Introductory Astronomy **NAME:**

Homework 28: Galaxies: Homeworks and solutions are posted on the course web site. Homeworks are **NOT** handed in and **NOT** marked. But many homework problems ($\sim$ 50–70 %) will turn up on tests.

Answer Table

Name:

	a	b	c	d	e		a	b	c	d	e
1.	O	O	O	O	O	37.	O	O	O	O	O
2.	O	O	O	O	O	38.	O	O	O	O	O
3.	O	O	O	O	O	39.	O	O	O	O	O
4.	O	O	O	O	O	40.	O	O	O	O	O
5.	O	O	O	O	O	41.	O	O	O	O	O
6.	O	O	O	O	O	42.	O	O	O	O	O
7.	O	O	O	O	O	43.	O	O	O	O	O
8.	O	O	O	O	O	44.	O	O	O	O	O
9.	O	O	O	O	O	45.	O	O	O	O	O
10.	O	O	O	O	O	46.	O	O	O	O	O
11.	O	O	O	O	O	47.	O	O	O	O	O
12.	O	O	O	O	O	48.	O	O	O	O	O
13.	O	O	O	O	O	49.	O	O	O	O	O
14.	O	O	O	O	O	50.	O	O	O	O	O
15.	O	O	O	O	O	51.	O	O	O	O	O
16.	O	O	O	O	O	52.	O	O	O	O	O
17.	O	O	O	O	O	53.	O	O	O	O	O
18.	O	O	O	O	O	54.	O	O	O	O	O
19.	O	O	O	O	O	55.	O	O	O	O	O
20.	O	O	O	O	O	56.	O	O	O	O	O
21.	O	O	O	O	O	57.	O	O	O	O	O
22.	O	O	O	O	O	58.	O	O	O	O	O
23.	O	O	O	O	O	59.	O	O	O	O	O
24.	O	O	O	O	O	60.	O	O	O	O	O
25.	O	O	O	O	O	61.	O	O	O	O	O
26.	O	O	O	O	O	62.	O	O	O	O	O
27.	O	O	O	O	O	63.	O	O	O	O	O
28.	O	O	O	O	O	64.	O	O	O	O	O
29.	O	O	O	O	O	65.	O	O	O	O	O
30.	O	O	O	O	O	66.	O	O	O	O	O
31.	O	O	O	O	O	67.	O	O	O	O	O
32.	O	O	O	O	O	68.	O	O	O	O	O
33.	O	O	O	O	O	69.	O	O	O	O	O
34.	O	O	O	O	O	70.	O	O	O	O	O
35.	O	O	O	O	O	71.	O	O	O	O	O
36.	O	O	O	O	O	72.	O	O	O	O	O

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001 qmult 00007 1 4 1 easy deducto-memory: reading done 2

1. Did you complete reading the Introductory Astronomy Lecture before the **SECOND DAY** on which the lecture was lectured on in class?

   a) YYYessss! b) Jawohl! c) Da! d) Sí, sí. e) OMG no!

   SUGGESTED ANSWER: (a),(b),(c),(d)

   Wrong answers:
   e) As Lurch would say AAAARGH.

   Redaction: Jeffery, 2008jan01

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046 qmult 00100 1 1 1 easy memory: galaxy nearest neighbor distance

2. A characteristic nearest neighbor distance between galaxies is of order:

   a) 1 Mpc. b) 1 kpc. c) 1 pc. d) 1 cm. e) 4283 Mpc.

   SUGGESTED ANSWER: (a) See CK-397 and FK-593, but no one is very explicit on this fine point.

   Wrong answers:
   d) A bit small.
   e) This is the Hubble length for the fiducial Hubble constant 70 (km/s)/Mpc. The Hubble length is a characteristic size scale for the observable universe (CL-45–47).

   Fortran-95 Code

```
          print*
          ckms=2.99792458d5    ! light speed in km/s
          parsec=(1.49597870700d11/(pi/(180.d0*3600.d0)))  !
http://en.wikipedia.org/wiki/Astronomical_unit
          h70=70.d0  ! http://en.wikipedia.org/wiki/Lambda-CDM_model gives
70.4(1.4)
          xmpc_km=1.d+6*parsec*1.d-3   !  km/Mpc
          yearj_sec=365.d0*86400.d0
          hsecin=h70/xmpc_km
          hlength=ckms/h70
          htime=((1.d0/hsecin)/yearj_sec)*1.d-9
          print*,'hlength,htime'
          print*,hlength,htime
   ! 4282.7493999999997        13.978027748293863
```

   Redaction: Jeffery, 2001jan01

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046 qmult 00200 1 4 5 easy deducto-memory: Hubble types

Extra keywords: CK-388,407

3. In the Hubble sequence of galaxies, the main types are:

   a) O0 and G2. b) Sa and SBa. c) spiral and barred spiral. d) elliptical and barred spiral.
   e) elliptical, lenticular, unbarred spiral, barred spiral, and irregular.

