x 100 ✓

X = 86,6 mm ✓

Depth of cut = $\frac{Dia.of\ shaft - \ distance\ across\ flat\ side}{2}$

= $\frac{100-86,6}{2}$ ✓

Depth of cut = 6,7 mm ✓ (6)

5.2
- Release the lock nuts of the compound slide. ✓
- Swing the compound slide to half the included angle. ✓
- Tighten the lock nuts (take care not to over tighten). ✓
- Mount the cutting tool in the tool holder in the tool post. ✓
- Set the cutting tool to the centre of the tailstock. ✓
- Use the compound slide feed handle and feed the cutting tool slowly into the work piece. ✓
- Proceed to the end of the cutting length. ✓
- Return to the starting position and feed the cutting tool in for the next cut. ✓
- Repeat the procedure until the taper is completed. ✓
- On completion, test the taper with the taper ring gauge for size and correct angle. ✓

(10)

5.3 Taper angle = $\frac{D-d}{2\ x\ L}$

= $\frac{90-80}{2\ X\ 180}$ ✓–

= $\frac{10}{360}$ ✓

= 0,O27 ✓

Θ = 1°59′✓

Θ = 1°35′✓

The angle is 1 degree and 35 minutes. ✓ (6)

5.4 Sin Θ = $\frac{X}{70}$

X = 70 Sin Θ ✓

= 70 Sin 45° ✓

x = 49,5 mm ✓

Depth of cut = $\frac{70-x}{2}$ ✓

= $\frac{70-49,5}{2}$ ✓

= 10,25 mm ✓ (6)

5.5 Indexing: Number of turns = $\frac{40}{N}$

Number of turns = $\frac{40}{5}$ ✓

Number of turns = 8 full turns of the shank ✓ (2)

[30]

QUESTION 6: JOINING METHODS

6.1 It is permanent joints that do not have to be dismantled or serviced. ✓ (1)

6.2
- Flux is used together with soldering to dissolve metal oxides and impurities on the metal ✓
- This allows the solder to flow into the joint. ✓
- The soldered joints are usually heated by an electric soldering iron or LP gas blowtorch. ✓
- The solder is applied when the surfaces are heated to melting point. ✓ (4)

6.3 Hard soldering. ✓/Brazing (1)

6.4
- The more welding runs that are required in a welding joint, the greater the heat in the parent metal. ✓
- It can lead to stress and distortion if not managed correctly. ✓ (2)

6.5
- Sizes of weld depends on the type of weld. ✓
- The size of the weld will affect how many weld runs will be needed to complete the joint. ✓ (2)

6.6
A Square butt ✓
B Single bevel butt ✓
C Double bevel butt ✓
D Single V-butt ✓
E Double V- butt ✓
F Edge ✓
G Single-U-Butt ✓
H Stud ✓ (8)

6.7
- Type of material. ✓
- Type of welding rod. ✓
- Presence of oxygen/hydrogen ✓
- Preparation ✓ (4)

6.8 6.8.1 Fillet

6.8.2 Plug or slot

6.8.3 Stud (3)

[25]

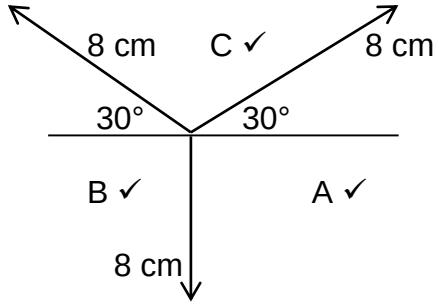
QUESTION 7: FORCES

7.1 7.1.1 If a system of forces acts on a body but a single force keeps the body at rest, ✓the single force is known as the equilibrant of the system of forces. ✓ (2)

7.1.2 If three forces, whose lines of action meet at a point, ✓ can be represented in magnitude and direction by the sides of a triangle, they are in equilibrium. ✓ (2)

7.1.3 If two or more forces have the same effect as a single force, ✓ these forces are called the components of the single force. ✓ (2)

