

**SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN**



**OCTOBER / NOVEMBER
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2004

MOTOR MECHANICS

**MOTORWERKTUIG-
KUNDE**

SG

707-2/0

**10 pages
10 bladsye**

MOTOR MECHANICS SG



707 2 0

SG

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GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

MOTORWERKTUIGKUNDE SG

TYD: 3 uur

PUNTE: 200

BENODIGDHEDE:

Sakrekenaar en tekeninstrumente

INSTRUKSIES:

- Beantwoord ALLE vrae.
- Sketse moet netjies en in verhouding wees.
- Alle sketse moet op die regterbladsy van die antwoordboek geteken word.
- Sorg dat alle vrae korrek genommer word.
- 'n Inligtingsblad met formules is ingesluit.

**VRAAG 1
MEERVOUDIGE KEUSEVRAE**

Elk van die volgende vrae is van 'n aantal moontlike antwoorde voorsien, waarvan slegs een moontlikheid korrek is. Gebruik die **antwoordblad** op die **binnekant van die omslag** van jou **antwoordboek** en trek 'n kruisie (X) oor die letter wat na jou mening die korrekte antwoord is.

- 1.1 Wanneer swaar voorwerpe opgetel moet word, is dit raadsaam om _____.
- A. die bene uitmekaar te hou en die arms te gebruik om die voorwerp op te tel
- B. die rug reguit te hou en die bene te gebruik om die voorwerp op te tel
- C. die bene reguit te hou en die rug te gebruik om die voorwerp op te tel (2)
- 1.2 Die gebruik van twee agterasse op 'n voertuig staan bekend as _____.
- A. dubbelreduksie-aandrywing
- B. tweespoed-aandrywing
- C. tandem-aandrywing (2)
- 1.3 Dit is noodsaaklik dat brandstof in _____ gestoor moet word.
- A. die magasyn
- B. 'n brandbestande kamer
- C. die meganiese werkwinkel (2)

GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

MOTOR MECHANICS SG

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

Calculator and drawing instruments

INSTRUCTIONS:

- Answer ALL the questions.
 - Sketches must be neat and in proportion.
 - All sketches to be done on the right-hand page of the answer book.
 - Ensure that all the questions are numbered correctly.
 - An information sheet containing formulae is included.
-
-

QUESTION 1
MULTIPLE-CHOICE QUESTIONS

Each of the following questions is supplied with a number of possible answers of which only one possibility is correct. Make use of the **answer sheet** on the **inside cover** of your **answer book** and draw a cross (**X**) over the letter which, in your opinion, is the correct answer.

- 1.1 When lifting heavy objects, it is advisable to keep the _____.
- A. legs apart and use the arms to lift the object
 - B. back straight and use the legs to lift the object
 - C. legs straight and use the back to lift the object (2)
- 1.2 The use of two rear axles on a vehicle is known as _____.
- A. double reduction drive
 - B. two-speed drive
 - C. tandem drive (2)
- 1.3 It is essential that fuel should be stored in _____.
- A. the store
 - B. a fire-proof room
 - C. the mechanical workshop (2)

- 1.4 Verwringingsvibrasies deur die krukas kan veroorsaak word deur _____.
 A. statiese wanbalans
 B. dinamiese wanbalans
 C. die verwringing wat deur die kragslae veroorsaak word (2)
- 1.5 In die kompressie-ontsteking-inspuitpomp word die lewering van brandstof (inspuiting) gestaak, sodra die heliks van die pompplunjer die _____.
 A. stortpoort ontbloot
 B. stortpoort sluit
 C. inlaatpoort sluit (2)
- 1.6 Abnormale bandslytasie aan die binnedeel van die loopvlak word veroorsaak deur _____.
 A. te veel toesporing
 B. te veel negatiewe wielvlug
 C. te veel positiewe wielvlug (2)
- 1.7 'n Verstoppte lugfilter benadeel die enjin se _____.
 A. volumetriese doeltreffendheid
 B. termiese doeltreffendheid
 C. kompressieverhouding (2)
- 1.8 Oneweredige druk op die suiers van 'n enjin versteur die _____.
 A. kragbalans
 B. meganiese balans
 C. statiese balans (2)
- 1.9 Die funksie van die diodes in die alternator-laaikring is om _____.
 A. die spanning in die kring te beheer
 B. wisselstroom in gelykstroom te omskep
 C. oorvonking tussen die sleepringe en borsels te voorkom (2)
- 1.10 Die element in die koppelomsitter wat verantwoordelik is vir die verhoogde draaimoment is die _____.
 A. pomp
 B. stator
 C. turbine (2)

