

Test Paper of Wuhan University of Technology (A)

2018-2019 Academic Year, 1st Semester, Course: Structures and Theory of New Energy Vehicle, Closed-book Exam

Time: 120 mins, 32 class hours, 2.5 credits, Total Points: 100, Percent in final evaluation result: 60%, Date: December 2018

No.	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Full score	10	20	15	20	15	20					100
Score	4	12	14	20	12	18					80

Score	4
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I. Fill in the blanks (2 points*5=10 points)

- The conventional methods of charging accumulators mainly include: constant-current charging method, constant-voltage charging method, stepped current charging method, constant-voltage charging method, and fast charging method etc.
- The main methods of recovering braking energy of electric vehicles include: effect energy storage, hydraulic energy storage and electrochemical energy storage.
- The drive motors commonly used in new energy vehicles include: permanent magnet synchronous motors, AC asynchronous motors, permanent magnet brushless motors and switched reluctance motors.
- Four directions of vehicles as defined in "Made in China 2025" include: electric vehicles, fuel-efficient vehicles, fuel-cell vehicles and intelligent and connected vehicles.
- The key technologies of electric vehicles include: battery and management technology, charging technology, vehicle control technology, and vehicle lightweight technology.

得分
Score

12

II. Single-choice questions (2 points * 10=20 points)

- What is the wrong description about SOC of batteries? (C)
 - Prevent battery from overcharge and overdischarge
 - Serve as a low-battery current limiting threshold
 - Serve as a threshold of vehicle control strategy
 - Serve as an important basis for measuring battery quality
- What's the fuel used by the positive pole of hydrogen cell? (B)
 - O₂
 - H₂
 - Methyl alcohol
 - Ni(OH)₂
- Which of the following options can be expressed as the speed characteristic of a shunt (separately) excited DC motor? (C)
 - $n = \frac{U - R_a I_a}{C_e \Phi}$
 - $n = \frac{U - 2\Delta U - 2I_a R_a}{C_e \Phi}$
 - $s = \frac{n_1 - n}{n_1}$
 - $n = n_0 + \Delta n$
- In order to obtain a high-voltage power battery, the single battery can be: (A)
 - Connected in series
 - Connected in parallel
 - Connected in series or parallel
 - None of the above
- Which of the following instruments in traditional vehicles is not installed in electric vehicles? (C)
 - Voltmeter
 - Power meter
 - Engine tachometer
 - Battery capacity indicator

11. What is the fuel cell most widely applied in fuel-cell electric vehicles? (~~B~~)

- A. AFC B. SOFC C. PAFC D. PEMFC

12. Which of the following components is excluded from the power assembly of a series hybrid electric vehicle? (~~D~~)

- A. Engine B. Generator C. Drive motor D. Control motor

13. What is the main evaluation index of vehicles' dynamic performance? (A)

- A. Starting acceleration performance and climbing performance
B. Battery performance and motor performance
C. Climbing performance and motor performance
D. Motor performance and starting acceleration performance

14. What is the function of accumulators in hybrid electric vehicles? (~~A~~)

- A. Provide auxiliary power supply for BMS
B. Transmit kinetic energy of automobiles to the accumulator through the traction motor
C. To be charged and discharged in a nonperiodic manner
D. To increase power

15. What's the wrong description about the reaction mechanism of fuel cells? (D)

- A. The chemical energy in the fuel can be converted into electric energy directly without burning.
B. The chemical energy can be converted into electric energy through electrochemical reaction.
C. In fact, it's the inverse process of water electrolysis.
D. Water will be generated and electric energy will be released through physical reaction between hydrogen and oxygen.

得分
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149 III. Short-answer questions (5 points * 3 = 15 points)

16. What are the main requirements of electric vehicles for power batteries? (5 points)

- ① high specific power 高比功率
② high specific energy 高比能量
③ long life 寿命长
④ small size and low quality 体积小, 质量小
⑤ no pollution 无污染
⑥ safety 安全

17. What are characteristics of permanent magnet synchronous motors? (5 points)

permanent magnet synchronous motors

For this kind of motor, there is a permanent magnet iron in the motor. It creates electricity by rotating the magnet field relevant with the stator. The current makes the relevant movement with the magnet field, and the motor because of this starts moving, and then it can output power. For this motor, it has a better output stability.