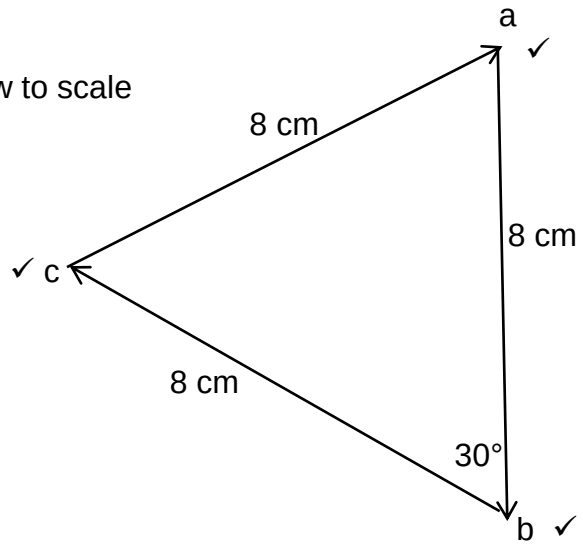
7.2 7.2.1



Scale: 4 cm = 10 N

(3)

7.2.2



(3)

7.2.3 Because the force diagram's end point is the same as its starting point. ✓ (1)

7.3 7.3.1 RR x 10 = (6 x 3) + (5 x 8) ✓
= 18 + 40
RR = 58/10
RR = 5,8 N ✓

RL X 10 = (5 x 2) + (6 x 7) ✓
= 10 + 42
L = 52/10
RL = 5,2 N ✓ (4)

7.3.2 BM A = (5,2 x 3) ✓ = 15,6 N/m ✓
BM B = (5,2 x 8) – (6 x 3) ✓ = 23,6 N/m ✓ (4)

7.3.3 RL + RR = DOWN FORCES
5,2N + 5,8N = 6N + 5N
11N = 11N ✓ (1)

7.4 Cross sectional area = (32 x 32) – (26 x 26) ✓ Load: 70 kN = 70 x 10^3
= 1024 - 676
= 348 mm² ✓

Stress = $\frac{Force}{Area}$

= $\frac{70\ x\ 10^3}{\frac{348}{10^6}}$ ✓

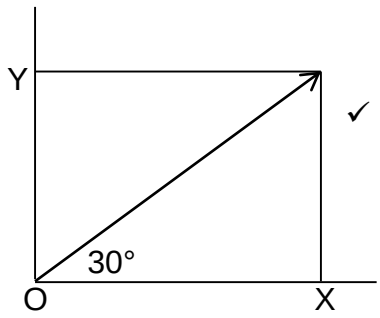
Stress = 2011494253 Pa ✓

OR

= 2011,49 x 10^6 Pa

Stress = 2011,49 MPa ✓ (5)

7.5 7.5.1



✓ (1)

7.5.2 X = F Cos 30°

= 220 x 0,866

Horizontal component = 190, 52 N ✓

Y = F Sin 30°

= 220 x 0,5

Vertical component = 110 N ✓ (2)

[30]

QUESTION 8: MAINTENANCE

8.1 8.1.1 Unbalanced wheels will cause:

- Unnecessary tyre wear. ✓
- Poor driving condition. ✓
- Excessive wear on the steering and suspension. ✓
- Shaking of the wheel assembly from side to side (wheel shimmy). ✓ (4)

8.1.2 Overloading of machines:

- When a machine is overloaded it will cause the lubricating barrier of oil to be squeezed out of the machine bearings. ✓
- This results in metal to metal contact that causes more friction due to heat. ✓
- Metal surfaces become scratched and scored, which will finally seize the operating system. (Any 2 x 1) (2)

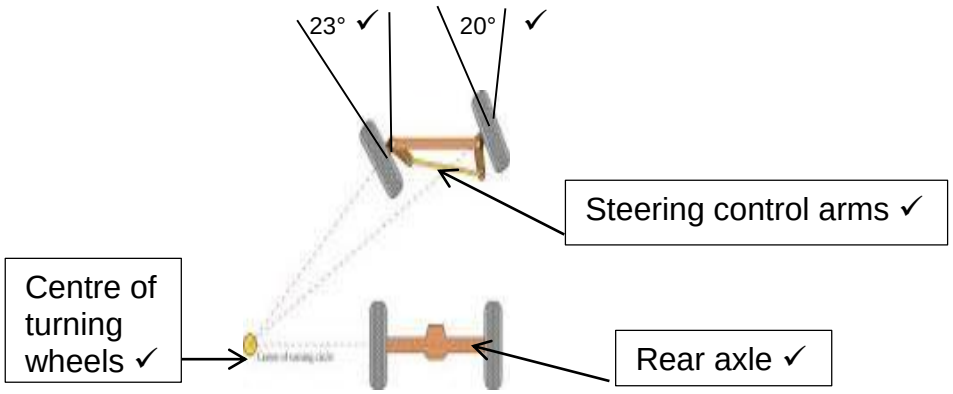
8.2 It is the outward tilt of the wheel at the top ✓ away from the vehicle when viewed from the front. ✓ (2)

