



education

Department:
Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

MECHANICAL TECHNOLOGY

NOVEMBER 2007

MEMORANDUM

This memorandum consists of 15 pages.

QUESTION 1: MULTIPLE CHOICE QUESTIONS
(Learning Outcome 3: Assessment Standards 1 – 9)

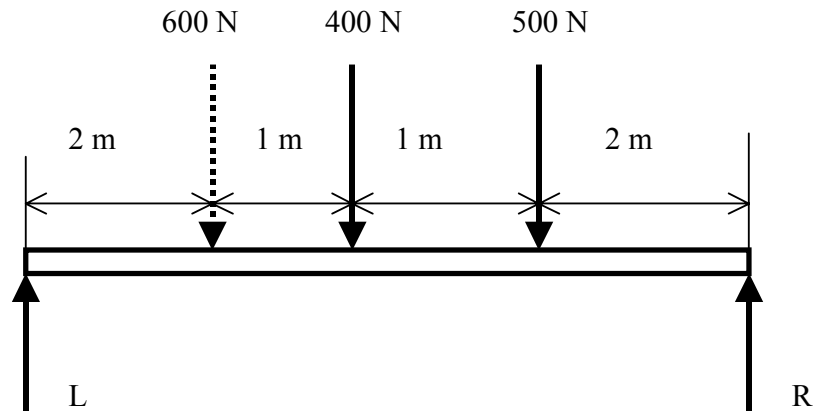
- 1.1 B ✓ (1)
- 1.2 D ✓ (1)
- 1.3 D ✓ (1)
- 1.4 A ✓ (1)
- 1.5 C ✓ (1)
- 1.6 C ✓ (1)
- 1.7 B ✓ (1)
- 1.8 B ✓ (1)
- 1.9 B ✓ (1)
- 1.10 A ✓ (1)
- 1.11 C ✓ (1)
- 1.12 D ✓ (1)
- 1.13 C ✓ (1)
- 1.14 C ✓ (1)
- 1.15 A ✓ (1)
- 1.16 B ✓ (1)
- 1.17 B ✓ (1)
- 1.18 D ✓ (1)
- 1.19 A ✓ (1)
- 1.20 A ✓ (1)

[20]

QUESTION 2: APPLIED MECHANICS(Learning Outcome 3: Assessment Standards 6 and 8)

2.1 Uniformly load

2.1.1



Taking moments about R:

$$\begin{aligned}
 R_L \times 6 &= (600 \times 4) + (400 \times 3) + (500 \times 2) \quad \checkmark\checkmark \\
 &= 2400 + 1200 + 1000 \quad \checkmark \\
 &= 4600 \\
 \mathbf{L} &= \mathbf{766.67 \text{ N}} \quad \checkmark
 \end{aligned}$$

Taking moments about L:

$$\begin{aligned}
 R_R \times 6 &= (500 \times 4) + (400 \times 3) + (600 \times 2) \quad \checkmark\checkmark \\
 &= 2000 + 1200 + 1200 \quad \checkmark \\
 &= 4400 \\
 \mathbf{R} &= \mathbf{733.33 \text{ N}} \quad \checkmark \quad (8)
 \end{aligned}$$

2.1.2

$$\begin{aligned}
 \text{Upward forces} &= \text{Downward forces} \\
 766.67 + 733.33 &= 600 + 400 + 500 \quad \checkmark \\
 1500 &= 1500 \quad \checkmark \quad (2)
 \end{aligned}$$

2.2 The carport

2.2.1 Taking moments about Q

$$\begin{aligned}
 P \times 16 &= (20 \times 11) + (40 \times 5) + (30 \times 2) \checkmark \checkmark \\
 &= 220 + 200 + 60 \\
 &= 480 \\
 \mathbf{P} &= \mathbf{30 \text{ N}} \checkmark
 \end{aligned}$$