- 1.4 Torsional vibrations by the crankshaft could be caused by _____.
A. static unbalance
B. dynamic unbalance
C. the effect of the torque resulting from power strokes (2)
- 1.5 In the compression-ignition-injection pump, injection ceases when the helix of the pump plunger _____.
A. uncovers the spill port
B. closes the spill port
C. closes the inlet port (2)
- 1.6 Abnormal wear on the inside tread of a tyre is caused by _____.
A. excessive toe-in
B. excessive negative camber
C. excessive positive camber (2)
- 1.7 A clogged air filter will have a detrimental effect on the _____.
A. volumetric efficiency of the engine
B. thermal efficiency of the engine
C. compression ratio of the engine (2)
- 1.8 Unequal pressure on the pistons of an engine will disturb the _____.
A. power balance
B. mechanical balance
C. static balance (2)
- 1.9 The function of the diodes in the alternator-charging circuit is to _____.
A. control the voltage in the circuit
B. change alternating current to direct current
C. prevent arcing between the slip rings and brushes (2)
- 1.10 The element in the torque convertor responsible for the increase in torque is called the _____.
A. pump
B. stator
C. turbine (2)

1.11 Een van die volgende word nie geklassifiseer as 'n positieweverplasing-aanjaer nie:

- A. Sentrifugale aanjaer
- B. Wiek-tipe aanjaer
- C. Roots-aanjaer

(2)

1.12 Die vuurorde vir 'n sessilinder-inlyn-enjin is _____.

- A. 1,4,2,5,3,6.
- B. 1,4,3,6,2,5.
- C. 1,5,3,6,2,4.

(2)

1.13 Die tweegang-eindaandrywing is in hoëspoed-gang wanneer die inskakelende rat _____.

- A. gesluit is
- B. vry is

(2)

1.14 Wat is die chemies korrekte (optimum) lug/brandstof-verhouding?

- A. 18:1
- B. 9:1
- C. 15:1

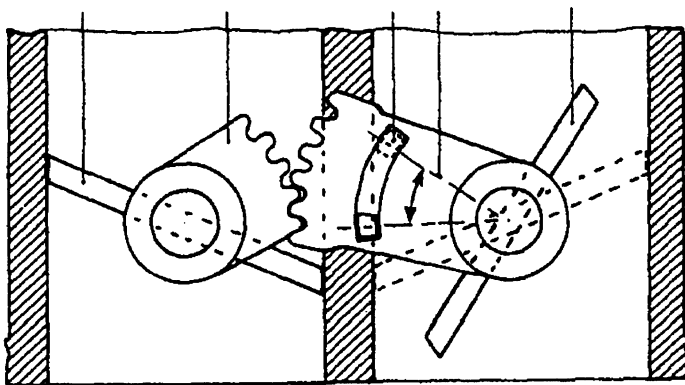
(2)

1.15 Indien 'n dikker silinderkop-pakstuk op 'n enjin gebruik word, sal die kompressiedruk _____.

- A. verlaag
- B. verhoog

(2)

