higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T370(E)(N12)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

DIESEL TRADE THEORY N2

(11040192)

12 November 2014 (Y-Paper)
13:00–16:00

This question paper consists of 5 pages.

ENGINEERING

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
DIESEL TRADE THEORY N2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. ALL sketches must be fully labelled.
5. Keep subsections of questions together and DRAW a LINE after each completed question.
6. Write neatly and legibly

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QUESTION 1

1.1 Name THREE functions of a gearbox. (3)

1.2 Name THREE of the most common types (with regard to the shape of gear teeth) used in modern gearboxes. (3)

1.3 Give ONE advantage and ONE disadvantage for each of the above-mentioned types of gear teeth (shape) in use in a modern gearbox. (6)
[12]

QUESTION 2

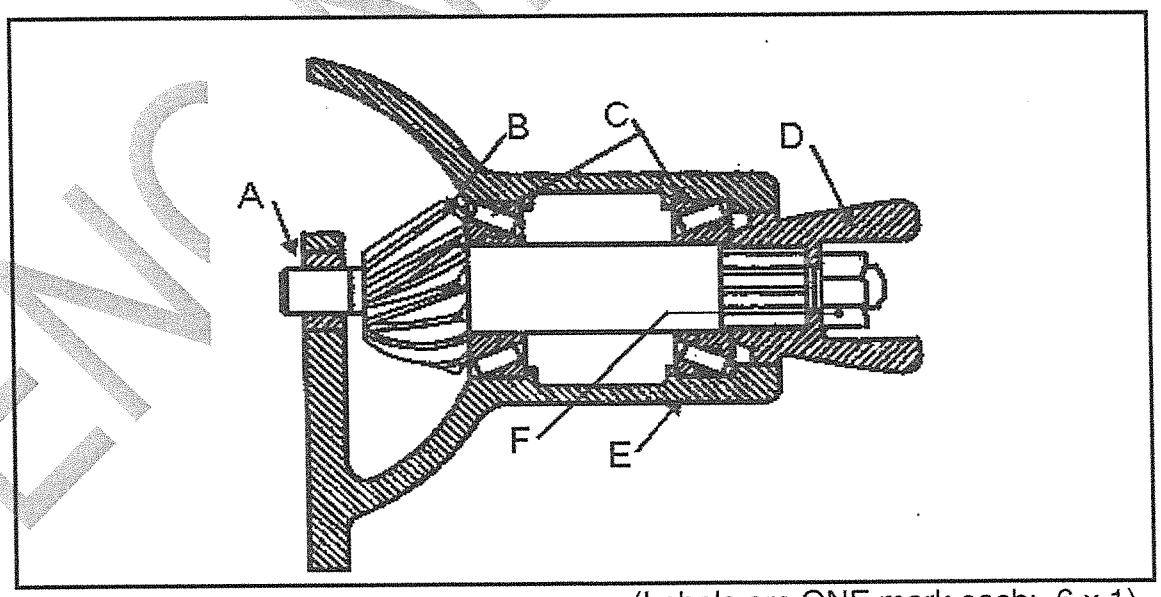
2.1 Explain the power flow through the differential and final drive when a vehicle is moving around a corner. (Sketches may be used to aid in the explanation.) (8)

2.2 State TWO functions of the final drive as used in heavy-duty vehicles. (2)

2.3 Name TWO functions of the differential as used in heavy-duty vehicles. (2)

2.4 The sketch below shows a pinion as it is used in the final drive.

Label the sketch by writing the names next to the letters (A–F) in the ANSWER BOOK.



(Labels are ONE mark each; 6 x 1) (6)

2.5 Use the above sketch to explain where the pinion depth adjustment shims are fitted. (2)
[20]

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QUESTION 3

3.1 Give FIVE reasons why wheel alignment is of great importance for the smooth running of a vehicle. (5)

3.2 Show by means of TWO sketches the difference between *a positive camber* and *a zero camber*. (6)

3.3 Name any TWO steering boxes in use on heavy-duty trucks. (2)

3.4 Name TWO functions of a steering box on a heavy-duty vehicle. (2)

3.5 Name the TWO types of balancing and which type needs to be done first during wheel balancing. (3)

3.6 What is the point of ensuring that the 'Ackerman principle' is correct when checking wheel alignment? (1)

3.7 What is the purpose of the dot on the outer wall of a tyre? (1)
[20]

QUESTION 4

4.1 Draw a neat sectional view of a double piston wheel cylinder as is used on the hydraulic rear wheel brakes of trucks. (8)