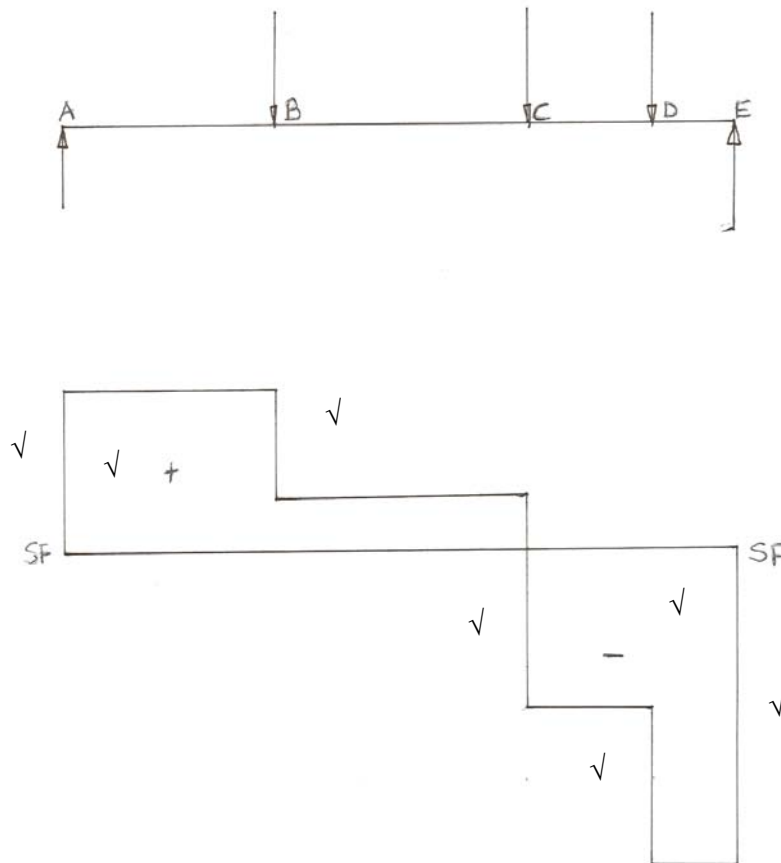
Taking moments about P

$$\begin{aligned}
 Q \times 16 &= (30 \times 14) + (40 \times 11) + (20 \times 5) \checkmark \checkmark \\
 &= 420 + 440 + 100 \\
 &= 960
 \end{aligned}$$

$$\mathbf{Q = 60 \text{ N}} \checkmark$$

(6)

2.2.2



(7)

2.3 V-belt application

- 2.3.1
- | | | | |
|-----|------------------------------|---|-----|
| (1) | Contact angle | √ | |
| (2) | Idle pulley (tensioner) | √ | |
| (3) | Small pulley (driver pulley) | √ | |
| (4) | Large pulley (driven pulley) | √ | (4) |
- 2.3.2
- part 2 is used to keep the tension of the belt constant √
 - part 3 is fitted to a motor shaft to effect driving √
 - part 4 is attached to the blower shaft √
- (3)

2.4 Torque wrench

2.4.1 Torque = Force x Radius

$$\text{And Force} = \frac{\text{Torque}}{\text{Radius}} \quad \checkmark$$

$$= \frac{78}{0.3} \quad \checkmark$$

$$\mathbf{P = 260 \text{ N}} \quad \checkmark\checkmark \quad (4)$$

2.5 Differential

- 2.5.1
- | | | | |
|---|-----------------------|---|-----|
| 1 | = Crown wheel | √ | |
| 2 | = Pinion | √ | |
| 3 | = Planet gear | √ | |
| 4 | = Side shaft gear | √ | |
| 5 | = Side shaft | √ | |
| 6 | = Planet gear shaft | √ | |
| 7 | = Differential casing | √ | (7) |
- 2.5.2
- To transfer drive through 90° angle √
 - To allow one wheel to turn faster than the other √
- (2)

2.6 Fuel injection

- 2.6.1
- Each cylinder receives a precisely measured amount of fuel √
 - The air-fuel ratio remains constant at low and high engine speeds √
 - The intake manifold of a petrol injection engine allows the air to flow freely, increasing the volumetric efficiency √
 - Air locks are eliminated √
- (4)
- 2.6.2
- A filter is used to remove dirt or tiny particles from the fuel √
 - The injector breaks up/sprays the fuel into the cylinder √
 - The pump pumps fuel from the tank via the filter to the injector √
- (3)

QUESTION 3: TOOLS AND EQUIPMENTLearning Outcome 3: Assessment Standard 2)

- 3.1 Precision tool
- 3.1.1 Micrometer (1)
- 3.1.2
- | | | |
|---------------------|---|-----|
| 1 = Anvil | √ | |
| 2 = Spindle | √ | |
| 3 = Locknut | √ | |
| 4 = Barrel | √ | |
| 5 = Thimble | √ | |
| 6 = Ratchet | √ | |
| 7 = Frame | √ | |
| 8 = Measuring faces | √ | (8) |
- 3.1.3 0.01 mm √ (1)
- 3.2 Vernier reading
- | | | |
|--------------|----|-----|
| 12.00 | | |
| <u>+0.86</u> | | |
| 12.86 mm | √√ | (2) |
- 3.3 Advantages of vernier
- The vernier could be used for taking inside, outside and depth measurements √√ (2)
- 3.4 Grinding machine
- 3.4.1 Surface grinding machine √ (1)
- 3.4.2
- | | | |
|----------------|---|-----|
| 1 = Box | √ | |
| 2 = Saddle | √ | |
| 3 = Table | √ | |
| 4 = Wheel head | √ | |
| 5 = Column | √ | (5) |

