Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2013

MECHANICAL TECHNOLOGY MEMORANDUM

MARKS: **200**

This memorandum consists of 10 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

ANSWER SHEET

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

(20 x 1) **[20]**

QUESTION 2: SAFETY

2.1
- Negligence
- Untidy workplace – tools/parts lying around √
- Loose clothing – loose clothing at rotating machines √
- Wrong use of tools – use tools for purpose it is invented for
- Inaccurate setup of machines – do not exceed the limits (Any 2 x 1) (2)

2.2
- The safety guard must be in place before starting √
- Protective shields must be placed around the object being grinded to protect people passing √
- Use the correct grinding disc for the job
- Do not force the grinding disc on the work
- Make sure that there are no cracks on the disc before you start
- Protective clothing and eye protection are essential (Any 2 x 1) (2)

2.3
- Store full cylinders apart from empty ones √
- Store in a cool place and protects them from sunlight and other heat sources √
- Store and use in a upright position √
- Store oxygen separate from acetylene
- Never stack cylinders on top of each other
- Never bang on cylinders or let them fall
- Do not allow grease near oxygen cylinders
- Keep the caps on the cylinders for protection (Any 3 x 1) (3)

2.4 2.4.1
- There should be sufficient lighting in workplace √
- Glare must be reduced so that it does not affect the workers sight
- Lightening on revolving machines must not have a stroboscopic affect
- Lights must be clean and maintained (Any 1 x 1) (1)

2.4.2
- Workers must inhale safe air √
- The concentration flammable gasses, vapours or dust must not exceed the safety levels (Any 1 x 1) (1)

2.5 The drive must be caged in so that it cannot be reached normally √ (1)

[10]

QUESTION 3: TOOLS AND EQUIPMENT

3.1 3.1.1 The dial gauge √ (1)

3.1.2 1 – Lock screw √
2 – Indicator pointer √
3 – Rotation indicator √
4 – Plunger √ (4)

3.1.3
- Over travel of pointer must not result in damage to DTI. √
- Do not let it drop or fall. √
- Store in a proper storage place.
- Clean DTI plus magnetic base after use. (Any 2 x 1) (2)

3.2 79 mm √ (1)

3.3 Thread pitch gauge √ (1)

3.4 N.m (newton.meter) √ (1)

3.5
- It prevents bolts or studs from breaking. √
- It prevents bolts and nuts from loosening. √
- It prevents castings from warping. (Any 2 x 1) (2)

[12]

QUESTION 4: MATERIALS

4.1
- It is the controlled heating and cooling of metals in their solid state so √
- as to change their properties. √ (2)

4.2
- The material's ability to absorb forces and bendings in different directions and to return back to the original shape √ when the load is removed. √ (2)

4.3 4.3.1 Produce a fine grain structure which is very hard. √ (1)

4.3.2 Relieves the strains induced and reduce brittleness. √ (1)

4.3.3 To make the material ductile refine grain structure and reduce brittleness. To soften the material for machining. √ (1)

4.3.4 To relieve internal stresses produced by machining, forging or welding. √ (1)

4.4
- Carburising √
- Nitriding (nitrogen/gas hardening) √
- Cyaniding/liquid hardening (Any 2 x 1) (2)

4.5
- The hardness penetrates the core √ and causes brittleness. √ (2)

4.6
- Brine cools twice as rapid as water. √
- It tends to remove scale from the steel.
- Which causes steel to cool more uniformly. (Any 1 x 1) (1)

[13]

QUESTION 5: TERMINOLOGY (MANUFACTURING PROCESS)

5.1 Angle for the compound slide: θ

Tan $\theta = \frac{D-d}{2 \times L}$ √ = $\frac{39,6-22}{2 \times 50}$ √

$Tan\ \theta = \frac{17,6}{100}$ √

θ = 9,98º √ (5)

5.2
- Can be set at any angle √
- Larger angles can be turned √
- Internal as well as external tapers (Any 2 x 1) (2)

5.3 5.3.1 Ind = $\frac{40}{N}$ √ = $\frac{40}{23}$ = $1\frac{17 \times (2)}{23 \times (2)}$ √

= 1 full revolution and 34 holes on the 46 hole circle √ (3)

