

Rivedere soprattutto i test in italiano della prime due pagine e quelli in inglese, che richiedono dei calcoli delle pagine 9 e inizio 10.

La linea spettrale  $\text{Ly}\alpha$  è vista nello spettro visibile per una:

- a) Nebulosa a emissione    b) buco nero    **c) galassia**    d) ammasso globulare

Per una galassia con  $z=3.5$  la riga  $\text{H}\alpha$  è osservabile nel

- a) visibile    **b) infrarosso**    c) microonde    d) ultravioletto

Per classificare secondo il metodo di Hubble una galassia, non dobbiamo tener conto di

- a) strumenti di osservazione utilizzati    **b) massa**    c) forma apparente    d) presenza di bracci

Una galassia ellittica è classificata E3. Il suo asse maggiore è in rapporto all'asse minore come:

- a) 1,4**    b) 4    c) 7    d) 3

Se la riga  $\text{H}\alpha$  è osservata alla frequenza di  $5 \times 10^{13}$  Hz il redshift dell'oggetto è circa:

- a) 2,0    b) 5,0    c) 6,4 **d) 8,1**

Una galassia in formazione darà luogo più probabilmente ad una galassia ellittica quanto più:

- a) densità grande, momento angolare grande    **b) densità grande, momento angolare piccolo**  
c) densità piccola, momento angolare grande    d) densità piccola, momento angolare piccolo

La probabilità di ricombinazione di un elettrone con uno ione è:

- a) indipendente dalla velocità    b) inversamente proporzionale alla velocità  
**c) proporzionale a  $v^{-2}$**     d) proporzionale a  $v^{-3}$ .

La sfera di Stromgren di una stella ha una estensione che dipende principalmente dalla presenza di

- a) HI    **b) HII**    c) HII, NII, OIII    d) OII, NIII

Per classificare una galassia come Sbc è necessario che si osservi:

- a) bulge prominente, bracci distesi e risolti    **b) bulge poco prominente, bracci distesi e risolti**

c) bulge prominente, bracci avvolti e poco risolti d) bulge poco prominente, bracci avvolti e poco risolti

(La presenza della barra, Sbc =spirale barrata di tipo c, è sottointesa)

Sapendo che la velocità del Sole di rivoluzione attorno al centro galattico è di circa 220 km/s, la massa della Via Lattea, in unità di masse solari risulta:

a)  $10^{13} M_{\odot}$  b)  $1.9 \times 10^{11} M_{\odot}$  c)  $2.1 \times 10^{10} M_{\odot}$  d)  $2 \times 10^{09} M_{\odot}$

Usare  $M = rV^2/G$

A binary system in which the binary nature of the system is inferred from periodic doubling of absorption lines is called \_\_\_\_\_ ? (Select one)

- A) a visual binary
- B) an eclipsing binary
- C) a period doubling binary
- D) a spectroscopic binary
- E) a close binary

D)

Object 1 has an apparent magnitude of  $-6$ ; object 2 has an apparent magnitude of  $-1$ . Which object is brighter, and by how much? (Select one)

- A) object 1 by a factor of 10
- B) object 1 by a factor of 100
- C) object 1 by a factor of 3
- D) object 1 by a factor of 2.5
- E) object 2 by a factor of 100

B)

If enough measurements can be made in a binary star system, the masses of the stars can be determined by using \_\_\_\_\_ ? (Select one)

- A) Newton's 1st law
- B) Kepler's 1st law
- C) the Stefan-Boltzmann law
- D) Kepler's 3rd law
- E) the theory of special relativity

D)

Which of the following pieces of information is not directly indicated by the location of a star in a Hertzsprung-Russell diagram? (Select one)

- A) Absolute Magnitude
- B) Color Index
- C) Luminosity
- D) Space Velocity
- E) Surface Temperature