   SUGGESTED ANSWER: (e)

   Wrong answers:
   a) These are star spectroscopic types.

   Redaction: Jeffery, 2001jan01

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046 qmult 00230 2 4 2 moderate deducto-memory: barred spiral subtypes

Extra keywords: CK-394 FK-585

4. "Let's play *Jeopardy*! For $100, the answer is: They are the subtypes of the Hubble type barred spiral."

   What are _____, Alex?

a) Sa, Sb, and Sc b) SBa, SBb, and SBc c) E0, E1, E2, E3, E4, E5, E6, and E7 d) SO and SBO e) Irr I and Irr II

SUGGESTED ANSWER: (b)

Wrong answers:
a) These are the spiral (or ordinary) spiral subtypes.
c) These are the elliptical subtypes.
d) These are the lenticular subtypes.
e) These are the irregular subtypes.

Redaction: Jeffery, 2001jan01

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046 qmult 00240 1 4 4 easy deducto-memory: Hubble's galaxy evolution idea not

5. "Let's play *Jeopardy*! For $100, the answer is: It's a common misconception that he/she originally theorized that galaxies evolved from ellipticals to unbarred spirals or barred spirals. In fact, he/she emphasized that his/her classification scheme was entirely empirical."

Who is _____, Alex?

a) Henrietta Swan Leavitt (1868–1921) b) Adriaan van Maanen (1884–1946)
c) Knut Lundmark (1889–1958) d) Edwin Hubble (1889–1953)
e) Georges Lemaître (1894–1966)

SUGGESTED ANSWER: (d) See Wikipedia: Hubble sequence: Physical significance.

Wrong answers:
a) She was the discoverer of the period-luminosity relation for Cepheid variable stars (No-488) while working at Harvard College Observatory. Distance determinations by Hubble using this relation established the extragalactic nature of the galaxies.
b) His mistaken observations of movement of the spiral arms of the spiral nebulae worked against the acceptance of the extragalactic nature of these objects (No-495).
c) Lundmark played around with rules connecting distances and velocities of galaxies in 1924, but my didn't come to a solid conclusion (Trimble 2013).
e) Lemaître had theoretically deduced Hubble's law prior to the observational discovery (No-524). He may not even have been the first to notice that such a law must hold in simple general relativity cosmology.

Redaction: Jeffery, 2001jan01

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046 qmult 00300 1 4 5 easy deducto-memory: ellipticals
Extra keywords: CK-393,395,407

6. "Let's play *Jeopardy*! For $100, the answer is: Galaxies of this Hubble type range in size from about $10^5\,M_\odot$ (small dwarfs) to $10^{13}\,M_\odot$ (large giants), consist mainly of Population II and old Population I stars, and have relatively little dust and gas."

What is the _____ type, Alex?

a) irregular b) lenticular c) spiral d) barred spiral e) elliptical

SUGGESTED ANSWER: (e) See CK-395 and FK-582

Wrong answers:
a) No.

Redaction: Jeffery, 2001jan01

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046 qmult 00310 2 4 1 moderate deducto-memory: ellipitcal E0-7 significance

7. The 8 elliptical subtypes E0 through E7 do **NOT** give unambiguous information about the intrinsic properties of the ellipticals because they are assigned:

a) just on the basis of the shape of the galaxy projected on the sky. b) on the basis of the 3-dimensional shape of the galaxy. c) arbitrarily. d) randomly. e) whimsically.

SUGGESTED ANSWER: (a) See CK-393.

Wrong answers:
b) Exactly wrong. If they could be so assigned then they would give unambiguous intrinsic information.
e) As Lurch would say: "Aaaarh."

Redaction: Jeffery, 2001jan01

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046 qmult 00400 1 4 2 easy deducto-memory: lenticular galaxies
Extra keywords: CK-394,407

8. Lenticular (SO and SBO) galaxies have:

a) spiral arms, but no well-defined disks. b) disks, but no well-defined spiral arms. c) bulges, but no disks. d) no bulges, disks, spiral arms, or halos. e) no size whatsoever.

