

Team name: KEY Team number: KEY

Answer Page: Section A

1. (a) FU Orionis or FUOr
(b) D or E
(c) 30
2. (a) hot Jupiter and/or gas giant
(b) Changing its rotation rate
3. 1,22,26,7
4. (a) Gliese 229b, 18
(b) 27
5. (a) Transit
(b) Size of planet (relative to that of star)
6. (a) B or D (A-E)
(b) A (A-E)
(c) C (A-E)
7. (a) 14
(b) Western hemisphere brighter, potential cloud cover
8. (a) Brown dwarfs
(b) 10, WISE 1049-5319
(c) Patchy clouds rotating in/out of view
9. (a) Beta Pictoris, Fomalhaut
(b) G
(c) Debris disks
(d) Direct imaging
10. (a) 9
(b) Radial Velocity
(c) Inclination
11. (a) 16
(b) 32
(c) Q
(d) Flared
12. (a) 25, TW Hydrae
(b) 35
13. (a) M20 (Trifid Nebula), HII or star formation region
(b) 22
14. 15,25,16
15. (a) 31,36
(b) Temperature, composition, presence of clouds
16. (a) 5, HR 8799
(b) G
17. (a) Has clouds or haze
(b) Super-Earth or Mini-Neptune
18. (a) N159, 24
(b) Has 2 massive protostars with bipolar outflow
19. 33
20. (a) Size of the planet/atmosphere
(b) Strong east-west winds
(c) HD 209458b

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Answer Page: Section B

21. (a) 40 ± 10 Parsecs
(b) 1219 ± 200 Kelvin
(c) 19.2 ± 2
(d) They are self-luminous, must be massive and young
(e) Planets clear gap in disk
22. (a) 0.057 ± 0.02 AU
(b) 125 ± 25 km/sec
(c) 12.1 ± 4 Degrees
(d) 17.5 ± 5 Parsecs
23. (a) 5.73 ± 2 Solar luminosities
(b) 0.7 ± 0.2 %
(c) 1.57 ± 0.3 Jupiter radii
(d) $(2.7 \pm 1) \times 10^{23}$ Watts
(e) 2332 ± 500 Kelvin
(f) 1.04 ± 0.3 Microns, Infrared
(g) 0.031 ± 0.015 AU

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Answer Page: Section C

24. (a) Absolute J-band magnitude
(b) Effective Temperature
(c) T
(d) L
25. (a) Radiation from star
(b) Transition disk, dip in near-infrared
(c) Debris disk
26. (a) 326 ± 50 Light years
(b) 0.926 ± 0.2 Solar radii
(c) 0.528 ± 0.2 AU
(d) 1.4 ± 0.3 Earth radii
(e) 350 ± 75 Kelvin
(f) Yes!
27. (a) Planets below the line are largely gaseous/icy, planets above rocky
(b) Sub-Neptune
(c) Super-Earth
(d) 4.7 ± 2 Earth radii
(e) HAT-P-11b