PAST EXAM PAPER & MEMO N3

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T390(E)(A6)T
APRILEXAMINATION
NATIONAL CERTIFICATE
DIESEL TRADE THEORY N3

(11041823)

6 April 2016 (X-Paper)
09:00–12:00

This question paper consists of 5 pages.
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. Write neatly and legibly.
QUESTION 1

1.1 An engine has a compression ratio of 15:1, a stroke length of 180 mm and a clearance volume of 250 cm³.

Use the following formulae and calculate:

\[ N = 1 - \left( \frac{1}{R} \right)^{0.4} \]; \hspace{1cm} Cr = \frac{V_s + V_c}{V_c}; \hspace{1cm} V_s = \left[ \frac{\pi D^2}{4} \right] \times L_s \]

1.1.1 The diameter of the cylinder. \hspace{1cm} (8)

1.1.2 The compression ratio of the engine with an air standard efficiency of 70%. \hspace{1cm} (6)

1.2 Draw and label a diagram of a rubber-type vibration damper used to minimise crankshaft vibrations. \hspace{1cm} (6)

QUESTION 2

2.1 Draw and label a diagram of a self-adjustable chain tensioner on a single overhead cam drive. \hspace{1cm} (8)

2.2 State SIX advantages of an overhead valve engine compared to a side valve engine. \hspace{1cm} (6)

2.3 Explain how the following improves volumetric efficiency of an engine:

2.3.1 Inlet-valve lead

2.3.2 Exhaust-valve lag

2.3.3 Exhaust-valve lead \hspace{1cm} (3 x 2) \hspace{1cm} (6)

QUESTION 3

3.1 FIGURE 1 shows a sectioned view of a Vacuum-type speed governor.
3.1.1 Label components (A–F) in your ANSWER BOOK.  
(6)

3.1.2 Explain the operation of the governor when the engine speed increases.  
(6)

3.2 State THREE functions of a torque converter.  
(3)

3.3 State THREE advantages of fluid clutches compared to plate clutches.  
(3)

3.4 Give TWO reasons for the high injection pressure of a diesel engine.  
(2)

[20]

QUESTION 4

4.1 FIGURE 2 shows a sectioned view of the main drive unit of a Three-speed automatic gearbox.

4.1.1 Label components (A–H) in your ANSWER BOOK.  
(8)

4.1.2 Give the clutch and brake-band selections for second gear.  
(2)

4.1.3 Explain the power flow through the gear set when second gear is selected.  
(5)

4.2 Explain with the aid of a neat diagram, the operation of a tandem rear-wheel drive.  
(5)

[20]
QUESTION 5

5.1 FIGURE 3 shows a sectioned view of a Power-steering unit.

![Diagram of Power-steering unit]

5.1.1 Label components (A–F) in your ANSWER BOOK. (6)

5.1.2 Explain the operation of the power-steering unit when the vehicle is steered to the left. (6)

5.2 Give TWO responsibilities of a receptionist. (2)

5.3 State the meaning of the following:

5.3.1 Time factor

5.3.2 Skill factor

5.3.3 Price factor (3 x 2) (6)

[20]

TOTAL: 100
MARKING GUIDELINE

NATIONAL CERTIFICATE
APRIL EXAMINATION
DIESEL TRADE THEORY

6 APRIL 2016

This marking guideline consists of 6 pages.
QUESTION 1

1.1.1

\[ Cr = \frac{Vs + Vc}{Vc} \]
\[ Vs = Vc(Cr - 1) \]
\[ = 250(15 - 1) \]
\[ = 3500 \text{ cm}^3 \]
\[ Vs = \frac{\pi D^2}{4} \times Ls \]
\[ D = \sqrt{\frac{Vs \times 4}{\pi \times Ls}} \]
\[ = \sqrt{3500 \times 4} \]
\[ = \frac{3500 \times 4}{\pi \times 18} \]
\[ = 15735 \text{ cm} \]

(8)

1.1.2

\[ N = 1 - \left[ \frac{1}{R} \right]^{0.4} \]
\[ 1 - 0.7 = \left[ \frac{1}{R} \right]^{0.4} \]
\[ 0.3^{2.5} = \frac{1}{R} \]
\[ R = \frac{1}{0.3^{2.5}} \]
\[ = 20286 : 1 \]

(6)

1.2

Sketch

RUBBER VIBRATION DAMPER

Rubber
Casing
Flywheel
Pulley
Crankshaft

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Please turn over
QUESTION 2

ADJUSTABLE CHAIN TENSIONER

2.2
- Improved thermal efficiency due to smaller heat loss. ✓
- Improved combustion chamber design. ✓
- Gravity flow of air into cylinder increases volumetric efficiency. ✓
- Exhaust gasses leave the cylinder faster and the flow is better. ✓
- Valve overlap is possible. ✓
- Space is available for larger valves and cross flow is possible. ✓
- Smaller valve clearance leads to a silent engine. ✓
- Simpler and easier engine to repair. ✓