4.2 Give TWO reasons why 'brake pedal free play' is needed on a brake system. (2)

4.3 Give THREE advantages of using a tandem master cylinder on a vehicle. (3)

4.4 Can you use a brake master cylinder consisting of a check valve on disk brakes? Motivate your answer. (3)

4.5 Explain which procedures should be followed when a truck's drum brakes are adjusted. (4)
[20]

QUESTION 5

5.1 Make a neat sketch of a paper element air cleaner. (8)

5.2 Name TWO functions of an air cleaner. (2)

5.3 What is meant by the term *cetane rating* when referring to diesel fuel? (1)

5.4 Name any TWO methods that assist in increasing air turbulence during the intake stroke of diesel engines. (2)

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5.5 Name THREE requirements for a suitable injection-pump test room. (3)

5.6 What is meant by the term *ignition delay period*? (1)

5.7 Name the function of each of the following:

5.7.1 Fuel lift pump

5.7.2 Diesel injection pump

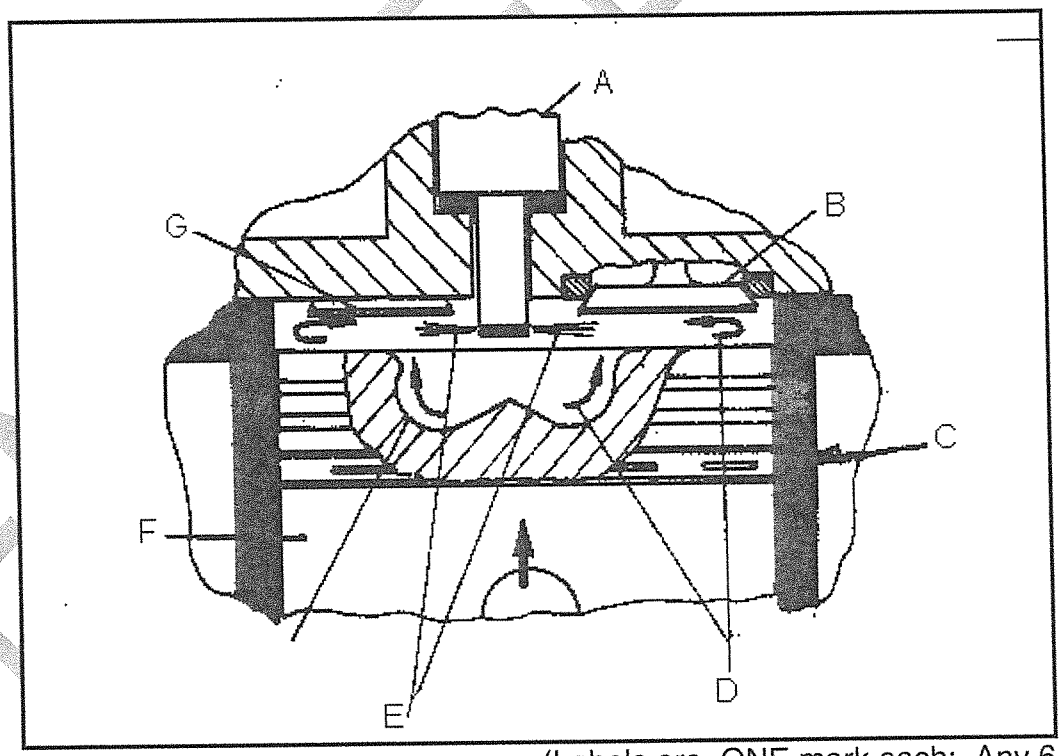
5.7.3 Injector

(3 × 1) (3)
[20]

QUESTION 6

6.1 The sketch below shows a combustion chamber as is found in diesel engines.

Label the sketch by writing the name for each part next to the letter (A–G) in the ANSWER BOOK.



