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This question paper consists of 5 pages and 1 diagram sheet.
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. Formula

\[
C.R = \frac{V_s + V_c}{V_c} \quad V_s = \frac{\pi d^2}{4} \quad h = \frac{SL}{CR - 1} \quad N = 1 - \frac{1}{r^{0.4}}
\]

5. Write neatly and legibly.
QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–C) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 In a two-speed double reduction final drive, the … reduction is obtained between the pinion and the crown wheel.

A  first  
B  second  
C  third

1.1.2 … is the efficiency with which the energy released by burning fuel can be converted into mechanical work.

A  Volumetric efficiency  
B  Thermal efficiency  
C  Mechanical efficiency

1.1.3 A sodium valve is filled with a substance that has … melting point.

A  low  
B  medium  
C  high

1.1.4 … filing means grouping of job cards in consecutive number order.

A  Alphabetical  
B  Numerical  
C  Chronological

1.1.5 … drives are noisy in operation.

A  Chain  
B  Gear  
C  Belt

(5 x 1)  
(5)

1.2 State THREE disadvantages of epicyclic gearing over conventional gearing.

(3 x 1)  
(3)

1.3 Explain the term firing order.

(2)

1.4 What are the TWO types of transistorised ignition systems?

(2 x 1)  
(2)

1.5 Name three valve layouts that allow cross-flow of gases through the cylinder.

(3 x 1)  
(3)

1.6 Name 5 engine sensors that send signals to the ECU (computer box) to enhance engine performance.

(5 x 1)  
[20]
QUESTION 2

2.1 Complete the following sentences by filling in the missing word(s). Write only the word(s) next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 … measured petrol injection systems uses an ECU, which stands for electronic … unit.

2.1.2 … multiplication occurs when there is a difference in speed between the … and turbine.

2.1.3 The … ratio for a petrol engine is between 4,5 : 1 and …

2.1.4 One of the advantages of the torque... is that it gives ... multiplication at low road speeds.

2.1.5 The accident … must be kept in a … place by the foreman of the workshop.

(5 x 2) (10)

2.2 Describe the operation of the overdrive which is fitted to a three-speed gearbox.

(10)

[20]

QUESTION 3

3.1 Complete the table below based on the power steering diagnosis, by filling in the cause of the condition, as well as the corrective action to be taken. Write only ONE possible cause and ONE corrective action per condition.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>POSSIBLE CAUSE</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.1</td>
<td>Steering-wheel action jerky during parking</td>
<td></td>
</tr>
<tr>
<td>3.1.2</td>
<td>Sudden increase in steering-wheel resistance</td>
<td></td>
</tr>
<tr>
<td>3.1.3</td>
<td>Steering-pump pressure low</td>
<td></td>
</tr>
<tr>
<td>3.1.4</td>
<td>Hard steering</td>
<td></td>
</tr>
<tr>
<td>3.1.5</td>
<td>Steering-pump noise</td>
<td></td>
</tr>
</tbody>
</table>

(5 x 2) 10

3.2 Explain the THREE important measures that should be taken when starting and stopping electrical machinery.

(3 x 2) (6)

3.3 Study FIGURE 1, ADDENDUM (attached) and label the parts numbered (3.3.1–3.3.4) of a silicon vibration damper.

(4) [20]
QUESTION 4

4.1 A diagnostic centre is used to check work done on a car as a means of quality control in the workshop. State THREE disadvantages of a diagnostic centre. (3 x 1) (3)

4.2 Name TWO different mounting positions for injectors that can be classified as indirect fuel injection. (2 x 1) (2)

4.3 Study FIGURE 2, ADDENDUM (attached) and label the parts numbered (4.3.1–4.3.6) of the power divider on a tandem drive vehicle. (6 x 1) (6)

4.4 State TWO functions of the part numbered 4.3.3 in the above question. (2 x 1) (2)

4.5 Name the FOUR members that make up an epicyclic gear system. (4 x 1) (4)

4.6 What are the advantages of using a computerised filing system when storing information of the company? Name three of the advantages. (3 x 1) (3)

QUESTION 5

5.1 Name FOUR types of petrol-injection systems. (4)

5.2 Make a neat labelled sketch of a fluid flywheel. (6)

5.3 An engine has a cylinder diameter of 85 mm and a stroke length of 75 mm. The ASE is 60%. Calculate the:

5.3.1 compression ratio (4)

5.3.2 stroke volume (3)

5.3.3 volume of the combustion chamber (3)

[20]

TOTAL: 100
FIGURE 1

FIGURE: 2

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MARKING GUIDELINE

NATIONAL CERTIFICATE
APRIL EXAMINATION
MOTOR TRADE THEORY N3

5 APRIL 2016

This marking guideline consists of 5 pages.
**QUESTION 1**

1.1 1.1.1 A
1.1.2 C
1.1.3 A
1.1.4 B
1.1.5 B  

(5 x 1)  

1.2 • Additional elements must be used to make the simple epicyclic gearset more versatile.
• The planetary gear system is more expensive than the conventional gear system.
• Brake bands that can wear are used.  

(3 x 1)  

1.3 Firing order is the order in which the power stroke occurs in different cylinders.  

(2)  

1.4 • Transistor ignition with breaker points.
• Transistor ignition without breaker points.  

