



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : VEHICLE SUB-SYSTEMS
TECHNOLOGY
- COURSE CODE : BNG 31003
- PROGRAMME CODE : BNG
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA
 Open book
 Closed book
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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- Q1** An internal combustion engine lies at the heart of most vehicles, providing the power needed to propel them forward. In essence, it's a complex system that transforms chemical energy into mechanical energy through controlled explosions within a chamber.
- (a) Define an internal combustion engine and explain how it converts chemical energy into mechanical energy.
(5 marks)
- (b) Consider an engine operating at a specific speed and temperature. If the engine is running with an Air/Fuel Ratio (AFR) that is 'rich', investigate how this might affect the engine's performance, emissions, and efficiency.
(8 marks)
- (c) Analyze the function and flow dynamics of a liquid cooling system for an internal combustion engine. Create a detailed diagram illustrating the key components of the system and label them accordingly. Additionally, describe the specific role of each component in maintaining optimal engine temperature and preventing overheating. Finally, explain the sequence of the hot and cooled liquid flow within the system, highlighting how heat exchange occurs and how the cooling process is facilitated.
(12 marks)
- Q2** Innovating automotive engineering involves integrating CVT for seamless acceleration and improved efficiency. Moving-off elements ensure smooth power transfer, while optimal chassis design enhances handling and stability. Proposing aluminum component replacement offers weight savings and enhanced performance for a winning edge in racing.
- (a) These days, most vehicles incorporate Continuous Variable Transmission (CVT) into their drivetrains. Identify **FOUR (4)** benefits of utilizing CVT.
(4 marks)
- (b) The clutch and torque converter are components of the hydrodynamic type of moving-off elements in the vehicle powertrain. Explain **TWO (2)** reasons why a powertrain necessitates a moving-off element.
(4 marks)
- (c) Analyze **THREE (3)** essential requirements for achieving an optimal chassis design for a vehicle, explaining how each contributes to its performance, safety, and functionality.
(6 marks)

- (d) Develop a persuasive proposal as an automotive engineer for a racing team, arguing for replacing specific components in the company's racing car with aluminium. Utilize critical evaluation and judgment, assessing the potential benefits of this transition for performance, safety, and competitiveness, supported by evidence and criteria.

(11 marks)

Q3 In motor vehicles, a power steering system helps drivers steer the car by augmenting the steering effort needed to turn the steering wheel, making it easier for the driver to turn. There are a few types of power steering systems.

- (a) Identifies **THREE (3)** advantages of Electric Power Steering (EPS) compared to Hydraulic Power Steering (HPS).

(6 marks)

- (b) State another **THREE (3)** types of power steering.

(3 marks)

- (c) Excessive play in the steering wheel is apparent when there is too much steering wheel movement before the wheels turn. Identifies **FOUR (4)** reasons that can cause that problem.

(4 marks)

- (d) When the driver feels the road's surface through the steering wheel, it is called feedback. Identifies **FOUR (4)** reasons that can cause that problem.

(4 marks)

- (e) Customers often complain of abnormal noises or vibrations from the steering system. Relates **TWO (2)** possible causes for each symptom shown in **Table APPENDIX A.1**.

(8 marks)

Q4 Tyres support vehicle weight, transmit forces, absorb shocks, and aid in direction control. The braking system ensures safety, provides control, and converts kinetic energy into heat. Both are vital for vehicle safety and performance. Regular maintenance is crucial.

(a) Describe seven features of the Unitech Rubber tyre depicted in **Figure Q4.1**.

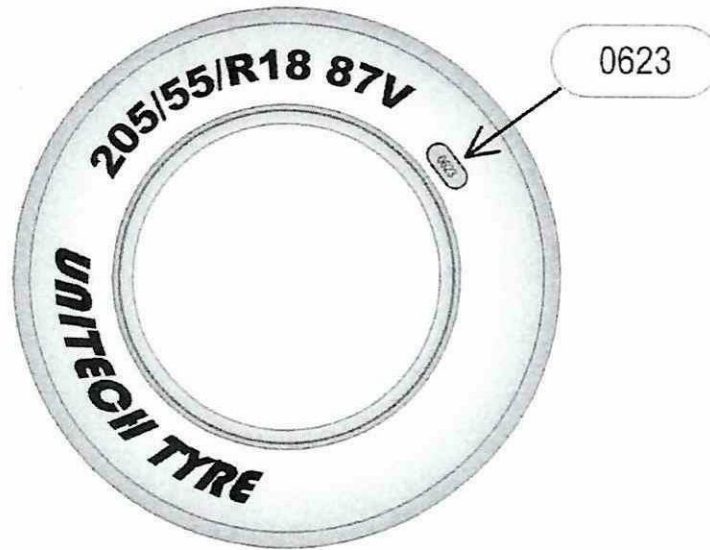


Figure Q4.1

(7 marks)

(b) Analyze the causes of center rib wear (A), outer rib wear (B), side wear (C), and cupped wear (D) based on the wear pattern shown in **Figure Q4.2**.

