An interstellar hydrogen cloud contains 50 atoms per cm³. The temperature of the cloud is 500 K. (Hint: the mass of each hydrogen atom is 1.67×10^{27} kg).

What is the density of the cloud in kg/m³?

| 8.35×10^-20 ÷ |

What is the mass of the cloud (in kg) in order to collapse by its own gravity (i.e. calculate the Jean's mass using eq. 6.54).

| 5.34×10^34 ÷ |

What is the radius of the cloud in meters?

| 5.34×10^17 ÷ |

Venus is the closest planet to the sun.

Select one:

The mass of Spica star is 10.25 $M_\odot$, radius 5.2 $R_\odot$, and luminosity 25400 $L_\odot$.

What is its thermal time scale in years.

1.23×10^3 ◆

What is its nuclear time scale in years.

4.11×10^6 ◆

Find the distance in km between New York (40.730610 N   73.935242 W) and Tokyo (35.652832 N, 139.839478 E) along the shortest route. Assume the radius of Earth is 6370 km.

Clear my choice

A **superior planet** is a planet outside the orbit of the Earth.

Select one:

⦿ True

○ False

Time le

Question 25

Not yet
answered

Marked out of
1.0

⚑ Flag
question

Saturn is a terrestrial planet.

Select one:

○ True

○ False

Question 26

When the sun is at the vernal equinox. Its right ascension is 0°.

Question 26

Not yet answered

Marked out of 1.0

⚑ Flag question

When the sun is at the vernal equinox, its right ascension is 0°.

Select one:

○ True

○ False

Question 27

Not yet

The speed of light $c = 3.0 \times 10^8$ m/s. Express c in astronomical units per minute.

Uestion **27**

al yet
nswered

arked out of
5

Flag
uestion

The speed of light c = 3.0×10⁸ m/s. Express c in astronomical units per minute.

○ a. 0.12

○ b. 2 × 10⁻³

○ c. 7.2

○ d. 3.3 × 10⁻⁵

uestion **28**

The Main Sequence phase is the longest phase in stellar evolution

○ c. 7.2

○ d. 3.3×10^{-5}

The Main Sequence phase is the longest phase in stellar evolution.

Select one:

○ True

○ False

The terrestrial (Earth-like) planets are more dense than the Jovian (Jupiter-like) or giant planets.

Select one:

○ True

○ False

Convert the hour angle 11 h 12 min 34 sec to degrees, minutes of arc and seconds of arc.

○ a. 168' 510' 0"

○ b. 165' 8' 30'
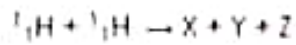
Question 31

Not yet
answered

Marked out of
1.0

⚐ Flag
question

The first reaction in the pp chain in the Sun is:

$^1_1H + ^1_1H \rightarrow X + Y + Z$

The X, Y and Z could be:

○ a. $^1_1H, e^+, v_e$

○ b. $^2_1H, e^+, \gamma$

○ c. $^2_1H, e^+, v_e$

○ d. $^2_1H, e^+, v_e$

○ e. $^2_1He, e^+, v_e$

Question 32

Not yet

If the altitude of the moon is -20° at your location, then

O d. ^2_1H, e^*, v_e

O e. ^2_1He, e^*, v_e

If the altitude of the moon is -20° at your location, then

Select one:

O A. You will see the moon if you look near the horizon

O B. You will not see the moon because it is below the horizon

O C. The moon will be a new moon.

O D. You will see the moon if you look high in the sky

○ False

Convert the hour angle 11 h 12 min 34 sec to degrees, minutes of arc and seconds of arc.

○ a. 168' 510' 0"

○ b. 165' 8 30"

○ c. 165' 0 30"

○ d. 168' 8 30"

○ e. 168' 34 30"

The first reaction in the pp chain in the Sun is:

$$_1H + _1H \rightarrow X + Y + Z$$

The X, Y and Z could be:

estion **33**

t yet
swered

arked out of
o

Flag
uestion

The Earth's satellite, the Moon, circles the Earth counterclockwise.

Select one:

○ True

○ False

The center-of-mass of the Moon-Earth system is located in the midway between the moon and Earth.

Select one:

○ True

○ False

If the mass of a cloud is much smaller than Jeans' mass, then it will collapse by its own gravitation.

Select one:

○ True

○ False

The Earth's satellite, *the Moon*, circles the Ea[r]
counterclockwise.