5.3.2 Ind = $\frac{40}{N}$ √ = $\frac{40}{5}$ = 8 √

= 8 full revolutions of the index crank √ (3)

5.4 5.4.1 Pa (pascal) √ (1)

5.4.2 m^2 (square meter) √ (1)

5.4.3 m/s (meter per second) √ (1)

5.4.4 7 000 meter √ (1)

5.4.5 revolutions per minute √ (1)

5.4.6 pitch circle diameter √ (1)

5.5 1 – 40 Teeth worm gear √
2 – Sector arm √
3 – Index plate √
4 – Crank √
5 – Single start/stray worm √ (5)

5.6
- Mount DTI in milling machine spindle √
- Use formula: $\frac{\text{dia of workpiece – width of cutter}}{2}$ √
- Move DTI plunger to side of work piece and touch. Set gauge to zero. √
- Now rotate spindle 180º. Compare readings and split the difference by moving the machine table. √
- The DTI readings must be identically 180º apart over the work piece centre line √
- Always double check DTI readings and the machine micrometre before machining commences. √ (6)

[30]

QUESTION 6: JOINING METHODS

6.1
1 – Arc welding √
2 – Convex weld face/bead weld face √
3 – Flame finishing √
4 – 2 mm root gap √ (4)

6.2
1 – Parent metal √
2 – Weld face √
3 – Reinforcement √
4 – Toe √
5 – Parent metal √
6 – Depth of fusion √
7 – Heat affected zone √
8 – Penetration √
9 – Root gap √
10 – Penetration bead √ (10)

6.3 6.3.1
- Make sure about correct personal safety equipment √
- Open the gas main √
- Set the regulators √
- Purge the system √
- Ignite the acetylene gas(flint-spark lighter)√
- Adjust the welding flame √ (6 x 1) (6)

6.3.2 The acetylene cylinder √ (1)

6.3.3 The opening of the cylinder valve briefly to blow out any dust and debris. √ (1)

6.4 6.4.1 T-fillet joint √ (1)

6.4.2 Edge joint √ (1)

6.4.3 Lap joint √ (1)

[25]

QUESTION 7: FORCES

7.1 7.1.1 Take moments about RL:

Clockwise = anti-clock

(4x1) + (5x3) + (3x5) = (RR x 6) √

√

($^{34}/_{6}$) = RR

RR = 5,67 N √

Take moments about RR:

Clock wise = anti-clock

(RLx6) = (3x1) + (5x3) + (4x5) √

√

RL = ($^{38}/_{6}$)

RL = 6,33 N √ (6)

7.1.2 UP = DOWN

5,67 + 6,33 = 4 +5 + 3 √

12 N = 12 N √ (2)

7.2 Torque = force x distance √

21,6 = force x ($\frac{350}{1\,000}$)√

force = $\frac{21,6}{0,350}$√

= 61,71 N √ (4)

7.3

FORCE	VERTICAL		HORIZONTAL	
6 N	**Y = 6 sin 50º** √	**4,6 N** √	**X = 6 cos 50º** √	**3,86 N** √
4 N	Y = 4 sin 0º	0 N	X = 4 cos 0º	4 N
TOTAL		**4,6 N** √		**7,86 N** √

(6)

Res = $\sqrt{X^2 + Y^2}$√

= $\sqrt{7,86^2 + 4,6^2}$√

= 9,11 N√ (3)

direction:

Tan θ = $\frac{sumY}{sumX}$√

Tan θ = $\frac{4,6}{7,86}$√

θ = 30,34° √

Resultant is 9,11 N in a direction 30,34º north of east (3)

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

= $\frac{\pi \times 0,025^2}{4}$ √

= 0,000490873 m^2 √

Stress = $\frac{Force}{area}$√

= $\frac{12 \times 10^3}{0,000490873}$ √

= 24446241,7 Pa

= 24,45 MPa √ (6)

[30]

QUESTION 8: MAINTENANCE

8.1 8.1.1 It helps to reduce friction √ (1)