(2 x 1)  

1.5 Hemispherical I-head
T-Head
F-Head  

(3x1)  

1.6 Vacuum sensor
Water temperature sensor
Intake air sensor
Throttle position sensor
Vehicle speed sensor
Knock sensor
High altitude compensator sensor  

Any 5 (5x1)  

[20]  

**QUESTION 2**

2.1 2.1.1 Time √ control √
2.1.2 Torque √ pump √
2.1.3 Compression √ 10 : 1 √
2.1.4 Convertor √ torque √
2.1.5 Register √ safe √  

(5 x 2)  

(10)
2.2 To overdrive means to drive faster. The overdrive ratio reduces engine wear and fuel consumption when the vehicle is cruising on the open road. In applications where an overdrive is fitted to a three-speed gearbox, the unit is activated in second gear to provide a gear ratio which falls between second and top gear. In this case the top gear becomes too high and second gear is too low. Oil under pressure from a pump driven by the input shaft, acts on pistons which force the cone clutch against the casing to prevent the sun gear from rotating. The input shaft will move the planet gears forward and cause them to rotate around the fixed sun gear. This motion will drive the annulus slightly faster than the input shaft to give overdrive. When the sun gear is held stationary and the carrier drives the epicyclic gear set, then the annulus is driven at an overdrive speed.

QUESTION 3

<table>
<thead>
<tr>
<th>Cause</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>3.1.1</td>
<td></td>
</tr>
<tr>
<td>• Loose pump belt</td>
<td>Adjust belt to specification</td>
</tr>
<tr>
<td>• Oily pump belt</td>
<td>Replace oily belt</td>
</tr>
<tr>
<td>• Insufficient pump pressure</td>
<td>Test and repair if necessary</td>
</tr>
<tr>
<td>3.1.2</td>
<td></td>
</tr>
<tr>
<td>• Low tyre air pressure</td>
<td>Inflate tyres to specification</td>
</tr>
<tr>
<td>• Slipping pump belt</td>
<td>Adjust belt tension</td>
</tr>
<tr>
<td>• Air in the system</td>
<td>Bleed air out of system</td>
</tr>
<tr>
<td>3.1.3</td>
<td></td>
</tr>
<tr>
<td>• Worn pump parts</td>
<td>Overhaul pump</td>
</tr>
<tr>
<td>• Defective hose</td>
<td>Replace the hose</td>
</tr>
<tr>
<td>• Flow-control valve stuck open</td>
<td>Clean or replace valve</td>
</tr>
<tr>
<td>3.1.4</td>
<td></td>
</tr>
<tr>
<td>• Power-steering pump fluid level low</td>
<td>Add fluid to reservoir</td>
</tr>
<tr>
<td>• Incorrect front wheel alignment</td>
<td>Adjust wheel alignment</td>
</tr>
<tr>
<td>• Sticky spool valve</td>
<td>Clean or replace valve</td>
</tr>
<tr>
<td>3.1.5</td>
<td></td>
</tr>
<tr>
<td>• Loose pump pulley</td>
<td>Tighten the pulley</td>
</tr>
<tr>
<td>• Plugged reservoir vent</td>
<td>Clean the vent.</td>
</tr>
<tr>
<td>• Dirty fluid</td>
<td>Drain, flush and refill</td>
</tr>
<tr>
<td></td>
<td>(Any 5 x 2)</td>
</tr>
</tbody>
</table>

3.2 The user shall cause every multi-section electrically driven machine which is required to be operated by more than one person to be provided with a stopping device at each section of the machine, so situated as to be readily and conveniently operated.

Any person intending to set a machine in motion shall before doing so take all reasonable precautions to ensure that no other person is in the act of repairing, cleaning, oiling, adjusting or working on or dangerously close to such machine.

The user shall provide every machine with an efficient stopping and starting appliance and the control of this appliance shall be in a position as to be readily and conveniently operated.
3.3 3.3.1 Free floating ring 3.3.2 Ring housing 3.3.3 Crankshaft front pulley 3.3.4 Liquid film (4 x 1) (4) [20]

QUESTION 4

4.1 • Space is taken up which could otherwise be used for repair bays. • Mechanics have to be trained to use the equipment. • It is a costly investment. (3 x 1) (3)

4.2 • The injector is placed into the inlet port of the cylinder. • The injector is placed into the inlet manifold. (2 x 1) (2)

4.3 4.3.1 Drive from main gearbox 4.3.2 Flange 4.3.3 Third differential 4.3.4 Differential lock mechanism 4.3.5 Second rear differential 4.3.6 First rear differential (6 x 1) (6)

4.4 • It is required to allow each set of wheels or axle to turn at their own speed. • It is used to prevent wind up or strain on the axle. (2x1) (2)

4.5 • Annulus Sun gear Planet gears Planet-carrier (4x1) (4)

• Large volume of information can be stored Quick retrieval of information Very compact

4.6 Variety of functions can be performed (Any 3x1) (3) [20]
QUESTION 5

5.1 • Mechanical petrol injection.
• Electronic petrol injection.
• Continuous petrol injection.
• Sequential petrol injection or time-measured petrol injection. (4 x 1) (4)

5.2

Sketch (2)
Labels (4)
5.3 5.3.1

\[ N = 1 - \frac{1}{R^{0.4}} \]

\[ R = \frac{1}{(1-N)^{2/4}} \sqrt{} \]

\[ R = (1-0.6)^{2/4} \sqrt{} \]

\[ R = 9.88 \sqrt{} \quad (4) \]

5.3.2

\[ V_s = \frac{\pi d^2}{4} \times SL \]

\[ V_s = \frac{\pi (65^2)}{4} \times 75 \sqrt{} \]

\[ V_s = 5674,502 \times 75 \sqrt{} \]

\[ V_s = 425 587.65 \text{ mm}^3 \sqrt{} \quad (3) \]

5.3.3

\[ V_c = \frac{V_s}{C.R-1} \]

\[ V_c = \frac{425 587.65}{9.88-1} \sqrt{} \]

\[ V_c = 47 926,537 \text{ mm}^3 \sqrt{} \quad (3) \]

[20]

TOTAL: 100
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