[20]

QUESTION 4: MATERIALS(Learning Outcome 3: Assessment Standard 3)

4.1 Heat treatment

COLUMN A		COLUMN B	
4.1.1	Tempering	C	✓
4.1.2	Annealing	D	✓
4.1.3	Normalising	A	✓
4.1.4	Case-hardening	B	✓

(4)

4.2 Annealing of steel

- To soften the metal ✓
- To make steel suitable for bending, drawing or cold work operations ✓ (2)

4.3 Case hardening

Steel articles to be case hardened need to have outer case converted from low carbon to that of a high carbon steel ✓✓ (2)

4.4 Ferrous and non-ferrous metals

Ferrous metals are those that contain iron and non-ferrous metals do not contain iron ✓ (2)

4.5 Hardening temperature

Steel becomes non magnetic ✓✓ (2)

4.6 Tempering colours

4.6.1 dark purple ✓ (1)

4.6.2 bright blue ✓ (1)

4.6.3 medium straw ✓ (1)

4.6.4 dark straw ✓ (1)

4.7 Tempering of cold chisels

- Heat to a temperature between 220°C and 300° C and quench ✓
- The tempering colours, which are oxides of iron, indicate a particular temperature ✓
- Each temperature indicate a degree of hardness, the higher the temperature, the softer the resulting metal ✓
- Heating can be by means of direct heat from Bunsen or a sand bath ✓ (4)

[20]

QUESTION 5: MANUFACTURING PROCESS, CONSTRUCTION AND SAFETY
(Learning Outcome 3: Assessment Standards 1, 4 and 5)

5.1 Milling machine safety

Any five of the following **(2 marks each)**:

- make sure that all guards are in place ✓✓
 - do not use a machine or come close to its moving parts while wearing loose clothing ✓✓
 - check that there is no oil or grease on the floor around the machine ✓✓
 - do not leave spanners or keys on rotary parts ✓✓
 - never apply a wrench to revolving work ✓✓
 - always clamp work pieces and holding devices safely and firmly ✓✓
 - do not use your hands to remove cutting while a machine is in motion ✓✓
 - never adjust the cutting tool while the machine is running ✓✓
 - resist the habit of leaning on machinery ✓✓
 - do not attempt to stop a machine by placing your hand on the chuck while the machine is slowing down ✓✓
 - give attention to cutting-fluid control before switching on a machine ✓✓
- (10)

5.2 Milling machine - purpose

- The milling machine is used to cut slots and shapes from blocks of metal ✓
 - The milling cutter is held firmly in the head of the machine and then lowered into the metal whilst rotating ✓
 - The bed of the machine (not the cutter) is then moved to machine slots or grooves in the workpiece ✓
- (3)

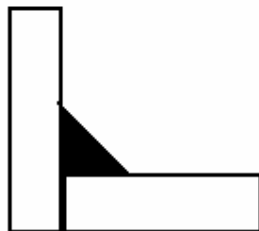
5.3 Welding joints

5.3.1 Single bevel butt joint ✓



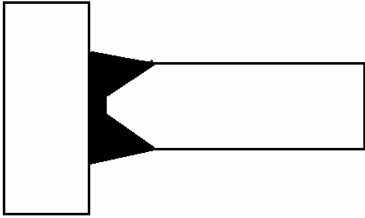
✓ (2)

5.3.2 Fillet joint ✓



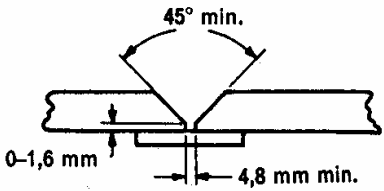
✓ (2)

5.3.3 Double bevel butt joint √



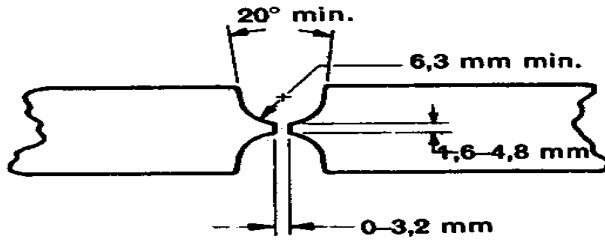
√ (2)