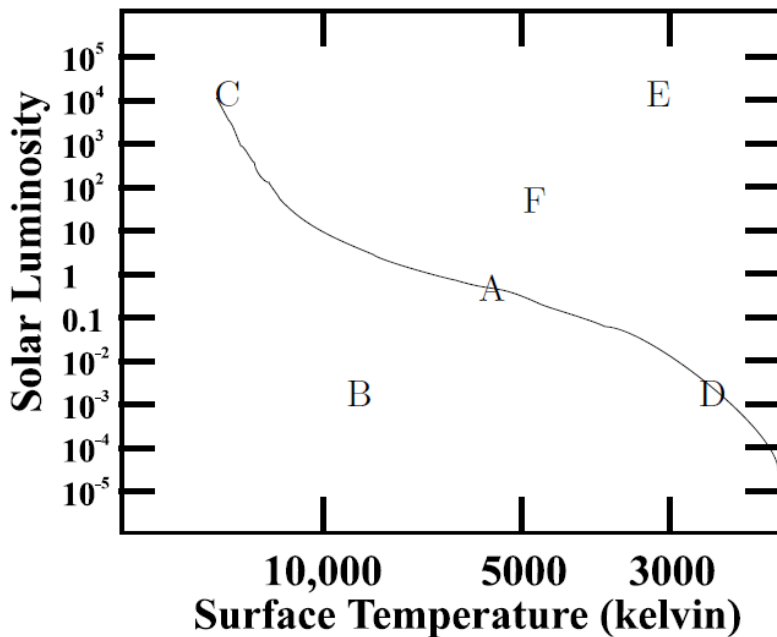
D)

The distance to a star is measured to be 100 parsecs and the apparent magnitude of this star is  $m = +2$ . What is this star's Absolute Magnitude,  $M$ ? (Select one)

- A)  $-3$
- B)  $+3$
- C)  $-5$
- D)  $+7$
- E)  $-7$

A)

[6pt] Using the Hertzsprung-Russell diagram match the letter with the type of star that is located at that position.



\_\_\_\_\_ A class M main sequence star

\_\_\_\_\_ A white dwarf star

\_\_\_\_\_ A class O main sequence star

\_\_\_\_\_ Our Sun

\_\_\_\_\_ A supergiant star

\_\_\_\_\_ A red giant star

[5pt] Determine the type of spectrum you would expect for the following. (Select E for Emission, A for Absorption, C for Continuous. .

- \_\_\_\_\_ A gas cloud in space that is excited by high energy photons.
- \_\_\_\_\_ A spectrum produced from electrons making transitions from higher-energy states to lower-energy states.
- \_\_\_\_\_ Light coming from a hot piece of metal.
- \_\_\_\_\_ Star light passing directly through a cold hydrogen gas cloud
- \_\_\_\_\_ Light coming from the Sun.

E, E,C,A,A

In realtà lo spettro del Sole e lo spettro "Star light passing directly....." sono spettri CONTINUO+ASSORBIMENTO.

A period-luminosity relationship for a variable star is very important because it allows us to determine \_\_\_\_\_?

- A) the spectral class of the star
- B) the space velocity of the star
- C) the distance to the star
- D) The surface temperature of the star
- E) whether the star is part of a binary system

C)

What is probably the primary reason for an upper limiting mass on stars?

- A) insufficient hydrogen in a typical nebula to make massive stars
- B) high radiation pressure in massive stars
- C) the low gas pressures associated with massive stars
- D) the limited helium abundance in a nebula
- E) the low temperatures for very massive stars

B)

If one Cepheid variable has the same period as another Cepheid but appears 4 magnitudes brighter, then its absolute magnitude is

- A) 1/4 magnitude fainter.
- B) 1 magnitude fainter.
- C) 4 magnitudes brighter.
- D) the same.
- E) 4 magnitudes fainter.

D)

2. [1pt] The location of clouds of neutral hydrogen in the galaxy can be mapped using the 21 centimeter line of hydrogen which comes in the \_\_\_\_\_ region of the spectrum?