1.16



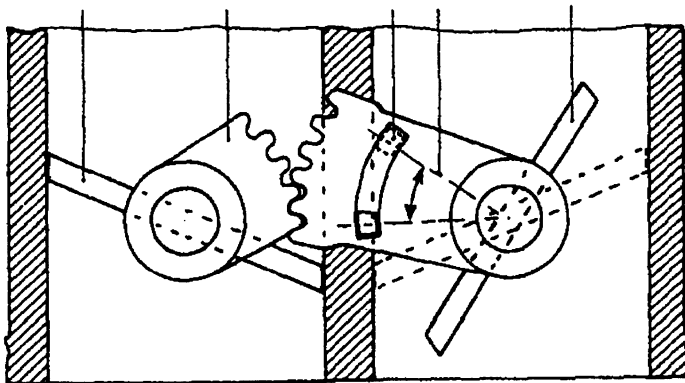
Die bostaande skets toon die aktiveermeganisme van:

- A. 'n Tweefasige meerkeel-vergasser
- B. 'n Enkelfasige meerkeel-vergasser
- C. Nie een van die bogenoemdes nie.

(2)

- 1.11 One of the following is not classified as a positive displacement blower:
- A. Centrifugal-type blower
 - B. Vane-type blower
 - C. Roots-type blower
- (2)
- 1.12 The firing order for a six-cylinder in-line engine is _____.
- A. 1,4,2,5,3,6.
 - B. 1,4,3,6,2,5.
 - C. 1,5,3,6,2,4.
- (2)
- 1.13 The two-speed final drive is engaged in high speed when the engaging gear is _____.
- A. locked
 - B. free
- (2)
- 1.14 What is the chemically correct (optimum) airfuel ratio?
- A. 18:1
 - B. 9:1
 - C. 15:1
- (2)
- 1.15 When a thicker cylinder head gasket is used on an engine, the compression will _____.
- A. decrease
 - B. increase
- (2)

1.16



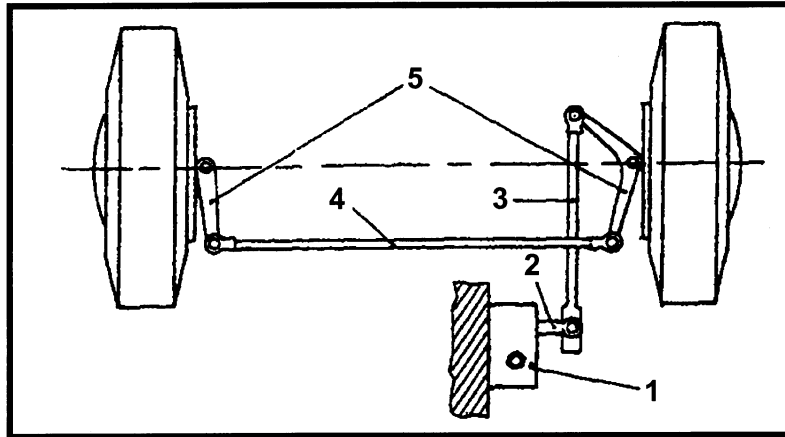
The sketch above shows the activating mechanism of:

- A. Two-phase multibarrel carburettor
 - B. Single-phase multibarrel carburettor
 - C. None of the above
- (2)

1.17 Die voltmeter is gekoppel in:

- A. Serie
- B. Parallel
- C. Geeneen van die bogenoemdes nie.

(2)



1.18 Die skets toon die stuuruitleg met 'n _____.

- A. enkele spoorstang
- B. oordragstang
- C. lang en kort spoorstang – afsonderlik verbind

(2)

1.19 Watter wanbalans word deur die vliegwiel beheer?

- A. Meganiese wanbalans
- B. Kragwanbalans
- C. Statiese wanbalans
- D. Dinamiese wanbalans

(2)

1.20 Wanneer die brandstoflug-mengsel binne die verbrandingskamer ontsteek weens gloeiende koolstof, staan dit bekend as _____.