5.3.4 Single v-butt joint √



√ (2)

5.3.5 Double "U" butt joint √



√ (2)

5.4 Sectional view on a arc-welded joint

5.4.1

1 = Parent or base metal	√
2 = Face of weld	√
3 = Reinforcement	√
4 = Toe of weld	√
5 = Parent or base metal	√
6 = Fusion zone	√
7 = Heat affected zone	√
8 = Root penetration	√
9 = Root gap	√
10 = Root face	√

(10)

5.4.2

- protect the joint from unwanted gases √
- help in gradual cooling for the joint √

(2)

5.4.3 Penetration is the depth of the root run, normally below the surface of the base plate √

(1)

5.4.4 Any four of the following

- incorrect manipulation of the molten pool ✓
 - incorrect root face, root gap and angle of bevel ✓
 - too rapid welding speed ✓
 - too large electrode diameter ✓
 - too low current too ✓
 - long arc length ✓
- (4)

5.5 Lightning of oxy-acetylene cutting flame

- open acetylene valve on cutting torch ✓
 - light acetylene with flint lighter ✓
 - adjust the flame until the smoke disappears ✓
 - open oxygen valve slowly to obtain a neutral flame ✓
 - press the oxygen cutting lever to check if the neutral flame is maintained ✓
 - if necessary, readjust the flame so that the neutral flame is maintained at all times ✓
 - the cutting oxygen should be a straight stream in the flame and should be clearly visible to obtain a neat cut ✓
 - if a straight, clear cutting stream of oxygen cannot be obtained, then the nozzle has to be cleaned with a nozzle cleaner ✓
- (8)

5.6 Welding and cutting nozzle

A welding nozzle has one hole and is used for gas welding and brazing purposes ✓

A cutting nozzle has eight holes and oxygen booster flame and is solely used for cutting purposes. ✓ (2)

[50]

QUESTION 6: PUMPS AND MAINTENANCE

(Learning Outcome 3: Assessment Standards 7 and 9)

6.1 Function of a pump

The function of a pump is to raise the level of a fluid from a low to a high level
√√ (2)

6.2 Eccentric vane pump

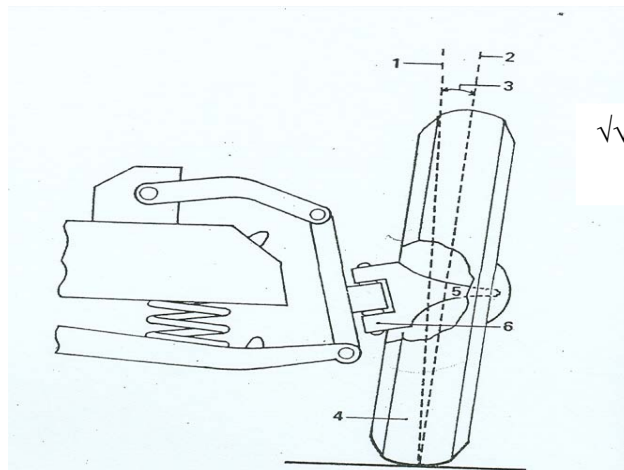
- 6.2.1 1 = Rotor casing √
- 2 = Inlet √
- 3 = Vane √
- 4 = Slot √
- 5 = Outlet √
- 6 = Rotor √ (6)

6.3 Wheel alignment

6.3.1 Positive camber angel

The end stub axle inclines slightly downwards, causing the top end of the wheel to tilt outwards √

The angle formed by the outward inclination of the upper end of the wheel between the perpendicular line and the centre line of the wheel is known as the positive camber angle √

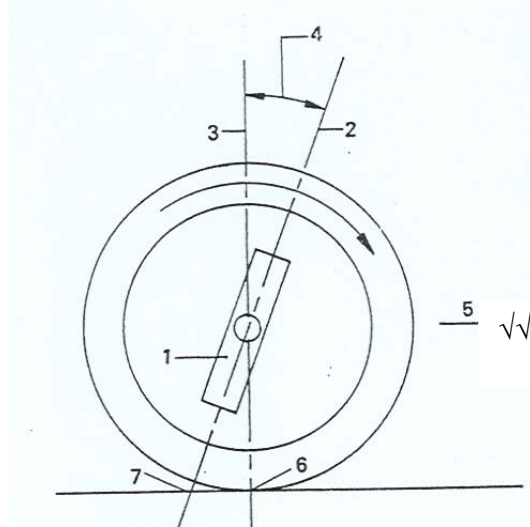


- 1 = perpendicular line
- 2 = centre line of the wheel
- 3 = positive camber angle
- 4 = wheel
- 5 = stub axle
- 6 = king pin