(ANY SIX/ANY OTHER RELEVANT ANSWER)

2.3 2.3.1
- The inlet valve opens more advanced to increase the inlet period. ✓
- Exhaust gasses cause a suction in the cylinder which assists to set the inlet air in motion. ✓

2.3.2
- The exhaust period is increased to assist proper cleaning of combustion chamber. ✓
- Air entering combustion chamber helps to force the exhaust gasses out. ✓

2.3.3
- To increase the exhaust period. ✓
- The pressure left in the cylinder after power stroke helps to get the exhaust gasses in motion. ✓

(2 x 3) (6) [20]
QUESTION 3

3.1 3.1.1  A Rack✓
B Spring✓
C Idling control valve✓
D Venturi✓
E Diaphragm✓
F Butterfly valve ✓

3.1.2 When the engine speed increases the butterfly valve opens✓ air passes through the venturi causing a vacuum in the venturi✓ which is transferred to the diaphragm chamber.✓ The diaphragm is forced to the right compressing the diaphragm spring.✓ The rack is also drawn to the right which causes the pump to deliver less fuel.✓ Less fuel leads to lower engine revolutions.✓

3.2 A torque converter changes the oil-flow direction between the pump and turbine by ninety degrees.✓
It accelerates the oil. ✓
It also returns the oil at the rear of the pump's fins in the line of rotation called torque multiplication. ✓

Any other relevant answer

3.3 More floor space in vehicle due to the absence of a clutch pedal. ✓
It ensures a smooth pull-away. ✓
Oil serves as a shock absorber between the engine and gearbox. ✓
The torque converter serves as an engine flywheel decreasing power imbalance. ✓

Any three/any other relevant answer

3.4 The injection pressure needs to be high to penetrate the high combustion pressure of the engine✓ and to ensure proper mixing with the air in the relative short time available.✓

Any other relevant answer

QUESTION 4

4.1 4.1.1  A Front clutch✓
B Rear clutch✓
C Front brake band✓
D Rear brake band✓
E Ring gear✓
F Secondary planetary gear (Long planetary gear) ✓
G Primary sun gear (Small sun gear) ✓
H Secondary planetary gear (Small planetary gear) ✓

4.1.2 • The front clutch connects the primary sun gear shaft to the turbine shaft. ✓
• The front brake band locks the secondary sun gear. ✓

Any other relevant answer
4.1.3 Drive takes place from the primary sun gear to the primary planetary gear. The primary planetary gears and secondary planetary gears rotate about their own shafts and drive the ring gear at an increased speed. (5)

4.2 Third differential

The drive shaft from the gearbox drives the third differential. The third differential divides the power between the front and rear differential by resistance between the driving wheels. (5) [20]

QUESTION 5

5.1 5.1.1 A Reservoir B Pump C Relief valve D Control valve E Spring F Piston (6)

5.1.2 The steering box rotates the drop arm clockwise. The drop arm forces the control valve to the right. The high pressure channel from the pump is opened to the rear of the piston in the cylinder and the return port is opened to the front of the piston. The cylinder moves to the right and pulls the front wheels to the left. The excessive oil in front of the piston is returned to the reservoir. (6) ANY OTHER RELEVANT ANSWER
5.2 A receptionist meets with the customer before and after repair or service work. ✓
He or she is responsible for completion of the job card. ✓
He or she should obtain the signature of the customer on the job card before repairs commences. ✓
The job card should be delivered at the mechanic or foreman. ✓
A receptionist should maintain the records of workshop loading. ✓
A receptionist should make sure that the different parts of the job card reach the costing department for payment. ✓
He or she should hand the car back to the customer and file a copy of the job card. ✓

ANY TWO/ANY OTHER RELEVANT ANSWER

5.3 5.3.1 A specific time-schedule book (Flat rate manual) is set up from which time units for almost every repair job on all makes of vehicles are recorded. ✓ These time units must then be multiplied by the labour rate to standardise the price charged for work done. ✓

5.3.2 The service station owner advertises his service to the public to undertake repairs to their vehicles and thus guarantees that his workmen are capable of doing the work. ✓ Should a service station therefore accept repair work, he enters into a contract and is forced to repair the vehicle satisfactorily. ✓

5.3.3 For any contract a price should be mentioned to enforce the contract. ✓ The customer signs the job card which is a binding contract but should be informed about extra costs. ✓

[20]

TOTAL: 100
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