SUGGESTED ANSWER: (b)

Wrong answers:
a) Exactly wrong.
e) As Lurch would say: "Aaaarh." "Whatsoever" is the intensive form of "whatever" (Ba-1387).

Redaction: Jeffery, 2001jan01

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046 qmult 00500 1 4 4 easy deducto-memory: spirals and barred spirals
Extra keywords: CK-388,392,407

9. Spiral galaxies are divided into ordinary spirals (or just spirals without qualification) and:

a) bulgeless spirals. b) haloed spirals. c) disked spirals. d) barred spirals. e) unbarred spirals.

SUGGESTED ANSWER: (d)

The terminology is a bit ambiguous because spiral can mean ordinary spiral or ordinary and barred spiral collectively. But it seems overly pedantic to try to remove the ambiguity. Context must decide what spiral sans qualification means.

Wrong answers:
e) This is just another name for ordinary spirals.

Redaction: Jeffery, 2001jan01

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046 qmult 00510 1 4 5 easy deducto-memory: grand-design and flocculent
Extra keywords: CK-389,407

10. Based on the appearance of their spiral arms, spiral galaxies are divided into grand-design spirals and:

a) sheeplike spirals. b) sheepish spirals. c) woolly spirals. d) fleecy spirals. e) flocculent spirals.

SUGGESTED ANSWER: (e)

Wrong answers:
c) Woolly means flocculent, but no galaxy is called woolly.
d) Fleecy means flocculent, but no galaxy is called fleecy.

Redaction: Jeffery, 2001jan01

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046 qmult 00530 1 4 1 easy deducto-memory: edge-on, face-on

11. To see a spiral or lenticular galaxy parallel to the disk is to see it _____ and to see it perpendicular to the disk is to see it _____.

a) edge-on; face-on b) face-on; edge-on c) edge-on; obliquely d) face-on; obliquely e) obliquely; opaquely

SUGGESTED ANSWER: (a)

Wrong answers:
b) Exactly wrong.
e) As Lurch would say: "Aaaarh."

Redaction: Jeffery, 2001jan01

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046 qmult 00540 1 4 4 easy deducto-memory: spiral subtype from bulge
Extra keywords: CK-388

12. One can usually tell the subtype of a spiral or barred spiral seen **EDGE-ON** because a subtype indication is provided by:

    a) the tightness of the winding of the spiral arms. b) the darkness of the disk dust lane. c) the relative size of the halo. d) the relative size of the bulge. e) the galaxy brightness on the sky.

SUGGESTED ANSWER: (d)

Wrong answers:
a) This is exactly what you cannot see when the galaxy is viewed edge-on.

Redaction: Jeffery, 2001jan01

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046 qmult 00800 2 4 3 moderate deducto-memory: irregular galaxy LMC

13. A well known example of an irregular galaxy (of subtype Irr I) is the:

    a) Whirlpool Galaxy (M51). b) Sombrero Galaxy (M104).
    c) Large Magellanic Cloud (LMC). d) Milk Way (i.e., the Galaxy).
    e) Andromeda Galaxy (M31).

SUGGESTED ANSWER: (c) See FK-585.

Wrong answers:
a) Does "whirlpool" sound like it could be anything other than a spiral galaxy.

Redaction: Jeffery, 2001jan01

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046 qmult 00900 1 1 1 easy memory: spiral density waves and SPSF
Extra keywords: CK-391,407 CK-408-3

14. Grand-design and flocculent spiral arms are believed to be caused by, respectively, _____ and _____.

    a) spiral density waves; self-propagating star formation plus differential rotation. b) self-propagating star formation plus differential rotation; spiral density waves c) spiral density waves; flocculent waves d) grand-design waves; flocculent waves e) galactic cannibalism; gravitational lensing

SUGGESTED ANSWER: (a)

Wrong answers:
e) As Lurch would say: "Aaaarh."

Redaction: Jeffery, 2001jan01

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046 qmult 02000 1 4 5 easy deducto-memory: naked-eye galaxies
Extra keywords: CK-409-7

15. The Andromeda galaxy (M31), the Large Magellanic Cloud (LMC), and the Small Magellanic Cloud (SMC) are all:

    a) elliptical galaxies. b) dwarf elliptical galaxies. c) irregular galaxies. d) spiral galaxies. e) naked-eye objects: i.e., they can all be seen by the naked eye.

SUGGESTED ANSWER: (e)

Wrong answers:
b) As Lurch would say: "Aaaarh."

Redaction: Jeffery, 2001jan01