Answer Key

1. T	7. T	13. F	19. T	25. T
2. F	8. T	14. F	20. F	26. T
3. F	9. F	15. F	21. F	27. F
4. T	10. T	16. T	22. T	28. T
5. F	11. T	17. T	23. T	29. T
6. T	12. F	18. F	24. F	30. F

31. B	37. A	43. A	49. D	55. C
32. A	38. D	44. A	50. D	56. B
33. A	39. A	45. A	51. C	57. B
34. D	40. D	46. B	52. B	58. C
35. B	41. C	47. A	53. B	59. D
36. B	42. C	48. C	54. B	60. D

61. (a) x: Color index (unitless); y: Apparent magnitude (unitless)
    (b) Upper HR stars = more massive = evolve off MS faster. Only works if stars are the same age i.e. formed at the same time.
    (c) 10 billion years, low metallicity because population II (i.e. ISM not yet enriched).
    (d) 4000 ± 500 pc
    (e) Formed before the galaxy collapsed into a disk, so spherically distributed. Does not flatten with gas because large bodies are essentially collisionless.

62. (a) SBb or SBc; Sb or Sc; Sb
    (b) Stars in ellipticals are older and therefore redder. A second reason is higher metallicity in elliptical populations.
    (c) Mergers can produce ellipticals from two spirals
    (d) Dense galaxy clusters have more frequent mergers, producing more ellipticals
    (e) Yes. The one with more gas. Internal gas friction will cause the galaxy to collapse into a disk. New stars will form in the disk, leaving a spiral galaxy.

63. (a) Shortest
    (b) Make sure the math makes sense
    (c) The disk starts to clump up. Planetary disk, grand design galaxy, etc.

64. (a) There are considerably more massive stars in starburst events than in ordinary star-forming spiral galaxies.

(b) Dust obscures UV light. In particular, dust grains absorb energetic wavelengths (blue and UV) because their size is comparable to the wavelength of the light. They then heat up and re-emit this radiation as infrared; an outside observer essentially loses all the UV/blue wavelength information. Without this information, we can't figure out the relative abundances of massive stars (since these massive stars emit mostly in the UV range) – at least, not using the traditional technique.

(c) Starburst is caused by a high density in interstellar dust and gas; in turn, an abundance of stars (especially red giants) increases the production of dust. Full credit for mentioning either aspect.

(d) Isotopes of carbon and oxygen. The numbers 13 and 18 refer to the number of nucleons.

(e) The majority of ^{13}C is produced by low- or intermediate-mass stars, whereas the ^{18}O is produced mainly by high-mass stars.