- A. ontstekingsklop
- B. detonasie
- C. voorontsteking

(2)

[40]

VRAAG 2 ELEKTRIES

2.1 Teken netjiese sketse van die volgende elektriese simbole:

2.1.1 Transistor aangeskakel

(4)

2.1.2 Diode

(2)

2.1.3 Weerstand

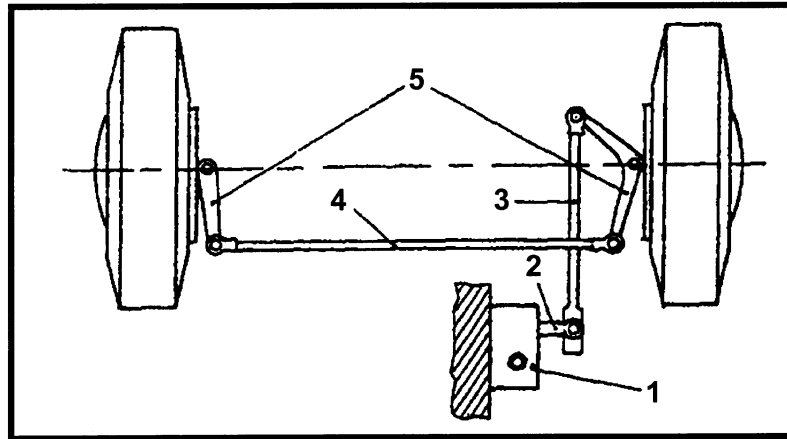
(2)

b.o.

1.17 The voltmeter is connected in:

- A. Series
- B. Parallel
- C. None of the above.

(2)



1.18 The sketch above shows the steering layout with a _____.

- A. single tie-rod
- B. relay rod
- C. long and short tie-rod connected separately

(2)

1.19 Which imbalance is governed by the flywheel?

- A. Mechanical imbalance
- B. Power imbalance
- C. Static imbalance
- D. Dynamic imbalance

(2)

1.20 When the airfuel mixture ignites inside the combustion chamber due to glowing carbon, it is known as _____.

- A. ignition knock
- B. detonation
- C. pre-ignition

(2)

[40]

QUESTION 2 ELECTRICAL

2.1 Draw neat sketches of the following electrical symbols:

2.1.1 Transistor switched on

(4)

2.1.2 Diode

(2)

2.1.3 Resistor

(2)

- 2.2 Teken 'n netjiese skets wat die uitleg van 'n transistor-ontstekingstelsel sonder onderbrekerpunte toon. (13)
- 2.3 Beskryf die begrip **elektromagnetiese induksie**. (2)
- 2.4 Noem die DRIE verbindingspunte van die transistor. (3)
- 2.5 Noem TWEE tipes verbindings wat binne die alternator gebruik kan word om die statorwindinge met mekaar te verbind. (2)
- 2.6 Watter komponent in die alternator skakel die wisselstroom na gelykstroom om? (2)
- 2.7 Noem TWEE metodes wat gebruik kan word om 'n elektromagneet se magneetveld sterker te maak. (2)
- [32]**

VRAAG 3 BRANDSTOWWE EN VERGASSERS

- 3.1 Definieer die volgende:
- 3.1.1 Vlampunt (4)
- 3.1.2 Voorontsteking (2)
- 3.1.3 Hittewaarde (4)
- 3.1.4 Effektiewe pompslag (4)
- 3.2 Watter installasie word gebruik om ru-olie te raffineer? (1)
- 3.3 Noem VIER voordele wat verkry word deur die katalitiese kraakproses te gebruik. (4)
- 3.4 Noem TWEE komponente in die meerkeel-vergasser wat die brandstofvlak beheer. (2)
- 3.5 Watter komponent in die konstantevakuum-vergasser is verantwoordelik vir die volgende funksies?
- 3.5.1 Sproeiergrootte (2)
- 3.5.2 Beheer van die opwaartse beweging van die suier gedurende versnelling (2)
- 3.6 Noem die doel van brandstoffilters. (2)
- 3.7 Teken 'n netjiese skets van die leweringklep. (5)
- [32]**