- A) x-ray
- B) ultraviolet
- C) infra-red
- D) gamma-ray
- E) radio frequency

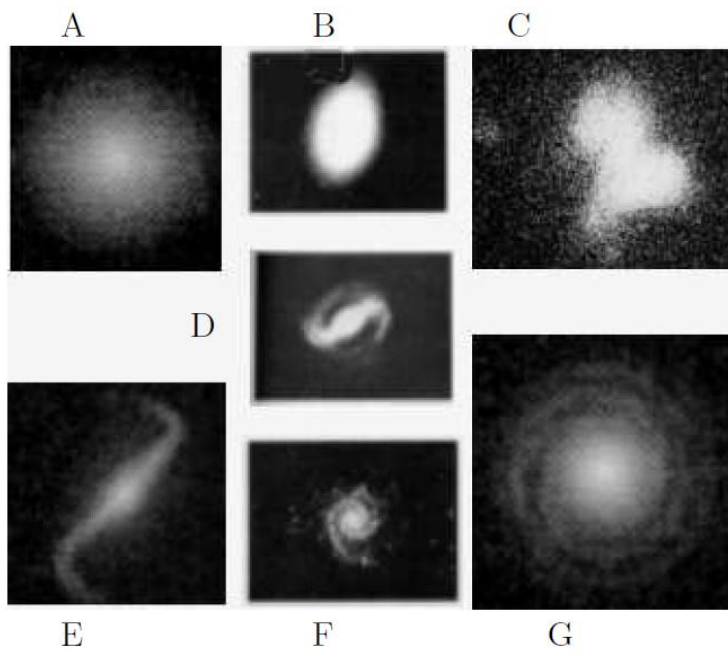
E)

In which of the following parts of the electromagnetic spectrum are we learning the least about the very center of our Galaxy?

- A) radio waves
- B) gamma
- C) visible light
- D) infrared

C)

Match the Hubble classification of the galaxy with the picture. (For each type below, enter the letter for the corresponding picture.)



_____ SBa	_____ E0	_____ E3	_____ Sa
_____ Irregular	_____ SBc	_____ Sc	

D A B G

C E F

The hydrogen in an H I region is predominantly

- A) ionized.
- B) molecular.
- C) within compounds.
- D) neutral.

D)

The kind of nebula that is illuminated by nearby cool stars is called a (an) \_\_\_\_\_ nebula?

- A) dark
- B) spiral
- C) reflection
- D) absorption
- E) emission

C)

Galaxies are known with look-back times out to about

- A) 4.5 billion years.
- B) 13 billion years.
- C) 65 million years.
- D) 3000 years.

B)

Le prime galassie sono osservate circa 700 milioni di anni dopo il big bang, quindi a 13 miliardi di anni fa.

Il look-back time: lontano nello spazio = indietro nel tempo.

The youngest stars in the galaxy are found in the \_\_\_\_\_ ?

- A) spiral arms
- B) core
- C) globular clusters
- D) central bulge
- E) halo

A)

Why must a star that produces an H II region be a hot star?

- A) Hot stars emit strongly in the UV
- B) Hot stars emit copious quantities of radio waves
- C) Only hot stars eject matter at sufficiently high rates
- D) Only hot stars emit H II
- E) Only hot stars have strong emission at large wavelengths

A)

The fact that circular velocity does not decrease at galactic radii greater than that of the Sun indicates that our Galaxy

- A) is more massive than previously believed.
- B) is less massive than previously believed.
- C) is rotating faster than previously believed.
- D) is rotating more slowly than previously believed.

A)

The Sun is located in the \_\_\_\_\_ of the galaxy.

- A) spheroidal component
- B) nucleus
- C) far outer edge
- D) disk
- E) halo

D)

The primary means of determining the mass of a spiral galaxy uses \_\_\_\_\_ ?

