ME419 Final Exam Practice

The exam will be Multiple Choice. Several of these problems will be chosen for the Final Exam scheduled for in-class on December 9, 2019. The number of problems will be determined by the level of difficulty and the available time. The exam is fifty minutes in length.

_____1. Diesel engines are categorized by either: (a) IDI or DI, (b) heterogeneous or homogeneous, (c) fuel rich or fuel lean, (d) NOx free or NOx producers, (e) SCR or particulate.

_____2. The major pollutants from a diesel engine are: (a) , (b) , (c) , (d) , (e) none of the above

_____3. Oxides of nitrogen, NOx, is significantly reduced in a diesel engine by: (a) selective catalytic reduction, or SCR, in the exhaust stream , (b) lean combustion , (c) proper fuel selection with an appropriate Cetane rating , (d) exhaust gas recirculation , (e) none of the above

_____4. The optimum location for the spark plug in the SI engine is: (a) near the edge of the cylinder wall , (b) between the exhaust valves , (c) in the engine head at the center of the combustion chamber , (d) in the intake port near the intake valve , (e) none of the above

_____5. The production of NOx as a function of fuel/air ratio during any combustion process occurs: (a) at ø = 1, (b) slightly on the rich side of ø = 1, (c) slightly on the lean side of ø = 1 , (d) at the far end of the lean side of ø = 1 , (e) none of the above

_____6. Sources of hydrocarbon emissions from a SI engine include: a)flame quenching, crevices, absorption and deposits on combustion chamber surfaces, b)flame quenching, soot formation, and oil from the lubricating system, c) bulk and flame quenching, d)exhaust gas residual, e)none of the above.

_____7. NO formation is kinetically modeled by a)a complex set of kinetic equations, b)the well known Zodimyer mechanism, c)a set of three relatively simple kinetic equations referred to as the Zeldovich mechanism, d) a temperature and pressure controlled mechanism of nitrogen, oxygen, and water vapor, e)none of the above.

_____8. NO formation is kinetically modeled by a)a complex set of kinetic equations, b)the well known Zodimyer mechanism, c)a set of three relatively simple kinetic equations referred to as the Zeldovich mechanism, d) a temperature and pressure controlled mechanism of nitrogen, oxygen, and water vapor, e)none of the above.

_____9. With regard to engine emissions control, three way catalysis refers to: a)reduction of CO, CO2, and NOx by selective catalytic reduction, b)the use of platinum, rhodium, and thorium in the engine exhaust to eliminate EPA controlled engine emissions, c)use of three reduction techniques to eliminate particulates, carbon monoxide, and hydrocarbons in the engine exhaust, d)the use of platinum and rhodium to reduce CO, hydrocarbons, and NOx in the exhaust stream, e)none of the above.

_____10. A 50 ft long 8” diameter duct delivering 500 cfm has a pressure loss of: (a) , (b) , (c) , (d) , (e) none of the above

_____11. A room requires 400 cfm. A reasonable size of a rectangular duct would be: (a) , (b) , (c) , (d) , (e) none of the above

_____12. The velocity of air within a duct should not exceed: (a) , (b) , (c) , (d) , (e) none of the above.

_____13. An air delivery system is shown in Figure A. The damper must be located at what position to ensure equal airflow to both vents: (a) in leg 2-5, (b) in leg 3-4 , (c) in leg 2-3, (d) in leg 1-2, (e) none of the above

(Figure A is provided)

_____14. The air velocity within a 5" diameter duct delivering 200 cfm is: (a) , (b) , (c) , (d) , (e) none of the above

_____15. A degree day is defined as: (a) a unit of measure that equals the daily average temperature multiplied by the number of days, (b) the number of days that fall under a reference temperature point usually 65 °F, (c) a unit that represents one degree of difference from a given point (such as 65°) in the mean daily outdoor temperature and that is used especially to measure heat requirements, (d) the number of days that fall below a reference temperature, (e) none of the above.

_____16. A typical heating load for a residential dwelling is: (a) 10000 Btu/hr, (b) 100,000 kW·hr, (c) 1 X 104 Btu, (d) 100,000 Btu/hr (c) none of the above.

_____17. A residential structure has a total volume of 20,000 ft^3 and is occupied by 4 people each with a minimum ventilation rate of 10 cfm each. The required air exchange rate, ACH, in air exchanges per hour is: (a) , (b) , (c) , (d) , (e) none of the above.

_____18. A wall having a gross surface area of 150 ft^2 composed of 25% single glass and the remainder brick veneer (U=0.25 Btu/h ft F) where the outside and inside temperatures are 10 °F and 65 °F respectively will have a heat loss of: (a) , (b) , (c) , (d) , (e) none of the above.

_____19. A wall in a residential structure in Minneapolis, Minnesota has a surface area of 650 ft^2 and is constructed of 4 in face brick; ¾ in plywood sheathing, 2 ½ in. glass fiber insulation in 2 by 4 stud space (16 in on centers) with ½ in plasterboard interior. The design winter heat loss through a wall located in Minneapolis, Minnesota is: (a) , (b) , (c) , (d) , (e) none of the above.

_____20. The heat loss for a standard concrete basement constructed entirely below grade (U_{walls} = 0.25 Btu/h·ft^2·°F, U_{floor} = 0.05 Btu/h·ft^2·°F) located in Detroit, MI measuring 60 ft X 30 ft X 8 ft high including the slab is: (a) , (b) , (c) , (d) , (e) none of the above.

_____21. The cost of heating (resistance baseboard heating, $0.10/kWhr) for a month during winter of a residence in Minneapolis, Minnesota with a design heating load of 10000 Btu/h is: (a) , (b) , (c) , (d) , (e) none of the above.

_____22. A home is located in Detroit, Michigan, and has a design heat loss of 112,000 Btu/h at an inside design temperature of 72 °F and an outside design temperature of 0 °F. The home has an oil-fired furnace. The savings per in gallons of fuel oil if the owner lowers the temperature in the home to 68 °F in January is: (a) , (b) , (c) , (d) , (e) none of the above.

_____23. The total design heating load on a residence in Jackson, Mississippi is 112,000 Btu/h for an indoor temperature of 72 °F. The furnace is off from June through September. The annual energy requirement for heating in Btu is: (a) , (b) , (c) , (d) , (e) none of the above.

_____24. Given the duct system shown in Figure A, the frictional pressure loss between points 2 and 3 is: (a) , (b) , (c) , (d) , (e) none of the above.

(Figure A is provided)

_____25. The efficiency of a fan (figure below) when delivering 15,500 cfm at 4" static pressure is: (a) , (b) , (c) , (d) , (e) none of the above.

_____26. An air delivery system is shown in Figure A. The airflow at vent B is: (a) , (b) , (c) , (d) , (e) none of the above

Figure A is provided