Select one:

○ True

○ False

Question 22

If the Azimuth of the moon is 62°, then its location in the sky is:

Select one:

○ A. Southeast

○ B. Northwest

○ C. Northeast

○ D. Southwest

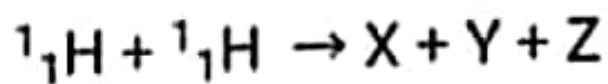The solar neutrino problem is solved.

Select one:
- ○ True
- ○ False

The Earth rotates about its poles from west to east (counterclockwise as viewed from above the north pole).

Select one:
- ○ True
- ○ False

The first reaction in the pp chain in the Sun is:

$$^1_1H + ^1_1H \rightarrow X + Y + Z$$

The X, Y and Z could be:

- a. ^2_1H, e^+, ν_e

- b. ^1_1H, e^+, ν_e

- c. ^2_1H, e^+, γ

- d. ^2_1H, e^-, ν_e

- e. ^2_1He, e^+, ν_e

Question 11

Not yet answered

Marked out of 1.0

⚑ Flag question

The solar neutrino problem is solved.

Select one:

○ True

The mass of a proton is 1.00728 amu, and that of the He nucleus is 4.001514 amu. (1eV = 1.6 × 10^{-19}J)

How many pp reactions take place in the Sun every second?

Choose... ◆

How many neutrinos are produced in these pp reactions in one hour?

Choose... ◆

How many helium atoms are made for each Joule of energy generated?

Choose... ◆

How much energy (in eV) is produced in ONE ppl reaction?

Choose... ◆

Question 7

7) At night, the diameter of the pupil of the human eye is about 6mm and the resolving capability of the eye is about 2'. If the diameter of the objective of a telescope is 100mm. Estimate a range for the useful magnification of such telescope. (4 points)

$\omega_{max} =$ .....100.....

$\omega_{min} =$ .....16.67.....

$$W_{max} = \frac{D}{1mm}$$

$$= \frac{100 \, mm}{1 \, mm}$$

$$W_{min} = \frac{100 \, mm}{6 \, mm}$$
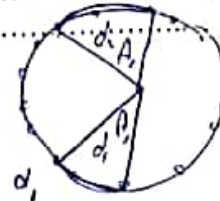
$$W_{max} = 100$$

$$W_{min} = 16,67$$

sweeps [1.5]

8) Write down the second Kepler law and explain it. (2 points)

...The radius vectors of the planet vector equal Area in equal amount of time.....

$$\frac{dA}{dt} = A = \frac{1}{2} k = Const.$$

The planet is faster when close to Sun

$d_2 > d_1$

$A_1 = A_2$

9) The perihelion and aphelion of the orbit of Eros are 1.1084 and 1.8078 astronomical units from the Sun. What is the velocity of Eros when its distance from the Sun equals 1.524 astronomical units? (4 points)
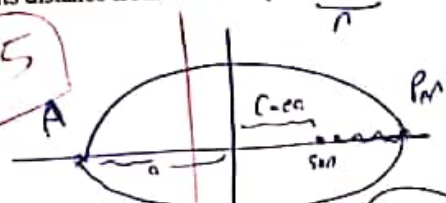
$$V = \sqrt{\frac{2M}{r} - \frac{M}{a}}$$

$$V_a = \sqrt{\frac{2M}{a+ea} - \frac{M}{a}}$$

$$= \sqrt{\frac{2aM - (a+ea)M}{(a+ea)a}}$$

$$= \sqrt{\frac{2aM - aM - eaM}{(a+ea)a}}$$

$$V_a = \sqrt{\frac{aM - eaM}{(a+ea)a}}$$

$$V_{pan} = \sqrt{\frac{2M}{r} - \frac{M}{a}}$$

$$= \sqrt{\frac{2M}{a-ea} - \frac{M}{a}}$$

$$= \sqrt{\frac{2Ma - M(a-ea)}{a(a-ea)}}$$

$$\delta = \tfrac{1}{2}(a_{min} + a_{max})$$
$$a_{min} = \delta + \phi - 90°$$

5) Given the coordinates of the moon at a given moment in a given location as follows: Latitude $\phi = 60.16°$, right ascension $\alpha = 2h\ 55\ min\ 7s$, declination $\delta = 14°\ 42'$, sidereal time $\Theta = 6h\ 19min\ 26s$. Calculate the altitude (a) and the azimuth (A) of the moon at this location. Also, based on your calculations, decide whether the moon is above the horizon or not and in which quadrant. (*Hint, use the given formulas on the first page*) (6 points)

A = ...4.26°..... 60.9° /above hor. 20^

a = ...44.5°..... 31.5° / South west

$h = \Theta - \alpha$
=

...h.=..Θ..-.α..=..6h 19 min 26 s..-.2h 55 min 7s.....