(Labels are ONE mark each; Any 6 x 1) (6)

6.2 Is the above-mentioned combustion chamber a single swirl or a double swirl combustion chamber? Motivate your answer. (2)
[8]

TOTAL: 100

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MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

DIESEL TRADE THEORY N2

12 NOVEMBER 2014

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 Functions of a gearbox:

Gearbox allows engine to operate at satisfactory revolutions to power output.
To provide neutral gear by disconnecting the engine from the gearbox
Allow engine torque to increase in stages in accordance with load and speed requirements
To provide forward and reverse movement of vehicle (Any 3 × 1) (3)

1.2 Types (shapes) of gear teeth in use:

Spur gears
Helical gears
Double helical gears (3 x 1) (3)

1.3 * Advantages of spur gears:

Have high mechanical efficiency
Relatively cheap to manufacture
Have reduced side thrust (1 x 1) (1)

* Disadvantages of spur gears:

Gears noisy in operation
Gears must be stationary when engaged or need double declutch (1 x 1) (1)

* Advantages of helical gears:

More than one tooth in contact at any given time. Therefore stronger
Gears less noisy in operation (1 x 1) (1)

* Disadvantages of helical gears:

More expensive to manufacture
Do not slide easily into mesh (1 x 1) (1)

* Advantage of double helical gears:

Stronger and can transmit more torque (1 x 1) (1)

* Disadvantage of double helical gears:

Very expensive to manufacture (1 x 1) (1)
[12]

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QUESTION 2

2.1 Operation of a differential final drive assembly:

Rotational drive comes in from the pinion to drive the crown wheel; the differential carrier is bolted onto the crown wheel. Thus, the carrier rotates with the crown wheel. When the vehicle moves around a corner, the inner wheel will turn much slower than others; this is because the inner wheel has to take a smaller radius than the outer wheel, and also because of the resistance of the road.
The side shafts are fixed to the wheel on one end and the other end is splined where the sun gears are splined on. The side shafts and sun gears turn at different velocities; the difference in velocity is taken up by the planetary gear(s) which mesh (es) between the sun gears. The planetary gears rotate around the cross-pin whilst the cross-pin is fixed onto the differential carrier while cornering; but are stationary about the cross-pin when the vehicle is moving straight ahead. By this means, the drive can still be obtained whilst the vehicle is turning the corner (turning around the corner). (8)

2.2
- Provides a constant gear reduction to enable the vehicle to pull away from rest.
- Changes the direction of the drive through 90° angle (2)

2.3
- Enables the drive wheels to turn at different velocities.
- Prevents unnecessary wear on parts and tyres. (2)

2.4 Labels for parts:

A = Pinion pilot bearing
B = Pinion
C = Taper bearings
D = Flange
E = Differential housing
F = Preload adjustment nut.

(Labels are ONE mark each; 6 x 1) (6)

2.5 On the pinion shaft, behind the pinion gear. (2)
[20]

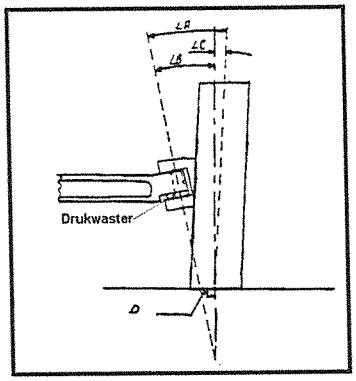
QUESTION 3

3.1 Reasons why wheel alignment is of great importance:

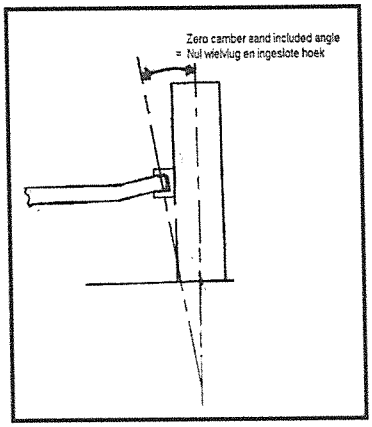
- Vehicle would be dangerous to handle if the wheel alignment is not set correctly
- Poor alignment of steering will lead to excessive tyre wear
- Vehicle will use more fuel due to extra drag on wheels with poor alignment
- Correct wheel alignment ensures smooth and easy handling
- Vehicle will pull to one side if alignment is not set correctly.
- With poor alignment, the vehicle will be difficult to bring to a straight ahead position after cornering
-

(Any 5 x 1) (5)

3.2 (a)



(b)



(2 x 3) (6)

3.3
- Recirculating ball and nut steering box
- Worm and roller steering box

(2)

3.4 The steering box on heavy-duty vehicles does the following:

- Provides a reduction in torque to enable the driver to use a small effort to turn the wheels of a truck;
- Enables the driver to move the truck straight as well as to change direction.