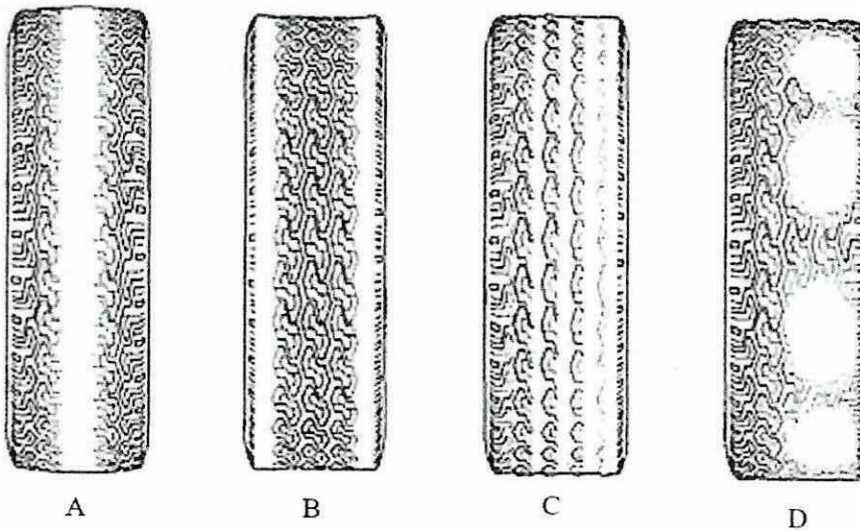


Figure Q4.2

(4 marks)

- (c) Heavy-load vehicles often employ drum brakes at all wheels, as illustrated in **Figure Q4.3**, which utilize a pneumatic braking system. Justify the rationale behind the use of drum brakes at all wheels for such vehicles.



Figure Q4.3

(4 marks)

- (d) Explain the continued relevance of the drum brake system, particularly in the context of the depicted heavy-load vehicle with a pneumatic braking system. (5 marks)
- (e) Investigate the brake system utilized by Car A and elucidate why it resulted in a broken line track on the road surface during emergency braking, as depicted in **Figure Q4.4**.

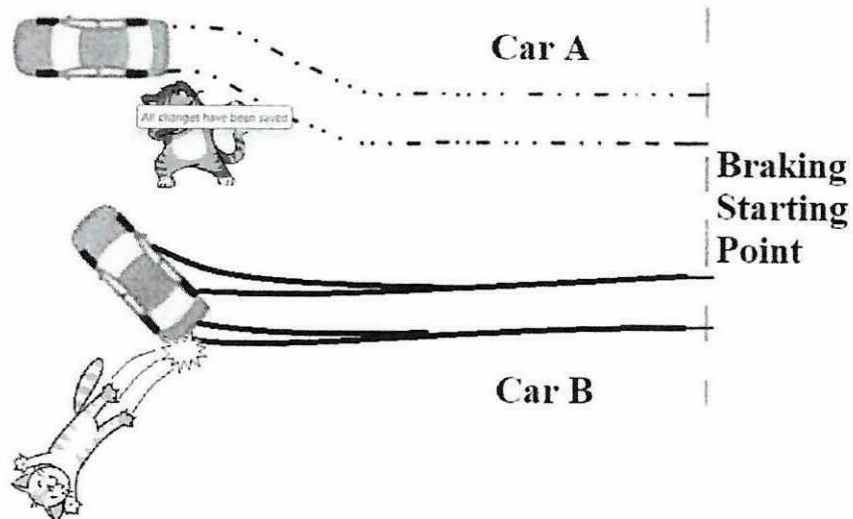


Figure Q4.4

(5 marks)

- END OF QUESTIONS -

APPENDIX A

Table APPENDIX A.1

No	Symptom	Possible Cause
1	Steering gear squeak	
2	Noise during a cold start	
3	Steering column rattle	
4	Power-steering hiss	

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