

## Grading Exam 1: Multiple Choice and Essays 1 & 2

### Multiple Choice:

1. B
2. A
3. B
4. D
5. C

### Essay 1:

First 9 items=1.6 points each

- \_ Hydrogen formed in the first few minutes after the Big Bang
- \_ H got to Earth in the icy mantles of dust particles
- \_ Oxygen and Iron formed in stars during fusion
- \_ Supernovae released O & Fe to be used later
- \_ O got to Earth in the icy mantles of dust particles
- \_ Fe got to Earth as dust particles
- \_ Earth formed in the collisions of dust particles/planetesimals
- \_ Earth was radioactively heated, causing differentiation where Fe sank to the core
- \_ Water got to the surface by being outgassed via volcanoes or acquired from comets

Other items=no more than 5 points total (for inclusion of any of these)

- \_ the atom formed much later than the nucleus
- \_ steps of the fusion processes that lead to O/Fe
- \_ Fe is last element formed before star explodes as supernova

### Essay 2:

10 pts – pick a value of  $R_*$  and describe that  $R_*$  is the number of stars in the galaxy

divided by the age of the galaxy

3 pts – for including all intermediate numbers; listing any numbers = 2 pts

$v=250$  km/s

$R=25000$  ly

$M_{gal}=10^{11}$  solar masses

$M_{gal}=1.6 \times 10^{11}$  solar masses (after correction for stars outside sun's orbit)

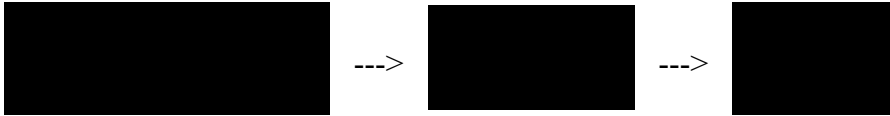
$M_{ave}=0.4$  solar masses (average mass of a star)

$N_*=4 \times 10^{11}$  stars

$t_{gal}=10^{10}$  years

3 pts – for explaining how we get  $N_*$ ; equations were not necessary, but if you didn't use them you must have described in words sufficiently that it was clear you fully understood what was going on

kinetic energy = \_ potential energy



4 pts – listing the assumptions in this calculation (2 pts each)

- This calculation is for an average rate of star formation. This assumes star formation is constant, while many astronomers believe it occurs in bursts.
- This calculation does not take into account the massive stars that have already died. We're assuming all the mass of the galaxy lies in stars and neglecting the interstellar matter ejected from those dead stars.