- A) the cepheid period-luminosity relation
- B) Kepler's third law
- C) Einsteins theory of special relativity
- D) Newton's first law
- E) the Wien displacement law

B)

Find the temperature of a star that is sixteen times as luminous as the sun with a radius that is three times as large as the sun. Answer in terms of the sun's temperature.

- a.  $5.33 \times T_{\odot}$
- b.  $2.30 \times T_{\odot}$
- c.  $1.7 \times T_{\odot}$
- d.  $1.33 \times T_{\odot}$
- e.  $1.15 \times T_{\odot}$

e.

Current estimates expect the sun to have a lifetime of 10 billion years. What is the lifetime of a 0.30 solar mass star?

- a.  $1.73 \times 10^9$  years
- b.  $3.33 \times 10^9$  years
- c.  $33.3 \times 10^9$  years
- d.  $4.93 \times 10^7$  years
- e.  $2.03 \times 10^{11}$  years

c.

Why are HII regions red in color?

- (A) They contain considerable quantities of dust
- (B) They emit hydrogen emission lines
- (C) They are moving away from us at high speed
- (D) Twenty-one cm photons are red in color

(B)



What effect do interstellar dust particles have on the appearance of a distant star?

- (A) They make it look bluer and brighter.
- (B) They make it look bluer and dimmer.
- (C) They make it look redder and brighter.
- (D) They make it look redder and dimmer.

(D)

Where are stars being formed in the galaxy?

- (A) In the spiral arms.
- (B) In globular clusters.
- (C) In the nucleus.
- (D) In the halo.

(A)

Which of the following is a true statement about the spiral arms of our galaxy?

- (A) Spiral arms are the crests of density waves.
- (B) Star formation occurs in the spiral arms.
- (C) They contain H II powered by the ultraviolet light from hot O and B stars
- (D) all of the above

(D)

Hubble's original classification of galaxies was based on

- (A) the visual appearance of the galaxies.
- (B) the physical shape and size of the galaxies.
- (C) the dominant spectral class of stars.
- (D) a completely random selection.

(A)

Elliptical galaxies are yellowish/reddish in color because they

- (A) Shine due to synchrotron radiation
- (B) Contain relatively few young, hot stars
- (C) Are moving away faster than other galaxies
- (D) Are surrounded by intergalactic dust clouds

(B)

The masses of galaxies are often determined by

- (A) Determining their star formation rates.
- (B) Counting their stars.
- (C) Measuring their tidal forces on the Milky Way.
- (D) Measuring their rotation curves.

(D)

Hubble's relationship between the distance to a galaxy and its speed of recession is interpreted as evidence for

- (A) the expansion of the universe.
- (B) galaxies being outside the Milky Way.
- (C) the evolution of galaxies.
- (D) the Doppler effect.

(A)

Which of the following statements best describes the distribution of galaxies in the universe?

- (A) the galaxies lie on sheets and chains surrounding empty regions
- (B) the galaxies are distributed uniformly in space
- (C) there are a few large clusters of galaxies with nothing in between
- (D) there are many clusters near us in space, but nothing beyond

(A)



Which of the following is NOT an implication of Hubble's law?

- (A) the universe is expanding.
- (B) we are in the center of the universe.
- (C) the universe had a beginning.
- (D) the universe was once denser than it now is

(B)

What was the universe made of one hour after it began to expand?

- (A) hydrogen and helium
- (B) carbon and oxygen
- (C) iron and nickel
- (D) potassium and carbon

(A)

Both the moon and Mercury have very large temperature variations between day and night. The main reason for this large variation is:

- (A) lack of atmosphere.
- (B) rocky composition.
- (C) distance from the sun.
- (D) small mass.

(A)

The Jovian planets

- (A) all have orbits larger than the orbit of Mars.
- (B) are the Jupiter-like planets.
- (C) have atmospheres containing mostly hydrogen and helium.
- (D) all of the above.

(D)

Infrared stars within the Orion Nebula are examples of which stage of stellar evolution?

