1. All auto engines, both gas & diesel are classified as ____________ combustion.

2. The engine ________ contains the cylinders through which the ________ reciprocate.

3. The cylinder ________ has the valves, the intake & exhaust ports, and seals off the top of the block.

4. The A/F mixture burns in the combustion ________________ area above the pistons & under the head.

5. The valve ________ is the series of parts used to open & close the ports. The cam shaft operates it.

6. The ______________ is linked to the pistons by the ________________ rods. Working together, 
   these parts change the reciprocating motion of the pistons into useful rotary motion.

7. The drive end of the crankshaft is connected to the ______________ (manual) or ______________ (auto).

8. Many engine castings & stampings are lightweight non-iron materials like ________________, 
   ______________, & fiber-reinforced _________________. (composites) Fasteners are also fewer & smaller.

9. Engines can be classified by their operational ________, # and arrangement of ________________, 
   options in the valve train, spark or compression ________________, cooling system & ________ type.

10. V-block, dual overhead camshaft engines actually have ____ camshafts total. (2 per cylinder head)

11. Most engines still function with the basic ______-_______ cycle of operation. I > C > P > E

12. By SAE standards, all engines rotate clockwise as viewed from the ________. CCW from output end

13. Complete combustion is burning all of the A/F mixture. Incomplete burn is called ____________.

14. ___ - ______, slant, V, & the opposed or ________ (flat) cylinder arrangements are most popular.

15. An ______________ ________ engine is also called a push rod style due to its valve train design.

16. An ______________ _____ engine may have rocker arms & tappets, but has no push rods. (OHC)

17. The 4 valve arrangements ever used are the ____, ____, ____, ____ head. ____-head is OHV.

18. ______________ drives can be gear-to-gear, timing chain & sprocket, or timing belt & sprocket.
19. Camshafts turn at _____ the speed of the crankshaft, rotating _____° for every four-stroke cycle.

20. Engines facing forward/backward are said to be _______________ mounted. ____________ mounted engines face sideways in the engine compartment. (Cars torque steer the way the engine faces.)

21. ____________ ________ is the sequence in which the air/fuel mixture is ignited in the cylinders.

22. _______ is the cylinder diameter. __________ is the distance the piston moves TDC to BDC.

23. If Bore = Stroke, the engine is “square”. Bore > Stroke = __________ Bore < Stroke = __________

24. ________________ is the distance measured from the main bearing centerline to the rod journal centerline.

25. ________________ is the term for total cylinder volume. (Either metric or standard units of measure)

26. ______ x ______ x ______ x .785 x # of cylinders = Displacement (either metric or standard)

27. ________________ is found by dividing cylinder volume w/piston @BDC by cylinder volume w/piston@ TDC. This is Cylinder Volume divided by Combustion Chamber Volume.

28. Engine ________________ is found by output energy ÷ input energy. (always less than 100%)

29. ____________ is twisting or turning force, expressed in pound-feet. ____________ is the rate at which torque is produced. (1 HP is the ability to lift 33,000 pounds 1 foot in 1 minute or 550# 1ft/sec)

30. The ____________ cycle engine holds the intake valve open longer during the compression stroke. This is done with variable valve timing & use the intake manifold as a “surge tank” for A/F mix.

31. The piston stroke, in inches, is longer, but the “__________” compression stroke is shorter.

32. ____________ vehicles use Atkinson cycle engines because of improved fuel economy, lower emissions, plus they have another source of power to add to the vehicle – the HV motor generator.

33. Atkinson cycle engines with forced induction of a supercharger are called ____________ cycle.

34. ____________ engines are compression ignition engines with a compression ratio as high as 25:1.

35. Compared to gasoline engines, diesels have higher ____________ output at lower engine RPMs.
36. Diesels once had distributor-type injection. New diesels have _______ ______ direct injection.

37. Combining common ______ DI with ___________________ can increase a diesel’s horsepower.

38. Emission laws now require diesels to have particulate ______ & filters to catch unburned carbon.

39. Selective ______ reduction (SCR) reduces diesel NOx by exhaust “after-treatment” with urea.

40. A ________ vehicle has at least 2 different types of power or propulsion systems. (gas/electric)

41. __________ hybrids can drive by just motor, just engine or a combination of both.

42. A full __________ operated vehicle is known as an EV. EVs are aka. ZEVs or zero emission vehicles.

43. ______ ______ vehicles convert chemical energy to electrical energy by combining H with O.

44. The ________ engine has no pistons or valves. Mazda Renesis is a twin rotor Wankel engine.

45. _______________ charge (layered) engines run on lower octane fuel & produces less emissions.

46. Homogeneous charge ___________ ignition engines “autoignite” a lean, diluted A/F mixture.

47. Variable ___________ ratio engines provide power when needed & reduce fuel consumption.

48. The ____ is a 17 - character code used to ID vehicle OEM options. The ___character tells the country of origin, the ___ character identifies the engine, the ___ character tells the year of mfgr.

49. The ______________ label, a.k.a. VECI label (vehicle emission control information) holds valuable information for use when servicing engine systems like mechanical, ignition, fuel, and emissions.

50. Diagnosis always begins with ______________ the customer complaint and searching for TSB’s.

Note: The 3 C’s of repair are: Complaint > Cause > Correction

Verify the customer complaint, perform testing to determine the cause, make the correction & be sure to prove - out that the problem was repaired properly with a final test drive.
51. A **dry** compression test followed by a ____ compression test can verify the **piston ring condition**.

52. Cylinder ____ tests can **pinpoint** the cause of a low compression problem.

53. A cylinder _______ _______ test can check if all the engine’s cylinders are producing the same amount of power. *This is sometimes known as a cylinder contribution test.*

54. A cylinder causing little or no decrease in RPM when it is shut off is the ____ cylinder.
   **Note:** Power balance tests can be done manually or with the use of a scan tool.

55. Checking for normal & stable intake manifold ____ also helps to diagnose engine condition.

56. ____ pressure problems are caused by lubrication system faults or by **loose bearing clearances**.

57. Interpreting exhaust ______ & fluid ______ can give clues to potential engine problems.

58. Engine **noises** tell a lot. Piston ____ *(skirt hitting cylinder wall)* is more noticeable on a cold engine.

59. **Piston pin** noises sound like a __________ ____ at idle speeds. *Use the chart on page 250.*

60. **Rod bearing** knock is heard at most speeds, but goes away when that cylinder is ________ out.

61. **Main bearing** knock is a ______, ________ knock from the lower end, oil pan or block area.

62. A loose crankshaft main ____________ bearing produces a **heavy thump at irregular intervals**.

63. ____ noise is a light, regular clicking sound, more noticeable at idle speeds **in the upper end**.

64. _______________ & _______________ are **knocks or pings** caused by abnormal combustion.