- 2.2 Draw a neat sketch to show the lay-out of a transistor-ignition system without contact points. (13)
- 2.3 Describe the concept **electromagnetic induction**. (2)
- 2.4 Name the THREE connecting terminals of the transistor. (3)
- 2.5 Name TWO types of connections which can be used inside an alternator to connect the stator windings with each other. (2)
- 2.6 Which component in the alternator is responsible for changing the alternating current into direct current? (2)
- 2.7 State TWO methods that can be used to increase the strength of the magnetic field of an electromagnet. (2)
- [32]

QUESTION 3
FUELS AND CARBURETTORS

- 3.1 Define the following:
- 3.1.1 Flash point (4)
- 3.1.2 Pre-ignition (2)
- 3.1.3 Heat value (4)
- 3.1.4 Effective pump stroke (4)
- 3.2 Which installation is used to refine crude oil? (1)
- 3.3 State FOUR advantages obtained by making use of the catalytic cracking process. (4)
- 3.4 Name TWO components in the multibarrel carburettor that control the fuel level. (2)
- 3.5 Which component in the constant-vacuum carburettor is responsible for the following functions?
- 3.5.1 Jet size (2)
- 3.5.2 Controlling the upward movement of the piston during acceleration (2)
- 3.6 Name a function of fuel filters. (2)
- 3.7 Draw a neat sketch of the delivery valve. (5)
- [32]

**VRAAG 4
BEREKENINGE**

4.1 Die volgende data het betrekking op 'n viersilinder-vierslagenjin:

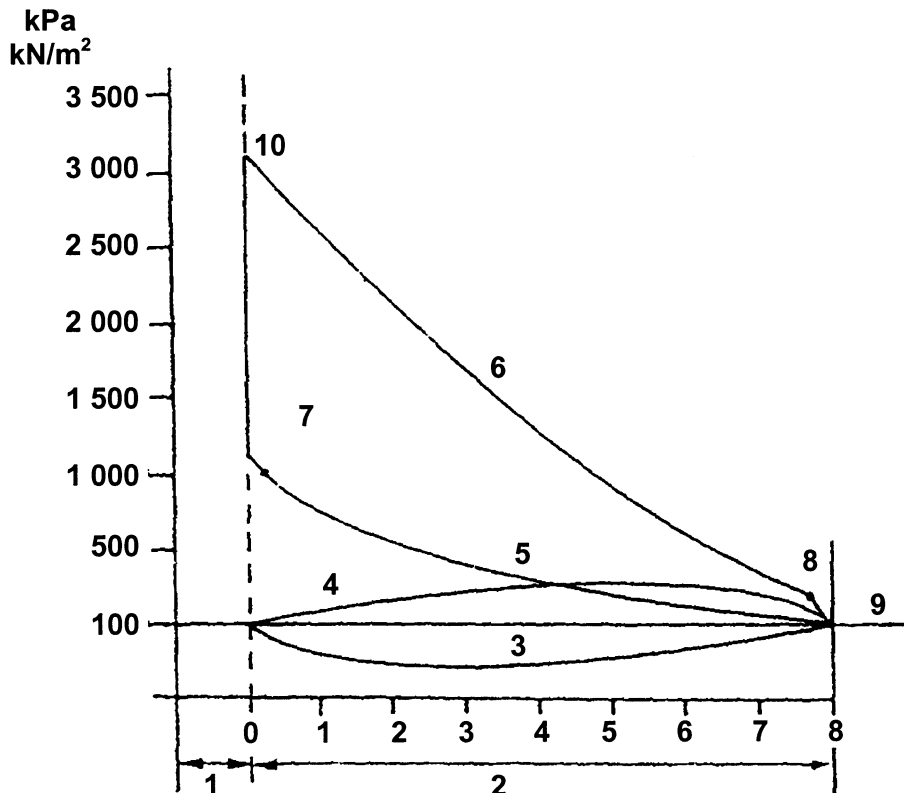
Gemiddelde effektiewe druk op suier = 800 kPa
 Slaglengte = 70 mm
 Silinderdiameter = 80 mm
 Omwentelings per minuut = 5 400