(4)

6.3.2 Negative caster angle

- the upper end of the king pin is tilted to the front ✓
- the angle formed between the perpendicular line and the centre line of the kingpin, as seen from the side, is known as the negative caster angle ✓

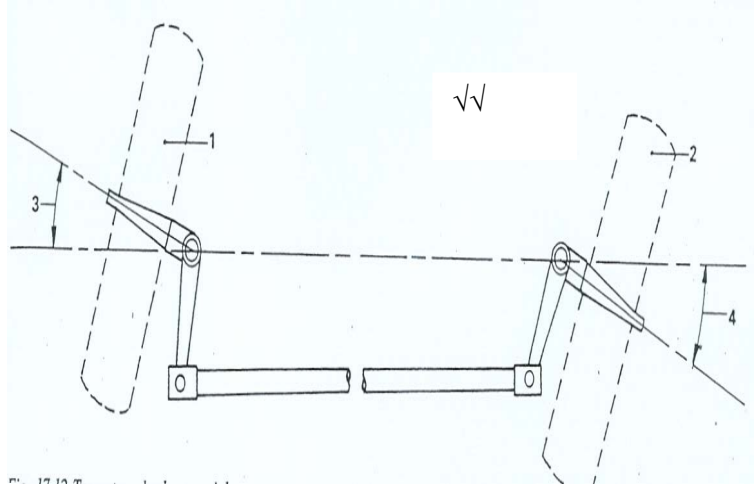


- 1 = kingpin
 2 = centre line
 3 = perpendicular line
 4 = positive caster angle
 5 = front of vehicle
 6 = point of wheel contact
 7 = contact point of king pin center line

(4)

6.3.3 Toe-out around a corner

- in order to prevent the wheels from dragging when a vehicle moves around the corner, all wheels should roll on a circle perpendicular to the radius of the turning circle ✓
- the above figure is a schematic layout of a vehicle turning a corner. The common turning point of the wheels is always on the imaginary extended centre line of the rear axle as shown. The front wheels are no longer parallel to each other, but are turned out. Hence the term, toe out on turns. ✓



- 1 = outer front wheel
- 2 = inner front wheel
- 3 = steering angle of outer front wheel
- 4 = steering angle of inner front wheel

(4)

6.4 Any five of the following:

- Examine the condition of the tyre treads and side walls. worn out tyres should be replaced ✓
 - The four tyres should be the same size and should have the same amount of tread wear ✓
 - Pump all four tyres to specifications ✓
 - Check tyres for run out which should not exceed 5mm ✓
 - Check the front wheel bearings for play and adjust these if necessary ✓
 - Examine all steering ball joints, rods, links and arms for wear and replace worn components if necessary ✓
 - Check the steering box for abnormal play and adjust to the specifications if necessary ✓
 - Examine the spring shackle pins and shackle bushes and replace all worn components ✓
 - Check the centre bolts on blade springs ✓
 - Check the condition and tightness of the spring U bolts ✓
 - Examine all shock absorbers and shock absorber mountings ✓
 - Examine all torsion bars, stabilisers, anti-roll bars and mountings ✓
 - Measure and compare the free height of the vehicle with the manufacturer's prescription ✓
- (5)

6.5 Lubricant - properties

Any three of the following:

- Hold its thickness ✓
 - Must not offer resistance to motion ✓
 - Must not gum ✓
 - Must be without acid ✓
 - High flash point ✓
 - Good unifying and adhesive properties ✓
- (3)

6.6 Lubricant - functions

Any three of the following

- Prevent corrosion ✓
 - Transmit power ✓
 - Control temperature ✓
 - Good sealant ✓
 - Control wear ✓
 - Remove contaminants ✓
- (3)

6.7 Lubricants - factors

- The price of lubricant √
- Rubbing speed √
- Rubbing pressure √
- Operating temperature √
- Clearance between the two components that needs to be lubricated √ (5)

6.8 Hydraulic system - air

Air will be compressed and as a result pressure will be reduced in the system resulting in initial pressure drop out. √√ (2)

6.9 Maintenance

Maintenance is important to eliminate the results of deterioration on machines. √√ (2)

[40]**TOTAL MARKS 200**