  $\doteq$ 6. 323 886 (h) - 2. 9186 11 (h) = 7.4 052 77 |

$SinA\ cos\ a = Sin\ 7.405277 \cdot Sin\ 14.7$
     = 0.015072

$cosA\ cosa = cos\ 3.405277\ cos\ 14.7\ Sin\ 60.16 - Sin\ 14.7\ cos\ 60.16$
     $= 0.8375\ 44 - 0.12626479$
     = 0.711279269

③ $Sina = cos\ 7.40\ 5277 \cdot cos\ 14.7°\ cos\ 60.16 + Sin14.7\ sin\ 60.16°$
     $= 0.480442965 + 0.220114282 = 0.70055\ 7247$

     $a = 44.5°$ $A = 4.26°$

6) When a star is at upper culmination, its hour angle h =0. While when it is at lower culmination, its hour angle h =12h. A star crosses the south meridian at an altitude of 85°, $h=0$, and the north meridian at 45°. Find the declination (δ) of the star and the latitude (ϕ) of the observer. (4 points)
$h=12$

$\delta = $ .....70°..... ⑤ 65°
$\phi = $ .....65°..... 70°

~~Since Sin(a) = (85+4)/~~

$h=0$.
$Sin\ a = cos(\delta - \phi)$
$Sin\ 85° = cos(\delta - \phi)$
$0.99619 = cos(\delta - \phi)$ → ①
$h = 12h$
$Sin\ 45° = cos(\delta + \phi)$
$0.707 = cos(\delta + \phi)$ → ②

* $h=0$
$Sina = cos\ \delta\ cos\ \phi + Sin\delta\ sin\ \phi$
    $= cos(\phi - \delta)$
$Sina = cos(\delta - \phi)$

$Sin(a) = Sin(90 - \delta + \phi)$
    $= Sin(90 ~~- \delta~~ + \delta + \phi)$
* $h = 12h$ ⑤ 180°

$Sin\ a = -cos\delta\ cos\phi + sin\delta\ sin\phi$
    $= Sin(\delta + \phi - 90)$
    ③ $= cos(\delta + \phi)$

8) A telescope has an objective with diameter of 90 mm and focal length of 1000 mm.

a) Find the focal length of an eyepiece whose exit pupil is 6 mm (2 points).

$$w = \frac{f}{f'} = \frac{D}{d} \quad : \quad \frac{1000\ mm}{f'} = \frac{90\ mm}{6\ mm}$$

$$\frac{1000\ mm}{f'} = 15$$

$$f' = 66.66 \simeq 67\ mm$$

[2]

b) Find the magnification of the telescope when used with the eyepiece in part a). (1 point)

$$w = \frac{f}{f'} \simeq 15\ times$$

[1]

c) If the angular diameter of the moon is 0.52° as seen by the naked eye. What is the angular diameter of the moon when seen through this telescope and eyepiece? (1 point)

$$\theta = w\,\alpha = 0.52° * 15 = 7.8$$

[1]

$$\frac{D}{f} \eta$$

$$L = \frac{fD}{f'}$$

d) If we use this telescope with an eyepiece whose focal length is 10 mm. What is the magnification? Is this magnification useful in visual observations or not, explain your answer? (3 points)

$$w = \frac{f}{f'} = \frac{1000\ mm}{10\ mm} = 100\ times$$

$$w > w_{max}$$

then not useful

$$d = \frac{D}{w} = \frac{90\ mm}{100} \quad 90\ times$$

$$100 > 90 \quad not\ useful$$

$$\frac{100\ f}{f'}$$

$$w = \frac{1000}{10}$$

$$100 > \frac{90\ mm}{6\ mm}$$

$$100 > 15$$

0.9 mm < is smaller than exit pupil eye

than exit pupil eye

we can see it

and when the difference between f and f'
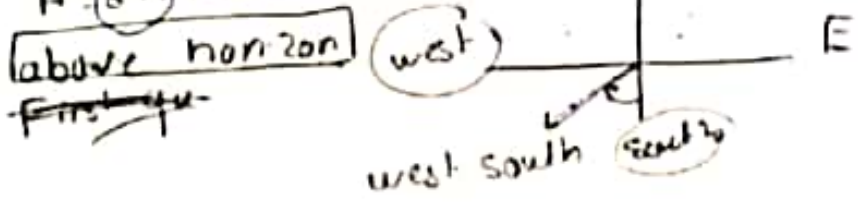
greater is more useful

$$L = \frac{f'D}{D}$$

[3]

