ME419 Exam Possibilities

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1. The four stroke cycle is comprised of: (a) intake, compression, expansion, and exhaust, (b) intake, heat addition, expansion, and compression, (c) intake, ignition, expansion, exhaust, (d) intake, combustion, expansion, heat rejection, (e) none of the above

2. Torque, as measured at the crankshaft of an engine: (a) remains constant throughout the cycle, (b) increases with increasing engine speed, (c) varies throughout the cycle, (d) has a minimum value at TDC during the combustion process, (e) none of the above

3. Load control of an SI engine is accomplished: (a) with a throttle in the exhaust, (b) with a throttle in the intake manifold, (c) by rate of fuel injection, (d) by intake valve timing, (e) none of the above

4. A four cylinder engine with a bmep of 1000 kPa, a bore of 4 cm and a stroke of 5 cm, operating at 4000 rpm has a torque nearest to: (a) 8 kN·m, (b) 0.0628 kJ, (c) 1.25 kJ, (d) 0.25 kJ, (e) none of the above

5. A single cylinder engine with a compression ratio of 8:1, a bore of 8 cm, and a stroke of 6 cm has a clearance volume nearest to: (a) 37.7 cm^3, (b) 86.17 cm^3, (c) 43 cm^3, (d) 13.7 cm^3, (e) none of the above.

6. A single cylinder engine with a brake power of 3.7 kW and a bsfc of 42 g/kW·hr has a fuel flow rate nearest to: (a) 155 g/s, (b) 0.043 g/s, (c) 126 g/hr, (d) 0.56 kg/hr, (e) none of the above

7. An Otto cycle with the same compression ratio and heat addition when compared to the Diesel cycle is: (a) less efficient, (b) more efficient, (c) has the same efficiency, (d) twice as efficient, (e) none of the above

8. An air standard Otto cycle with a compression ratio of 10:1 has a theoretical thermal efficiency nearest to: (a) 32%, (b) 96%, (c) 57%, (d) 60%, (e) none of the above.

9. The advantage of a one dimensional model of an SI engine over that of a zero dimensional model is: (a) temperature and pressure as a function of crankangle can be predicted, (d) both time and temperature as a function of crankangle can be predicted, (c) the temperature of the burned gas and unburned gas can be predicted as a function of crankangle, (d) flow within the cylinder can be predicted (e) none of the above.

Note: for the next few problems MW of C is 12, air (apparent) is 29, N_2 is 28, O_2 is 32

10. A fuel having the overall formula C_7H_{16} has a stoichiometric AF nearest to: (a) 0.0624, (b) 3.2, (c) 11.2, (d) 15.2, (e) none of the above

11. The percent volume of CO2 in the exhaust in the problem above is nearest to: (a) 12.4%, (b) 32.3%, (c) 28%, (d) 56%, (e) none of the above

12. Consider combustion of the fuel in the previous problem. If there is excess fuel (the fuel air ratio is greater than the stoichiometric value and the temperature of the exhaust products is known) then: (a) CO can be neglected, (b) there is excess oxygen in the exhaust products, (c) CO produced can be estimated using water gas equilibrium, (d) combustion does not occur, (e) none of the above

13. The difference between the higher heating value and lower heating value of a fuel is due to: (a) the energy of water condensed in the exhaust, (b) the stoichiometric FA ratio and the AF ratio, (c) the temperature at which reaction occurs, (d) the Nitrogen in the exhaust, (e) none of the above

14. Straight chain hydrocarbons, when compared to isomers of the same formula, have: (a) less resistance to auto-ignition, (b) greater resistance to auto-ignition, (c) higher aromatic content, (d) AF ratios that are higher than their isomers, (e) none of the above

15. Gasoline is composed mostly of: (a) straight chain and branching chain hydrocarbons, (b) alkanes that are liquid at atmospheric pressure, (c) iso-octane and n-octane blended to yield a particular octane number, (d) a blend of aromatic and non-aromatic hydrocarbons, (e) none of the above

16. Independent variables of engine operation are: (a) speed and bsfc; (b) torque and power; (c) torque, speed, and power; (d) speed and engine load; (e) none of the above.