Bereken die aangeduide drywing in kW. (8)

4.2 Bereken die kompressieverhouding van 'n enjin met 'n silinderdiameter van 70 mm en 'n slaglengte van 80 mm. Die verbrandingskamer se volume is 30 cm³. (6)

4.3 Die onderstaande skets toon 'n silinderdruk-diagram vir 'n vierslag-petrolenjin teen 700 omwentelings per minuut. Teken hierdie skets oor in jou antwoordboek om te toon waar die enjin teen 3 000 omwentelings per minuut loop. Gebruik 'n kompressieverhouding van 10:1.

NOTA: Omkring alle veranderings.



(8)

QUESTION 4 CALCULATIONS

4.1 The following data refers to a four-cylinder four-stroke engine:

Mean effective pressure on piston	=	800 kPa
Length of stroke	=	70 mm
Bore diameter of cylinder	=	80 mm
Revolutions per minute	=	5 400

Calculate the indicated power in kW.

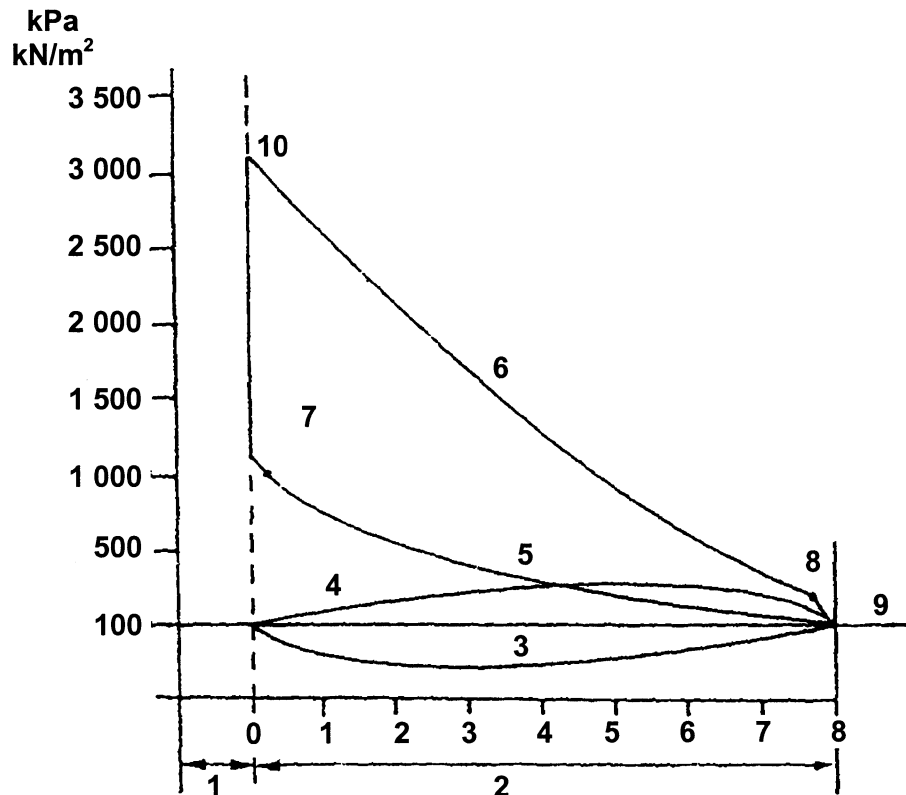
(8)

4.2 Calculate the compression ratio of an engine with a bore diameter of 70 mm and a stroke of 80 mm. The combustion chamber volume is 30 cm³.

(6)

4.3 The sketch below shows an indicator diagram for a four-stroke petrol engine running at 700 revolutions per minute. Draw this sketch into your answer book to show the engine running at 3 000 revolutions per minute. Use a compression ratio of 10:1.