8.1.2 It is the force that resists the movement of one object against another. √ (1)

8.2 7 kg x 10 = 70 N √ **OR** 7 kg x 9,81 = 68,67 N

F = N x μ √ F = N x μ

= 70 x 0,4√ = 68,67 x 0,4

= 28 N√ = 27,47 N (4)

8.3 8.3.1 It is the oil's resistance to flow (1)

8.3.2 It is the ability to cling to a surface. (1)

8.3.3 Society of Automotive Engineers (1)

8.4 8.4.1
- By adding small mass pieces. √
- Material can be removed by drilling. √
- Material can be removed by grinding. (Any 2 x 1) (2)

8.4.2
- Compare kerb mass to manufactures specifications √
- Uneven tyre wear √
- Tyre pressure √
- Screw wheel run-out – test wheel nuts with spanner √
- Check wheel bearings
- Check kingpins and bushes
- Check suspension ball joint for wear
- Check suspension bushes for wear
- Check steering box for play
- Check for play on tie-rod ends
- Check for sagged springs, riding height
- Check for worn shocks
- Check for loose U-bolts on springs
- Check for cracks on chassis or loose cross-members (Any 4 x 1) (4)

[15]

QUESTION 9: SYSTEMS AND CONTROL

9.1 9.1.1 Gear D will rotate clockwise √ (1)

9.1.2 The pinion drive gear √ (1)

9.1.3 $\frac{N_{in}}{N_{out}} = \frac{product\ of\ the\ number\ of\ teeth\ on\ the\ driven\ gears}{product\ of\ the\ number\ of\ teeth\ on\ the\ drive\ gears}$ √

$N_{out} = \frac{Ta \times Tc}{Tb \times Td} \times Na$ √

$= \frac{15 \times 15}{60 \times 60} \times 480$ √

= 30 r/min √ (4)

9.2 A – Pitch √ – is the distance from a point on a screw thread to a corresponding point on the next screw thread measured parallel to the axis of the screw thread √

B – Thread angle √ – is the included angle between the sides of the thread √

C – Major diameter √ – it is the largest diameter or theoretical diameter √ (6)

9.3
- Mechanical √ – positive contact, friction type, over-running
- Hydraulic √
- Electrical √ (3)

9.4 9.4.1 Pressure in system = $\frac{Force}{area}$ √

$= \frac{300}{0,2}$ √

= 1 500 Pa

= 1,5 kPa √ (3)

9.4.2 Load that can be lifted = Force

Pressure in system = $\frac{Force}{area}$ √

Force = pressure x area √

= 1 500 x 1,8 √

= 2 700 N

= 2,7 kN √ (4)

9.5 1 – The cam √

2 – The follower √

3 – The frame √ (3)

[25]

QUESTION 10: PUMPS

10.1

Piston	Plunger
Length of piston is shorter than stroke length √ **OR** Piston has rings (Any 1 x 1)	Length of plunger longer than stroke length √ **OR** The cylinder has a stuffing box with soft packing at the end of the cylinder (Any 1 x 1)

(2)

10.2
- Worn external packing √
- Worn internal packing √
- A strainer exposed above the fluid level √
- A faulty foot valve √
- Faulty or loose flanges or joints
- A faulty or weak seat or spring of a valve (Any 4 x 1) (4)
-

10.3 1 – inlet √
2 – eye √
3 – outlet √
4 – casing √
5 – impellor/wheel √
6 – fluid/flow direction √ (6)

10.4
- Centrifugal pumps are more compact. √
- The initial cost is relatively low. √
- Maintenance cost is low due to rotation motion of parts. √
- Centrifugal pumps are adaptable. √
- The construction is simple and reliable.
- It works at high speed therefore connect directly to motor.
- No water hammer and shocks.
- Delivery can be adjusted from no flow to full flow without switching the pump off.
- Centrifugal pumps do not have moving valves or sensitive parts. (Any 4 x 1) (4)

10.5
- Food and liquor pumping √
- Oil pumping √
- Fodder
- Sewerage slick/sludge pumping
- Tough chemicals
- Storm water sifts (Any 2 x 1) (2)

10.6
- It is necessary to get the oil between the friction surfaces. √
- To keep it there under pressure as an oil cushion between the surfaces. √
- Also to cool the friction surfaces. (2)

[20]

TOTAL: 200