Energy!

1. ENERGY: *Multiple Choice:* A diesel engine would ideally use a fuel with a:  
W) high octane number and low cetane number

X) high octane number and high cetane number

Y) low octane number and high cetane number

Z) low octane number and low cetane number  
  
ANSWER Y) low octane number and high cetane number

2. ENERGY: *Short Answer:* Which straight-chain alkane is used as the zero point of the octane scale?

ANSWER: n-heptane

3. ENERGY: *Multiple Choice:* Which of the following fuels has the highest octane number?  
  
W) n-octane

X) heptane

Y) iso-octane

Z) methanol

ANSWER: Z) methanol

4. ENERGY: *Short Answer:* What generation are most currently-operating nuclear power plants classified under?  
  
ANSWER: Generation II

5. ENERGY: *Short Answer:* What type of thermal nuclear reactor is the most common nuclear reactor design used around the world due to its simplicity and cheapness and uses normal water as a coolant and neutron-moderator?  
  
ANSWER: light-water reactor

6. ENERGY: *Short Answer:* By name or number, denote all of the following five choices which are used to classify nuclear reactors:  
  
1) moderator material

2) type of coolant

3) phase of fuel

4) neutron energy

5) reactor vessel

ANSWER: 1, 2, 3, 4

7. ENERGY: *Short Answer:* What Japanese theoretical physicist received the 1949 Nobel Prize in physics for his work with pions?  
  
ANSWER: Hideki Yukawa    
  
  
  
  
8. ENERGY: *Multiple Choice:* Which of the following statements best describes why the strong and weak interactions only work over very small distances?  
  
W) the particle carriers for the two interactions are massless, and so cannot exist over long distances due to the Heisenberg Uncertainty Principle

X) the particle carriers for the two interactions are massive, and so cannot exist over long distance due to the Heisenberg Uncertainty Principle

Y) the particle carriers for the two interactions are travelling at the speed of light, and so cannot interact with matter that is far away

Z) the particle carriers for the two interactions are travelling slower than the speed of light, as so cannot interact with matter that is far away  
  
ANSWER: X) the particle carriers for the two interactions are massive, and so cannot exist over long distance due to the Heisenberg Uncertainty Principle

9. ENERGY: *Short Answer:* In terms of c, give the rest mass of an electron with a rest energy of 0.511 MeV

ANSWER: 0.511 MeV/c2

10. ENERGY: *Multiple Choice:* Which of the following particles would be affected by the strong force?  
  
W) muon

X) electron  
Y) photon

Z) pion

ANSWER Z) pion

11. ENERGY: *Short Answer:* How much heat, in Joules, will a toaster with resistance 10 Ω produce if 50 amperes of current runs through it in one second?  
  
ANSWER: 2500 Joules

12. ENERGY: *Multiple Choice:* Which of the following statements regarding ethanol fuel blends is true?  
  
W) E85 refers to the 85% gasoline content by volume in ethanol fuel

X) Ethanol has less energy content per volume than gasoline

Y) Ethanol has a lower octane rating than premium gasoline

Z) For an engine to run efficiently on ethanol, it must have a compression ratio lower than that of most standard gasoline engines

ANSWER: X) Ethanol has less energy content per volume than gasoline

13. ENERGY: *Short Answer:* By name or number, denote all of the following four statements which must hold true for an ideal gas during isochoric heating?

1. ΔU is equal to Q

2. W is equal to zero

3. there is a change in temperature

4. ΔU is directly proportional to Q

ANSWER: all of them

14. ENERGY: *Multiple Choice:* Which is not a factor that is used to measure the quality of diesel fuel?  
  
W) oxygen content

X) sulfur content

Y) density

Z) cetane number

ANSWER: W) oxygen content

15. ENERGY: *Short Answer:* What relatively potent greenhouse gas is also the principal component of natural gas and is one of the most abundant organic compounds on earth?  
  
ANSWER: methane

16. ENERGY: *Short Answer:* By name or number, denote all of the following four statements that is or are true for an adiabatic process:  
  
1. ΔU is equal to -W

2. ΔU is equal to W

3. Q is zero

4. the temperature of the system must remain constant

ANSWER 1 and 3

17. ENERGY: *Multiple Choice:* Which of the following statements best describes how the anti-knock index is calculated in the US?

W) the anti-knock index is calculated by testing the fuel in real-world multi-cylinder engines

X) the anti-knock index is calculated by running the fuel through a variable-compression test engine at 600 rpm

Y) the anti-knock index is calculated by running the fuel through a variable-compression test engine at 900 rpm

Z) the anti-knock index is calculated by running the fuel through a variable-compression test engine at both 600 and 900 rpm, and then averaging the two octane numbers

18. ENERGY: *Short Answer:* What form of petroleum, found in the oil sands of Alberta, is more difficult to refine due to its large molecules in comparison to light crude but may now prove to be a economical solution due to advances in extraction technology?  
  
ANSWER: heavy oil

19. ENERGY: *Short Answer:* Oil shale is produced when what organic compound accumulates in rock formations, but does not experience high-enough temperature to be converted into oil?  
  
ANSWER: kerogen

20. ENERGY: *Multiple Choice:* In 2009, what percentage of the electricity of the United States was generated by sources that did not utilize fossil fuels?  
  
W) 10%  
X) 20%  
Y) 30%  
Z) 40%

ANSWER: Y) 30%

21. ENERGY: *Short Answer:* What state is the biggest domestic producer of natural gas in the United States?  
  
ANSWER: Wyoming

22. ENERGY: *Multiple Choice:* How do Generation III+ nuclear reactors differ from current-day nuclear reactors?  
  
W) different types of reactor coolants are used

X) different elements are used in the fission process

Y) the reactor vessel is submerged in water to prevent a meltdown

Z) passive safety features are used which can prevent a meltdown if power is lost

23. ENERGY: *Multiple Choice:* To the nearest percent, what percentage of electricity produced in the US in 2009 was from biomass?

W) 1%

X) 4%

Y) 10%

Z) 20%

ANSWER: X) 4%

24. ENERGY: *Short Answer:* What reactor design are almost half of the world's 440 nuclear reactors based on?  
  
ANSWER: Westinghouse

25. ENERGY: *Short Answer:* What international fusion research and engineering project is currently constructing a tokamak in France, with the goal to produce fusion-based power by 2040?  
  
ANSWER: ITER