NOTE: Circle all changes made.



(8)

- 4.4 Definieer die volgende:
- 4.4.1 Aangeduide drywing (3)
 - 4.4.2 Remdrywing (3)
 - 4.4.3 Meganiese doeltreffendheid (2)
- 4.5 Noem die toerusting wat gebruik kan word om die remdrywing van 'n enjin te bepaal. (2)
- [32]**

VRAAG 5
AANDRYWINGS

- 5.1 Noem die tipe voertuie wat dubbelreduksie-eindaandrywings gebruik. (2)
- 5.2 Noem die komponent wat gesluit word in die dubbel-episikliese ratstelsel wanneer die volgende ratte ingeskakel word:
- 5.2.1 Eerste gang (2)
 - 5.2.2 Trugang (2)
 - 5.2.3 Hoogste gang (2)
 - 5.2.4 Tweede gang (2)
- 5.3 Beskryf, aan die hand van eenvoudige sketse, die voordele van die geboë wieke in die turbine van die koppelomsitter bo dié van die reguit wieke in die turbine van 'n vloeistofkoppeling. (14)
- 5.4 Teken 'n netjiese, benoemde skets van die dubbel-episikliese ratstelsel. (8)
- [32]**

VRAAG 6
STUURWERK / WIELSPORING

- 6.1 Definieer die volgende:
- 6.1.1 Rolpunt (2)
 - 6.1.2 Onderstuur (2)

- 4.4 Define the following:
- 4.4.1 Indicated power (3)
 - 4.4.2 Brake power (3)
 - 4.4.3 Mechanical efficiency (2)
- 4.5 Name the equipment that can be used to determine the brake power of an engine. (2)
- [32]**

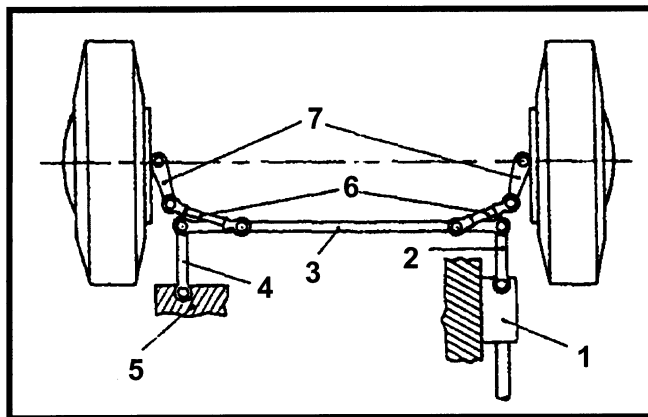
**QUESTION 5
DRIVES**

- 5.1 State the type of vehicles which make use of the double-reduction final drive. (2)
- 5.2 Name the component which is locked in the double-epicyclic gear train when the following gears are selected:
- 5.2.1 First gear (2)
 - 5.2.2 Reverse gear (2)
 - 5.2.3 Top gear (2)
 - 5.2.4 Second gear (2)
- 5.3 Describe, with the aid of simple sketches, the advantages of the curved vanes in the turbine of the torque convertor as compared to the straight vanes in the turbine of a hydraulic drive. (14)
- 5.4 Draw a neat, labelled sketch of the double epicyclic gear train. (8)
- [32]**

**QUESTION 6
STEERING / WHEEL ALIGNMENT**

- 6.1 Define the following:
- 6.1.1 Rolling point (2)
 - 6.1.2 Under steer (2)