5) Given the coordinates of the moon at a given moment in a given location as follows: Latitude $\phi = 32.16°$, right ascension $a = 2h\ 55\ min\ 7s$, declination $\delta = 14°(42')$, sidereal time $\Theta = 6h\ 19min\ 26s$. Calculate the altitude (a) and the azimuth (A) of the moon at this location. Also, based on your calculations, decide whether the moon is above the horizon or not and in which quadrant. (Hint: use the given formulas on the first page) (6 points)

A = $81.7855°$ west south (third quarter)

$a = 40.50497406 \cong 40.5°$ above the horizon

above horizon and in third quarter.

[6]

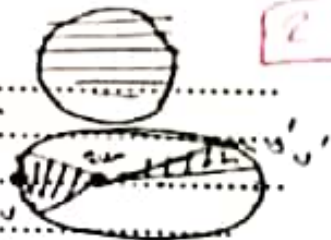$\alpha. 43.77916667°$
$\delta. 14.7°$
$\Theta. 94.858333°$
$\Theta: h + \alpha$
$h: 51.07916 33°$

$\sin a = \cos h \cos \delta \cos \phi + \sin \delta \sin \phi$

$a = 40.50497406$

$A = 81.7855433$

above horizon (west)

First qu-

west south (south)

6) Write down the second Kepler law and explain it. (2 points)

[2]

equals area at the equal time.
and, so the speed of planet at position
which is close to the perihelion is
faster that aphelion (or away from those)
the planet

surface velocity $A \to \boxed{A = \frac{1}{2}k}$ $d > d'$, $v > v'$

$A = \frac{1}{2}f^2$

perihelion $a(1-e)$
aphelion $a+c$
$a(1-e)$

7) The perihelion and aphelion of the orbit of Eros are 1.1084 and 1.8078 astronomical units from the Sun. What is the velocity of Eros when its distance from the Sun equals 1.4581 astronomical units? (4 points)

$\frac{1}{2}v^2 - \frac{\mu}{r} = -\frac{\mu}{2a}$

$\frac{1}{2}v^2 = \left(-\frac{\mu}{2a} + \frac{\mu}{r}\right)^2 = \frac{-\mu}{2a} + \frac{2\mu}{r}$

$v^2 = -\frac{\mu}{a} + 2\frac{\mu}{r} = $

$v = \sqrt{\mu\left(-\frac{1}{a} + \frac{2}{r}\right)} = \sqrt{4\pi^2\left(\frac{-1}{1.4581} + \frac{2}{1.4581}\right)}$

perihelion = $a(1-e)$
aphelion = $a(1+e)$
1.1084 = $a - ea$
1.8078 = $a + ea$
2.9162 = $2a$
$a: 1.4581\ AU$

[4]
$\frac{-1}{r}$

$1.49\ sq\ 787\ \times\text{rot}^u$ $\left(\frac{-1}{b}\right)$

$\sqrt{4\pi^2}$

Au (a)

$V = 5.20\ Au/a = 5.20$
$2\pi s \times 24\ h\ d\ 3600$

$24\ Sq\ 8\ m/s$

At night, the diameter of the pupil of the human eye is about 6mm and the resolving capability of the eye is about 4'. If the diameter of the objective of a telescope is 100 mm. Estimate a range for the useful magnification of such telescope.

$$* \omega_{max} = \frac{e}{\theta} = \frac{4'}{5.5 \times 10^{-6} \, rad} \boxed{210}$$

$$\theta = \frac{\lambda}{D_r}{}^m = \frac{550 \times 10^{-9}}{100 \times 10^{-3}} = \frac{D_a}{} = 5.5 \times 10^{-6} \, rad$$

$$* \omega_{min} = \frac{D}{d(t)} = \boxed{17}$$

$$\frac{4'}{60}$$

$$\left| * \omega_{max} = \frac{1.15 \times 10^{-3}}{5.5 \times 10^{-6}} \right| = 0.21 \times 10^{3} \boxed{210 \; times}$$

Sun > Earth > moon

1) Rank the three astronomical objects: Sun, Earth and Moon according to their masses. (1 point)