- (a) supernova remnants
- (b) protostar and young star
- (c) red giant
- (d) planetary nebula
- (e) old dying stars

Comparing spectra of the red giant star Arcturus with spectral class B stars in the Pleiades star cluster reveals the wavelength of greatest intensity for Arcturus is

- (a) shorter (b) longer (c) same (d) cannot be determined from the information given

The star  $\alpha$  Centauri C and the star Groombridge 34B have the same apparent brightness, but  $\alpha$  Centauri C is 1.3 pc away from the Earth while Groombridge 34B is 3.5 pc away. What is the luminosity of Groombridge 34B, compared to that of  $\alpha$  Centauri C?

- a) 7.25 times fainter b) 2.69 times fainter c) the same d) 2.69 times brighter e) 7.25 times brighter

$L_1/L_2 = (d_1/d_2)^2$  se a noi arriva lo stesso flusso (magnitudine apparente)

A certain galaxy is observed to be receding from the Sun at a rate of 75,000 km/s. The distance to this galaxy is measured independently to be  $1.5 \times 10^9$  pc. Based on this data what is the value of the Hubble constant?

- a) 65 km/s/Mpc b) 50 km/s/Mpc c) 75 km/s/Mpc d) 112 km/s/Mpc e) none of the above

ricordarsi che  $H_0$  va espressa in km/s/Mpc, si deve convertire  $1.5 \times 10^9$  pc in  $1.5 \times 10^3$  Mpc

Betelgeuse (the bright star in the constellation Orion) has a surface temperature of 3300K and a luminosity 100,000 times that of the Sun. What is its approximate radius, in terms of that of the Sun?

- a) 10 times larger b) the same c) 100 times larger d) 1000 times larger e) 10000 times larger

la T superficiale del Sole è circa 5800 K.  $L=4\pi R^2\sigma T^4$ , quindi dividendo le due luminosità si trova il rapporto dei raggi.

Using the Hubble constant (65 km/s/Mpc) to estimate the age of the Universe gives an age of

- a) 25 billion years   b) 8 billion years   c) 10 million years   d) 13 million years   **e) 15 billion years**

La stima della età dell'universo si facalcolando  $1/H_0$

The predominant color of an HII region is

- a) green-yellow, from the 530.3nm emission line of ionized iron, equivalent to that from the hot solar corona
- b) a continuum of colors, the combined light from the stars in the region
- c) blue, from the scattering of light from hot stars by dust particles
- d) red, from the Balmer  $H_{\alpha}$  line**
- e) yellow, from sodium emission lines

If an astronomer wants to find and identify as many stars as possible in a star cluster that has recently formed near the surface of a giant molecular cloud (such as the Trapezium cluster in the Orion Nebula), what instrument would be best for her to use?

- an infra-red telescope (and camera)
- an x-ray telescope
- a very good camera attached to a large reflector telescope on the ground
- an ultraviolet spectrograph attached to the Hubble Space Telescope
- the instruments that were part of the Compton Gamma Ray Observatory

a.

Classify the following constituents of our own Galaxy in terms of stellar populations of increasing age:

- Halo, bulge, disk.
- Disk, bulge, halo.
- Halo, disk, bulge.
- Bulge, disk, halo.
- Bulge, halo, disk.

b.

The rotation curve of our galaxy shows that:

- Our galaxy does not extend beyond 20 kpc from the Galactic center.
- The velocities of stars decrease steadily towards the edge, as expected from Kepler's laws.
- The stellar velocities remain at about 200 km/s towards the edge.
- Our Galaxy must have a massive halo, consisting mostly of dark matter.
- Two of these options.

e.

Spiral galaxies have spiral arms that are less and less wound-up from:

- a.  $S0 \rightarrow Sa \rightarrow Sc$ .
- b.  $E0 \rightarrow E7 \rightarrow S0 \rightarrow Sa \rightarrow Sc$ .
- c.  $Sc \rightarrow Sa \rightarrow S0$ .
- d.  $Sc \rightarrow Sa \rightarrow S0 \rightarrow E7 \rightarrow E0$ .
- e. independent of galaxy type.