6.2 Bestudeer die volgende skets van die stuuruitleg en beantwoord die onderstaande vrae.

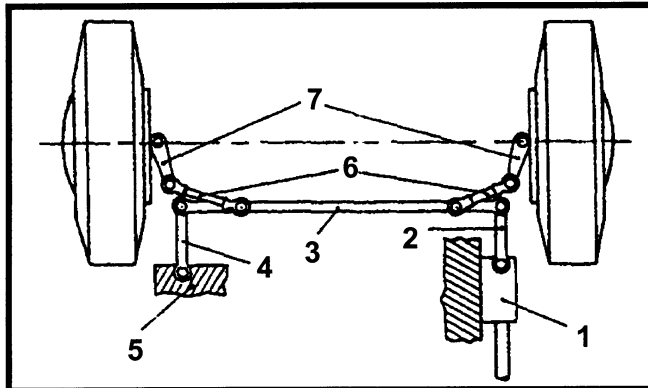


- 6.2.1 Noem die stuurwerk-uitleg. (2)
- 6.2.2 Noem die funksie van komponent 6. (2)
- 6.2.3 Watter stuurwerk-beginsel sal deur komponent 7 bepaal word? (2)
- 6.3 Teken 'n netjiese, benoemde skets van 'n tandstang-en-kleinrat-stuurkas. (8)
- 6.4 Noem DRIE funksies van die stuurkas. (6)
- 6.5 Noem TWEE nadele van kragstuur. (2)
- 6.6 Teken 'n eenvoudige skets om toesporing te illustreer. (4)
- 6.7 Noem enige TWEE vereistes waaraan bande moet voldoen wanneer dit nagegaan word, voordat wielsporing gestel kan word. (2)

[32]

TOTAAL: 200

6.2 Study the following sketch of the steering layout and answer the questions below.



- 6.2.1 State the type of steering layout. (2)
- 6.2.2 State the function of component 6. (2)
- 6.2.3 Which steering layout is determined by component 7? (2)
- 6.3 Draw a neat, labelled sketch of a rack and pinion steering box. (8)
- 6.4 State THREE functions of the steering box. (6)
- 6.5 State TWO disadvantages of power steering. (2)
- 6.6 By means of a simple sketch, illustrate toe-in. (4)
- 6.7 State any TWO requirements for tyres when inspecting these before doing wheel alignment. (2)

[32]

TOTAL: 200

FORMULEBLAD

- $F = m \times a$
- $\text{Arbeid} = F \times \text{afstand}$
- $T = F \times R$
- $\text{Drywing} = \frac{F \times \text{afstand}}{\text{tyd}}$
- $\text{Drywing} = \frac{\text{G.E.D.} \times \pi \times D^2 \times \text{slaglengte} \times r/s \times \text{getal silinders}}{4 \times 2}$
- $\text{Drywing} = \frac{\text{G.E.D.} \times \pi \times D^2 \times \text{slaglengte} \times r/s \times \text{getal silinders}}{4}$
- $AD = PLANn$
- $\text{Remdrywing} = F \times 2 \pi R \times N$
- $\text{Remdrywing} = 2 \pi NT$

$$\text{Meganiese doeltreffendheid} = \frac{R.D.}{A.D.} \times \frac{100}{1}$$

$$KV = \frac{SV + VV}{VV}$$

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

$$\text{Slagvolume} = \frac{\pi D^2 L}{4}$$

FORMULAE SHEET

- $F = m \times a$
- $\text{Work} = F \times \text{distance}$
- $T = F \times R$
- $\text{Power} = \frac{F \times \text{distance}}{\text{time}}$
- $\text{Power} = \frac{M.E.P. \times \pi \times D^2 \times \text{stroke length} \times r/s \times \text{number of cylinders}}{4 \times 2}$
- $\text{Power} = \frac{M.E.P \times \pi \times D^2 \times \text{stroke length} \times r/s \times \text{number of cylinders}}{4}$
- $IP = PLANn$
- $\text{Brake power} = F \times 2 \pi R \times N$
- $\text{Brake power} = 2 \pi NT$

$$\text{Mechanical efficiency} = \frac{B.P.}{I.P.} \times \frac{100}{1}$$

$$CR = \frac{SV + CV}{CV}$$

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

$$\text{Stroke volume} = \frac{\pi D^2 L}{4}$$