~~Sun, Earth, Moon~~   Sun > Moon > Earth

2) At the town of Birzeit, the geographic coordinates are: Latitude: $\phi = 32°$ north and Longitude: $\lambda = 35°$ East of Greenwich. In Time units, the longitude would be (Express it on the form 00h 00min). (2 points)

~~2h 60 min~~

20

3) True or False (1 point each):
   a. The sum of the angles of a spherical triangle is always greater than 180°. (.....T.....)
   b. The sum of the angles of a spherical triangle is always 200°. (....F........)
   c. When the sun is at the vernal equinox, its right ascension α = Its declination $\delta = 0$. (..... T .....)
   d. The Horizontal system has two coordinates: the altitude or elevation (a) which ranges between [-90°, +90°] and the azimuth (A) which ranges between [0°, 360°]. (......T.....)
   e. The hour angle (h) of an object grows at a steady rate due to the Earth's rotation. (......T.....)
   f. If the mass of a cloud is much higher than the Jeans' mass, then it will collapse by its own gravitation. (....T........)
   g. According to the virial theorem, the potential energy (U) and the kinetic energy (T) of the system are related as: $<T> = -2<U>$ (....F....).
   h. A 'supermoon' refers to the moon when it is 100% illuminated. (....../.....)

4) Explain the effect of Aberration or Parallax (choose ONE only) on the apparent direction of an object. Write 3 statements at least. (3 points)

$W = \dfrac{f}{f'}$ ......ظاهرة أقرب أ.ه. IS .... الـ W .... كل ظاهرة......

$W = \dfrac{\text{م}}{f'}$ ......ظاهرة الموقع تكون عليه إذا كان ظاهرة .....

......فإن ظاهرة الموقع تكون فى نقطة......

1) In celestial mechanics, there are few constants of motion. Name TWO constants of motion stating their units in the SI system. (3 points)   scalar not vector

a) $h = \pm v^2 - \dfrac{\mu}{r}$ (energy integral) Constant $\dfrac{m^2}{s^3}$

b) $\vec{k} = \vec{r} \times \vec{\dot{r}}$ $\left(\dfrac{m \cdot m}{s}\right) = m^2/s$ (the angular momentum) $(\vec{k}) \perp$ to the orbital plane) (vector) and $\vec{k}$ in the orbital plane

2) At the town of Birzeit, the geographic Latitude: (ϕ = 32° north of the equator. In Time units, the latitude would be (Express it on the form xx(h) yy(min). (2 points)   [2]

$\phi = \underline{02\ h\ 08\ min}$

0.133333 h

3) True or False (1 point each):
   a. The mass of the sun is always greater than the mass of the Earth. (......T......).
   b. The sum of the angles of a spherical triangle is always 210°. (......F......).
   c. When a star is at upper culmination, its hour angle (h) = 0. (......T......).
   d. The Equatorial system has two coordinates: the altitude or elevation (a) which ranges between [-90°, +90°] and the azimuth (A) which ranges between [0°, 360°].
      (......F......).
   e. The hour angle (h) of an object does NOT change due to the Earth's rotation. $2T$ [10°]
      (............). $\theta: h + \alpha$ icrust ir nw $U = 2$
   f. When a planet is at its perihelion, it is at its closest distance from the Sun.
      (......T......)
   g. According to the virial theorem, the potential energy (U) and the kinetic energy (T) of the system are related as: $<T> = -2 <U>$ (......F......).
   h. If the eccentricity of an ellipse is zero, it becomes a straight line. (............). F
   i. The maximal shift due to the Earth's rotation (the diurnal aberration constant) is 23°. 0.3"
      (......F......).
   j. A radio telescope covers a frequency range in the visible spectrum region only.
      (......F......)

4) Explain the effect of Aberration on the apparent direction of an object. Estimate the maximum shift due to the Earth's orbital motion around sun. (3 points)   [3]

aberration: because the speed of light is finite, if an observer in motion sees an object shifted in direction her/his motion
E.O.m ≈ (21")(second of arc) (the change in appearal called aberation).

$a = \dfrac{V}{C_0} \sin\theta$

V speed of observer
C_0 speed of light
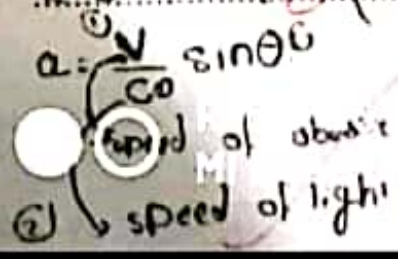
θ: angle between true direction of object and that's vector of the observer