8.3 It is the setting of an angle relative to the true vertical line, ✓ as viewed from the front or back of the vehicle. ✓

OR

Kingpin inclination is the inward tilt from the vertical in degrees. (2)

8.4



(5)
[15]

QUESTION 9: SYSTEMS AND CONTROL

9.1 The handbrake lever pulls on a single cable, ✓which is coupled to a pivoted T-piece to transmit the pull identically or evenly to both rear brakes, ✓or there may be two cables from the handbrake lever, one to each of the rear brakes. ✓ (3)

9.2
- When the driver pushes down on the clutch pedal, a push rod is forced into the master cylinder. ✓
- As the push rod moves down into the master cylinder, the rod forces a piston down the cylinder. ✓
- This action puts pressure on the hydraulic fluid in the cylinder, and some of the fluid is forced out. ✓
- The fluid flows through a tube or pipe into a servo cylinder at the clutch. ✓
- The fluid flowing into the servo cylinder from the master cylinder, forces the piston in the servo cylinder to move. ✓
- This movement is carried through a push rod to the release lever, thus releasing the clutch. ✓ (6)

9.3
$$\frac{Revs\ of\ final\ driven}{Revs\ of\ first\ driver} = \frac{Product\ of\ Number\ of\ teeth\ on\ all\ the\ drivers}{Product\ of\ Number\ of\ teeth\ on\ all\ the\ driven}$$

$$\frac{N_D}{N_A} = \frac{T_A}{T_B} \times \frac{T_C}{T_D} \checkmark$$

$$N_D = \frac{T_A}{T_B} \times \frac{T_C}{T_D} \times N_A \checkmark$$

$$= \frac{20}{80} \times \frac{63}{42} \times 12 \checkmark$$

$$N_D = 4{,}5 \checkmark$$

Rotational frequency of driven shaft = 4,5 r/s. ✓ (5)

9.4 <u>Determine the effective tension:</u>

Given: $\frac{T_A}{T_B}$ = 2 : 1 = 2 AND T_A = 600

$T_B = \frac{600}{2}$ = 300 N ✓

Effective tension in belt = $T_A - T_B$

= 600 – 300 ✓

= 300 N ✓

$\frac{Distance\ moved}{S}$ = ∏ X D X N

= ∏ X $\frac{300}{1000}$ X $\frac{950}{60}$ ✓

= 14,92 m/s

Power transmitted = $\frac{300\ X\ 14{,}92}{1000}$ ✓

= 4,48 kW ✓ (6)

9.5 Pressure = $\frac{Force}{Area}$

= $\frac{7500}{3}$ ✓

= 2 500 Nm² ✓

= 2 500 Pa ✓ (3)

9.6 It draws in fluid as it is pulled back (or retracted) ✓ and expels it on the forward stroke. ✓ (2)

[25]

QUESTION 10: PUMPS

10.1
A Inlet port ✓
B Driven gear ✓
C Driver gear ✓
D Casing ✓
E Outlet port ✓ (5)

10.2
- When one of the vanes moves past the inlet port, the space between this vane, the rotor and the housing increases gradually. ✓
- This causes a vacuum in the space, which causes oil to be drawn from the sump. ✓
- When the next vane moves past the inlet port, the oil is trapped and is carried along by the rotating rotor. ✓
- Due to the eccentric rotor, the space now decreases and the oil is pressurised. ✓
- The first vane now moves past the outlet port while the space is still decreasing. ✓
- The decreasing space and the next vane force the oil through the outlet port to the oil channels. ✓ (6)

10.3
- Pumping grout/cement ✓
- Pumping lubrication oil ✓
- Pumping marine diesel fuel ✓
- Pumping mining slurry ✓
- Pumping oilfield mud (Any 2) (2)

10.4
- Grout/cement pump ✓
- Lubrication oil pump ✓
- Marine diesel fuel pump ✓
- Mining slurry pump ✓
- Oilfield mud motors ✓
- Winery use ✓ (Any 2) (2)

10.5
- The centrifugal pump consists of a casing which contains a rotating wheel with blade or vanes. ✓
- This rotating wheel is known as an impeller of the pump. ✓
- If the pump casing is filled with fluid and the impeller is in operation, the impeller will sling the fluid outwards by centrifugal force, and force it out at the outlet. ✓
- This creates a vacuum at the centre, or eye, of the impeller. ✓
- As a result of atmospheric pressure, fluid is again drawn through this eye into the pump casing. ✓ (5)

[20]

TOTAL: 200