A schnitzel is put in a microwave oven, and heated to a temperature of 10,000 K. .  
the schnitzel will radiate most of its light [Note:  $1\text{\AA} = 10^{-10}\text{m}$ ]:

- a. in the near-infrared, or around 10,000  $\text{\AA}$  wavelength.
- b. at microwave wavelengths, of course.
- c. in the Ultraviolet, or around 2900  $\text{\AA}$  wavelength.
- d. in the orange-red, or around 5800  $\text{\AA}$  wavelength.
- e. none of these options.

c.(leggedellospostamento)

A cloud of interstellar dust is found with a temperature of 29 K. This cloud radiates most of its light at the following wavelengths:

- a. mid-IR ( $10\ \mu$ )
- b. far-IR ( $100\ \mu$ )
- c. optical (5000  $\text{\AA}$ )
- d. near-IR ( $1\ \mu$ )
- e. at microwave wavelengths (1 mm).

calcolare con la leggedellospostamento

What are the main general features that make clusters of stars useful to astronomers?

- A) The stars are at the same distance from Earth, were formed at approximately the same time, and were made from same chemical mix.
- B) The stars are all at the same distance from Earth, have the same surface temperature, and joined the cluster at various times.
- C) The stars all have the same apparent magnitude, the same surface temperatures, and the same sizes.
- D) The stars all have the same intrinsic brightness but differ in size and surface temperature.

A)

Which of the following is TRUE about emission nebulae?

- A) They have a black-body spectrum, which gives them their reddish color.
- B) They account for most of the mass of the interstellar medium.
- C) They are never associated with molecular clouds.
- D) The gas is mostly ionized, and emits light at specific wavelengths, which gives them their reddish color.

D)

The fact that this nebula is glowing with emission-line light tells us what about the object at its center?

- a. The object emits a lot of red and blue light, which reflects off the nebula.
- b. The object must be moving away from us very rapidly, which explains why this nebula looks so heavily redshifted.
- c. The object is hot enough to emit significant amounts of ultraviolet radiation.
- d. The object is very cool, emitting most of its energy in the infrared.

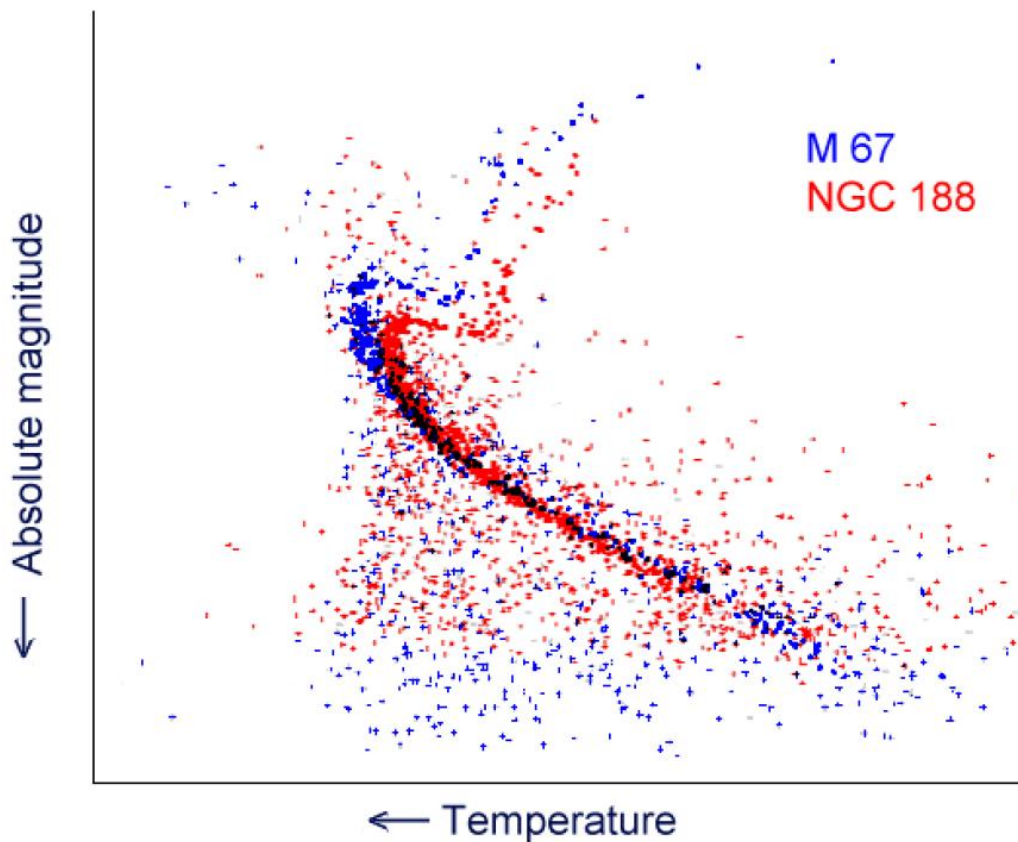
c.

