P162 Final Exam

Answer the following questions by filling in the appropriate circle on your scantron sheet. You can use 1 cheat sheet.

The first 6 questions deal with some the particles listed below. For each question, select the best fit from this list. You may or may not use a particle more than once

a n

b e^-

c ν

d e^+

e $\bar{\nu}$

(1.) Nucleon with no electric charge

(2.) Positron

(3.) $e^+ + e^- \longrightarrow \nu + ?$

(4.) Escapes directly from the Sun's core

(5.) lepton with no charge

(6.) The Sun, a garden variety star, derives its energy from

a gravitational heating

b chemical burning

c thermonuclear fusion

d conversion of rotation into mechanical energy

(7.) Stellar death occurs when

a core cannot reach temperatures necessary for further fusion

b an iron core is reached

c a black hole swallows the entire star, envelope and all

d either (a) or (b)

e both (b) and (c)

(8.) Gas pressure inside the Sun is (*fill in the blank*) the weight of the outer layers of the Sun.

a greater than

b less than

c equal to

d unrelated to

(9.) Which of the following is the correct ordering according to size (from smallest to largest)?

a mass of neutrino, mass of proton, mass of positron

b atom, nucleus, nucleon, molecule

c white dwarf, neutron star, main sequence star

d nucleon, nucleus, atom, molecule

e proton, uranium nucleus, alpha-particle, helium atom

(10.) Rank, from longest to shortest, the lifetimes associated with the 3 possible mechanisms of stellar energy (chemical, nuclear, gravitational):

a τ_{grav}, τ_{chem}, τ_{nuke}

b τ_{nuke} ,τ_{grav}, τ_{chem}

c τ_{nuke} , τ_{chem}, τ_{grav}

(11.) Which of the following β decays of tritium (^3_1H) are allowed?

a $^3_1H \longrightarrow ^4_2 He + e^- + \nu$

b $^3_1H \longrightarrow ^3_2 He + e^+ + \nu$

c $^3_1H \longrightarrow ^3_2 He + e^- + \bar{\nu}$

d $^3_1H \longrightarrow ^3_2 He + e^+ + \bar{\nu}$

e $^3_1H \longrightarrow ^3_2 He + e^- + 2\nu$

(12.) Which of the following concepts required the existence of the neutrino?

a conservation of energy in β-decay

b degenerate electron pressure

c Pauli Exclusion Principle

d all of the above

(13.) Which of the following most accurately describes the ratio of typical energies involved in nuclear reactions to that of chemical reactions?

a about the same

b about 10 times greater

c about 10^6 times less

d about 10^6 times greater

e about 10^3 times greater

(14.) How old is the Universe?

a 6000 years old

b 10 million years old

c 10 billion years old

d 10^{10} years old

e both (c) and (d)

(15.) In class we learned that when the Sun burns 4p$\rightarrow^4$He + 25 Mev it can last 10 billion years. If it had to burn 8 protons (instead of 4 protons) to generate the same amount of energy per reaction, how long would it last?

a 10 billion years

b 5 billion years

c 20 billion years

d 40 billion years

(16.) Which of the following is an accurate description of the behavior of the nucleons in the reaction p+p $\rightarrow$ ^{2}H + e$^+$ + ν?

a one neutron changes to a proton

b one proton changes to a neutron

c the nucleons retain their identities

d none of the above

(17.) Which of the following statements are TRUE?

a photons travel straight to Earth from the core of the Sun

b the Sun radiates from its surface like a black body radiator

c the Sun is powered by the thermonuclear fusion of 3 ^{4}He nuclei to ^{12}C in its core

d the speed of the Earth orbiting the Sun does not depend on the Sun's mass

(18.) Which of the following processes is most likely to be seen in Nature?

a $p + p \longrightarrow e^+ + e^+ + \gamma$

b $p \longrightarrow e^+ + \gamma$

c $\nu + n \longrightarrow p + e^-$

d $^2_1H + n \longrightarrow ^3_2 He + e^+ + e^- + \nu$

e $p \longrightarrow e^- + n + \nu$

(19.) A white dwarf is not

a powered by thermonuclear fusion

b supported by degenerate electron pressure

c the end state of the evolution of stars similar to the Sun

d made up of carbon and oxygen

(20.) We know that neutrinos come from the core of the Sun because

a neutrinos interact much more weakly than photons or charged particles

b neutrinos exert a pressure, helping the Sun oppose gravitational collapse

c neutrinos are emitted when protons change to neutrons

d both (a) and (c)

e all of the above