18. What are the advantages of fuel-cell electric vehicles? (5 points)

- ① solve energy and no pollution 节能, 没有污染
② high efficiency 高效率
③ satisfy the working characteristic of the vehicle, when accelerate, the overload can be active 200%.
满足汽车工作特性, 在加速时, 过载可以达到200%.
④ 结构简单, 实用耐用. the structure of the fuel-cell is simple and has long life
⑤ with high driving trip 高行驶里程
⑥ without much extra energy using, and has low heat effect.

得分

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IV. Fill in the blanks according to the figure (10 points*2=20 points)

19. Please fill in the following table in combination with characteristics of power battery for electric vehicles. (2 point*5=10 points)

Table 4.1 Technical Performance of Three Kinds of Power Batteries

Technical performance	Lead acid battery	Nickel metal hydride battery	Lithium ion battery
Operating voltage (V)	2.0	1.2	3.6
Specific energy (Wh/kg)	40	65	105-140
Specific power (W/kg)	150-200	160-230	250-400
Charge and discharge life (times)	500-700	600-1200	800-1200
Self-discharge rate (%) (monthly)	3	30-35	6-9
With/without memory effect	with	With	without
With/ without pollution	With	without	without

+10

20. Please fill in the blanks in the figure below according to the characteristics of the series-parallel hybrid electric vehicles (PSHEV). (2 points*5=10 points)

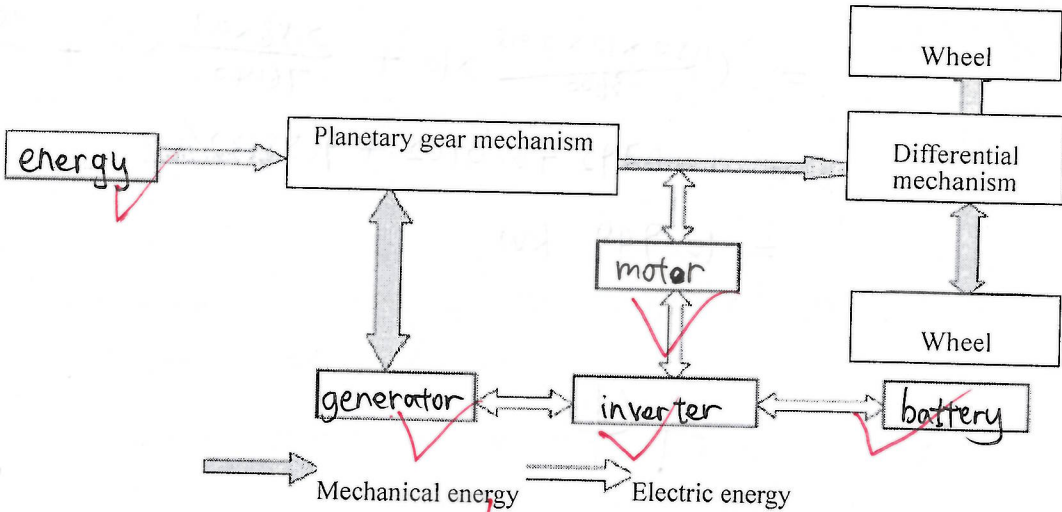


Figure 4.1 Diagram of Power Flow of PSHEV

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V. Calculation and analysis questions (15 points*1=15 points)

21. The relevant data of a full electric vehicle are as follows:
The gross vehicle mass (m): 1,150 kg; coefficient of air resistance (C_D): 0.3; windward area (A): 2.58 m^2 ; rolling resistance coefficient (f): 0.015; transmission efficiency (η_T): 92%; tyre radius (r): 0.305 m; maximum speed ($u_{a,max}$): 120 km/h; overall efficiency of motor and motor controller ($\eta_m\eta_{mc}$): 90%; total voltage of power battery pack (V_b): 342 V; allowed discharge depth (DOD): 90%. It is required that when the speed ($u_{a,i}$) is 10 km/h, the maximum gradability (i) shall be 30%; when the speed ($u_{a,s}$) is 40 km/h, the mileage (S) for which the vehicle can travel at a constant speed shall be 150 km.