Which of the following wavelength regions are we capable of observing from the Earth reasonably well (meaning it must contain at least a few major gaps in the atmosphere's opacity)?

- i. X-ray (0.1 - 10 nm)
- ii. Visible (300 - 700 nm)
- iii. Near Infrared (1 - 5 microns)
- iv. Far Infrared (40 - 350 microns)
- v. Radio (10 cm - 10 m)

- (a) ii and iii
- (b) ii, iii, and v
- (c) i, ii, iii, and v
- (d) ii, iii, iv, and v

ii, iii, v. Quindi (b)



Which of these two clusters is older?

- a. They are the same age.
- b. H-R diagrams like this can't be used to estimate the ages of star clusters.
- c. NGC 188
- d. M67

c.

In each of these clusters, what has happened to the most massive stars?

- a. They have evolved into emission nebulae and HII regions.
- b. The helium in their cores has all been used up, which means they've started burning hydrogen for the first time.
- c. They have been ejected from the cluster by gravitational encounters with other stars.
- d. They've run out of hydrogen to burn in their cores, and have evolved into red giants.

d.

An asteroid's orbit lies 5 AU from the Sun. Assuming it absorbs all of the incident energy from the Sun and then reradiates all of it into space, what is the asteroid's surface temperature (solar luminosity is  $3.8 \times 10^{26}$  W)?

- (a) 2.7 K
- (b) 27 K
- (c) 127 K
- (d) 227 K

(a) l'asteroide è in equilibrioterminico con la radiazionecosmica di fondo, chesitrova a 2.7 K. Questoperchéil test dice chetutta la radiazionechearriva dal sole ma ancheche la re-irradianellospazio.

Black body radiation is one of the most important and basic forms of radiation understood by astronomers. Planck explained it, but before that Wien related the wavelength of peak intensity to the temperature of the black body. What is this relation (known as Wien's Law)?

- (A)  $\lambda \propto 1/T^2$  (B)  $\lambda \propto 1/T$  (C)  $\lambda \propto T$  (D)  $\lambda \propto T^4$

(B)

What is the approximate diameter of the Milky Way galaxy.

- a) 30 pc
- b) 30 kpc
- c) 30 Mpc
- d) due to the dust, we can't determine it

b)

The Magellanic clouds are

- a) high atmospheric clouds seen in the tropics
- b) nebulae within our own galaxy
- c) small galaxies in orbit around the Milky Way
- d) distant galaxy clusters

c)

How are elliptical galaxies and spiral galaxies different?

- A) Elliptical galaxies have almost no gas or dust. B) Elliptical galaxies vary more in shape than spiral galaxies. C) Spiral galaxies have almost no gas or dust. D) Spiral galaxies contain only old stars.

A)