(2)

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3.5
- Dynamic balancing
- Static balancing

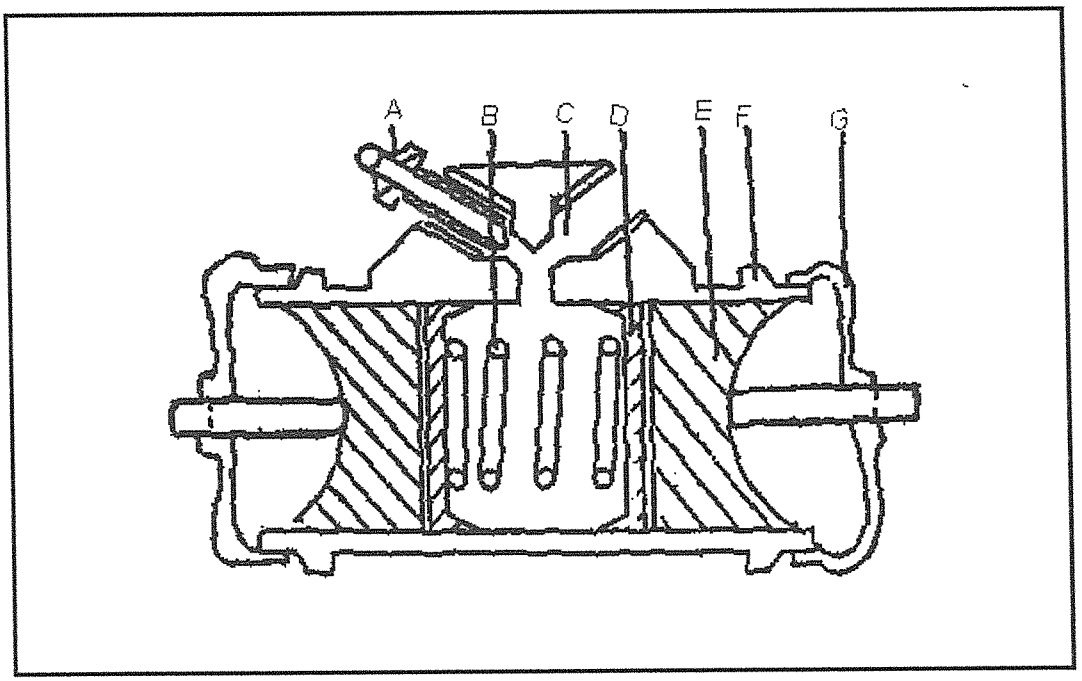
Static balancing is usually be done first (3 x 1) (3)

3.6 To ensure precise geometrical roll of all the wheels around a common point when moving around a corner. (1)

3.7 To indicate the lightest point of the tyre which must be put in line with the valve on the rim Also, to show the outer wall of the tyre. (Any 1 x 1) (1)
[20]

QUESTION 4

4.1 Double piston wheel cylinder:



A = Bleeding nipple
B = Piston return spring
C = Intake pipe
D = Rubber washers
E = Piston
F = Casing
G = Dustcover

(Labels are ONE mark each; Any 4 x 1 + Correctness = 4 points) (8)

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4.2 Reasons for brake pedal free play :
No brake pedal free play will lead to binding brakes which leads to overheating.
Brake pedal free play allows for the master cylinder piston to return to its stop position and to release pressure in chamber
Excess volume of brake fluid will return to reservoir.

(Any 2 x 1) (2)

4.3 Advantages for the use of a Tandem Master Cylinder used:
Hydraulic system for front and rear wheels is completely separate.
Vehicle will still have breaks if something should happen to front or rear.
Driver will notice failure in front or rear system because of further travel of break pedal
Two pistons compensate for unequal displacement of fluid in chamber
Two separate master cylinder circuits are place together and operated by a common push rod.