17. The two stroke SI engine was developed because: (a) it is a simpler design; (b) exhaust gases contain less unburned hydrocarbons in the two stroke compared to a four stroke engine; (c) more work is produced in a two stroke engine per engine revolution; (d) the engine is stronger and more durable; (e) none of the above.

18. Bsfc is: (a) brake specific fuel consumption at a given engine speed and load; (b) brake specific fuel/air ratio; (c) average pressure exerted on the piston throughout the power stroke; (d) fuel consumption of a engine; (e) none of the above.

19. Cold start of an electronically fuel injected SI engine is achieved: (a) through use of a choke plate ahead of the throttle plate; (b) by delivering much more fuel than necessary to reach a vapor air/fuel ratio close to the stoichiometric value; (c) by heating the fuel before fuel delivery; (d) through the use of EGR or exhaust gas recirculation; (e)none of the above.

20. There are two advantages to the CI engine over the SI engine regarding efficiency: (a) A high degree of compression allows for more expansion after combustion and greater efficiency and the fuel “finds” its own air during combustion thus it is not necessary to mix the fuel and air outside the engine; (b) higher compression ratio and absence of a throttle plate on the intake side; (c) diffusion combustion is better than premixed combustion and higher temperatures are achieved in CI combustion; (d) diesel engines are more durable than SI counterparts and run at lower speeds; (e) none of the above.

21. Cetane number is: (a) smoke or particulate rating of a diesel fuel; (b)ignition quality of a diesel fuel; (c) antiknock rating of gasoline fuels; (d) the number of cylinders divided by engine displacement; (e) none of the above.

22. The volumetric efficiency of an engine is: (a) generally very close to 100%; (b) reduced significantly by intake and exhaust manifold tuning; (c) effected by intake manifold tuning, exhaust tuning, charge heating, backflow, friction, choking at the valves, and momentum of the flow; (d) increased by piston geometry and intake valve angle; (e) none of the above.

23. A two stroke SI engine has an exhaust stroke: (a) every fourth revolution of the crankshaft; (b) every revolution of the crankshaft; (c) every two revolutions of the crankshaft; (d) every revolution of the camshaft; (e) none of the above

24. A crosshead engine: (a) has opposed cylinders, (b) has intake and exhaust manifolds folded in a cross pattern, (c) utilizes a long rod between the crankshaft and connecting rod to reduce piston skirt forces, (d) has connecting rods at angled geometries, (e) none of the above.

25. A prechamber diesel engine (a) has one combustion chamber for two opposed pistons, (b) allows fuel to be ignited in a small chamber where the significant burn occurs in the main chamber, (c) has a higher compression ratio than a direct injected diesel engine, (d) allows use of low quality fuels in a diesel engine, (e) none of the above.

26. Mechanical efficiency of an engine is directly related to (a) piston geometry, (b) friction work and indicated work (c) oil and lubricity of engine components, (d) sliding forces and piston pin configuration, (e) none of the above.

27. The heating value of a fuel combusted in an engine with a fuel conversion efficiency of 43% and sfc of 230 g/kWhr is closest to:

28. The specific weight of an engine that has an output of 300 bhp and 400 lbs is:

29. A typical range of bsfc for passenger cars is:

30. The effect of increasing vapor pressure of a fuel in an engine : (a) increases volumetric efficiency, (b) decreases volumetric efficiency , (c) has no effect, (d) increases overall fuel conversion efficiency, (e) none of the above.

31. The effect of closing the throttle on an engine: (a) decreases speed, (b) increases bsfc, (c) increases exhaust gas residual, (d) decreases the air to fuel ratio, (e) none of the above.

32. A typical range of bmep for passenger cars is:

33. The torque of an engine can be increased in an engine by: (a) increasing rotational speed, RPM, (b) increasing the fuel to air ratio, (c) increasing engine displacement, (d) increasing exhaust gas residual, (e) none of the above.

34. A roots blower is: (a) incorporated in two stroke engines for scavenging, (b) a clever device for removing tree roots with engine exhaust, (c) a style of exhaust scavenging devices for turbocharged engines, (d) a pre-compressor to reduce work of compression in an internal combustion engine, (e) none of the above.

35. Intake and exhaust valve overlap (a) occurs when the timing chain (or belt) slips, (b) used for starting high compression ratio engines, (c) can improve volumetric efficiency at certain engine speeds due to tuning effects, (d) allows better heat transfer reducing the need for sodium filled valve stems, (e) none of the above.

36. Increasing the ratio of fuel to air (increasing the f/a ratio) at full load in both a CI and SI engine: (a) has no effect on volumetric efficiency, (b) decreases volumetric efficiency, (c) increases volumetric efficiency, (d) increases the thermal efficiency, (e) none of the above.

37. Four or five valves per cylinder in a production engine (three intake and two exhaust) are becoming more common because: (a) reduced pressure losses during intake and exhaust contribute to increased volumetric efficiency, (b) reduced temperatures during intake and exhaust decrease engine exhaust emissions, (c) increased complexity increases market value and hence profits, (d) more intake and exhaust valves reduce wear and contribute to greater engine lifetime, (e) none of the above.

38. Residual gas mass fraction is: (a) the air trapped in the cylinder when the intake valve closes, (b) the ratio of measured CO_2 concentration trapped in the cylinder upon compression to that of the total CO_2 in the cylinder after combustion , (c) the mass ratio of exhaust gas to unburned air in the exhaust system, (d) the amount of CO_2 that is re-circulated into the intake to reduce overall temperatures and NO_x formation, (e) none of the above.

39. Supercharging differs from turbocharging: (a) because supercharging means that the fuel and air concentration is increased beyond that of normal engine operation, (b) turbocharging makes use of waste heat/energy in the exhaust to drive a compressor to increase manifold pressure above atmospheric, (c) supercharging includes the addition of an intercooler, (d) turbocharging involves a small turbine to compress the fuel, (e) none of the above.

40. Variable valve timing is incorporated in production engines: (a) to increase complexity and hence market value, (b) to improve the performance of a gas turbine expander, (c) to improve volumetric efficiency at a wider range of engine speed, (d) to decrease hydrocarbon emissions during engine deceleration, (e) none of the above.

41. An engine with the same heat added and compression ratio can be operated on a diesel cycle (constant pressure combustion) or operated on the Otto cycle (constant volume combustion). (a) efficiency is higher with the diesel cycle, (b) efficiency is higher with the Otto cycle, (c) efficiency is the same with either cycle, (d) efficiency is greater than 100% because the Otto cycle will have a very high compression ratio, (e) none of the above.

42. Increased valve overlap: (a) increases fuel conversion efficiency at lower engine speeds, (b) increases volumetric efficiency at low engine speeds, (c) increases volumetric efficiency at higher engine speeds, (d) increases exhaust residual at higher engine speeds, (e) none of the above

43. The mean piston speed of an engine with a stroke of 90 mm and a bore of 90 mm operating at 4000 rpm is nearest: (a) 20 m/s, (b) 10 m/s, (c) 2 m/s, (d) 0.5 m/s, (e) none of the above

44. The valve curtain area, A_c, of an engine with an intake valve diameter of 40 mm and lift of 10 mm is nearest: (a) 1.256 m^2, (b) 0.00636 m^2, (c) 0.00126 m^2, (d) 6.35 mm, (e) none of the above.

45. The pressure drop across the inlet valve in the middle of the intake stroke (maximum piston speed) for a four stroke SI engine at 4000 rpm and WOT with a intake velocity across the intake valve of 2 m/s, an intake density of 1.1 kg/m^3, and the curtain area, A_c, of 0.00126 m^2 is nearest: (a) 0.47 kPa, (b) 28 kPa, (c) 2.2 kPa, (d) 100 kPa, (e) none of the above. (Note: $\dot{m} = \rho A_c V = A_c[2\rho(\Delta p)]^{\frac{1}{2}}$