(Any 3 x 1) (3)

4.4 No; that is because the purpose of the check valve is to enable a pre-determined amount of pressure into the brake pipes. Therefore, if a check valve should be used, then the brakes will be permanently and partially applied on the disk brakes. (3)

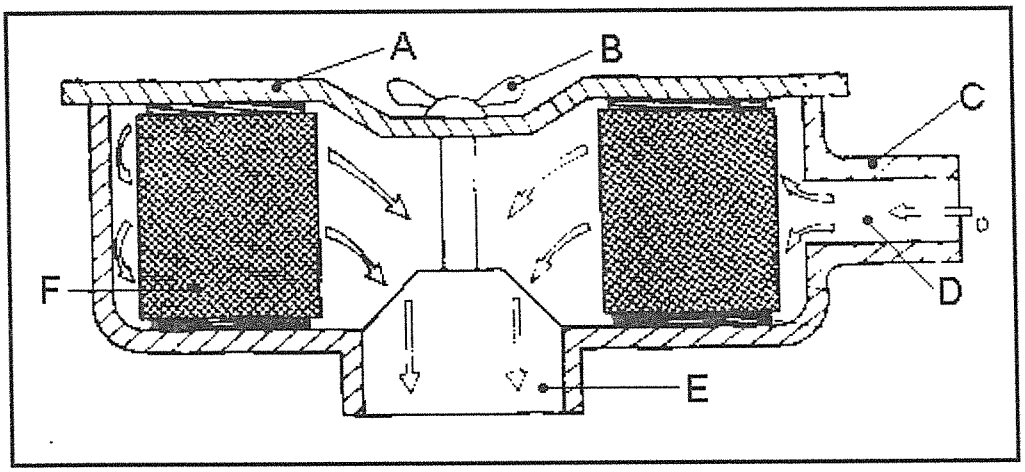
4.5 Lift the vehicle up in the air the wheels to be adjusted to enable them to be turned by hand; tightly adjust by means of an adjuster each lining against the drum until that wheel cannot be turned by hand; then, just loosen the adjuster until the wheel can be turned by hand, in the future. Remember that each wheel consists of two adjusters to be adjusted.

(4)
[20]

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QUESTION 5

5.1 Sketch of an air cleaner:



A = Air Cleaner cover
B = Wing nut
C = Air Cleaner casing
D = Air intake
E = Air intake into intake manifold
F = Paper element

(Labels are ONE mark each; Any 4 x 1 + Correctness = 4 points) (8)

5.2
- Reduces engine noise.
- Prevents all types of filth (dust, insects, vapour, etc.) from entering the engine. (2)

5.3 It is that property of diesel which measures its resistance against combustion under pressure. (1)

5.4
- By using a masked intake valve
- Design the intake manifold in such a way as to increase the turbulence of air during the intake stroke. (2)

5.5
- Due to fine tolerances of equipment and parts a constant temperature must be maintained.
- Owing to diesel fuel which can cause fire hazards, extractor fans must be used.
- Care must be taken when handling or storing fuel; and also, remember that diesel oil is slippery; avoid smoking or rather do NOT smoke in the test room at all.
- The test room must be equipped with the correct tools and care must be taken that testing equipment is calibrated as specified.
- (Any 3 x 1) (3)

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5.6. It is the time taken from the moment that the diesel is injected into the combustion chamber until it ignites. (1)

5.7 5.7.1 Transfer the diesel from the fuel tank to the fuel injection pump on applications where the fuel tank is lower than the engine.

5.7.2 It is to pump the correct amount of diesel, at the correct time, into the injector to be delivered for a specific condition.

5.7.3 It is to deliver diesel under pressure and in vapour form into the combustion chamber for complete combustion during the power stroke.

(3 × 1) (3)
[20]

QUESTION 6

6.1 A = Injector
B = Exhaust valve
C = Cylinder sleeve
D = Airflow
E = Injection spray pattern
F = Piston
G = Intake valve

(Labels are ONE mark each; Any 6 x 1) (6)

6.2 Double swirl, piston combustion chamber; it is a chamber designed to allow air swirl inside the combustion chamber, as well as, on top of the piston. (2)
[8]

TOTAL: 100

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