SOLAR SYSTEM

EXAMPLE EXAM
B DIVISION 2017-2018

TEAM NUMBER:_____

TEAM NAME:_____

STUDENT NAMES:_____

_____

Do not open the test packet until instructed by the event supervisor. Ensure that you have all 6 pages of the test, 3 image sheets, and 2 answer sheets. You are encouraged to use the backs of the test sheets as scratch paper. Only answers recorded on the answer sheet will be graded. All questions are of equal value. Good luck!

IMAGE SHEET A

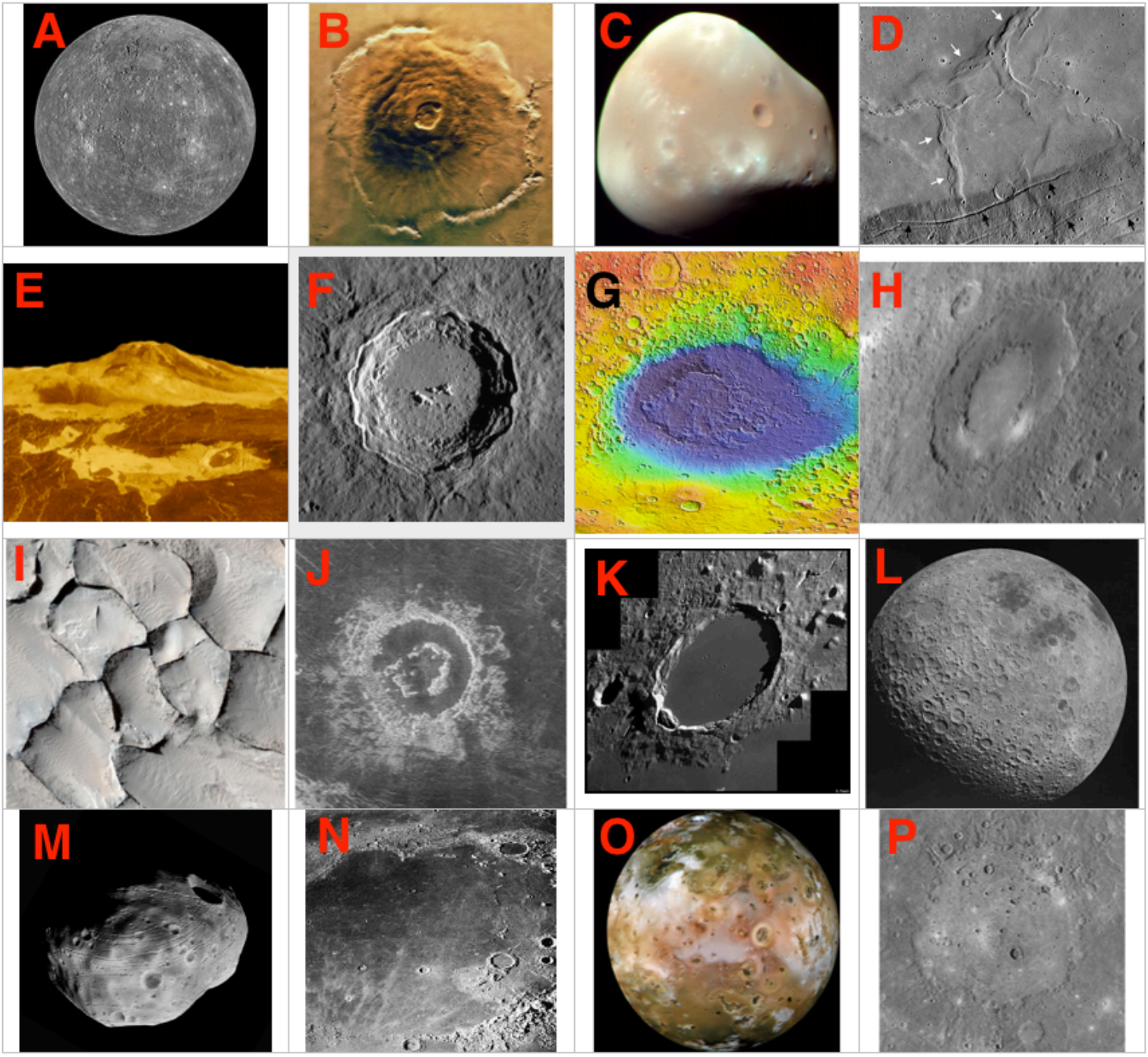
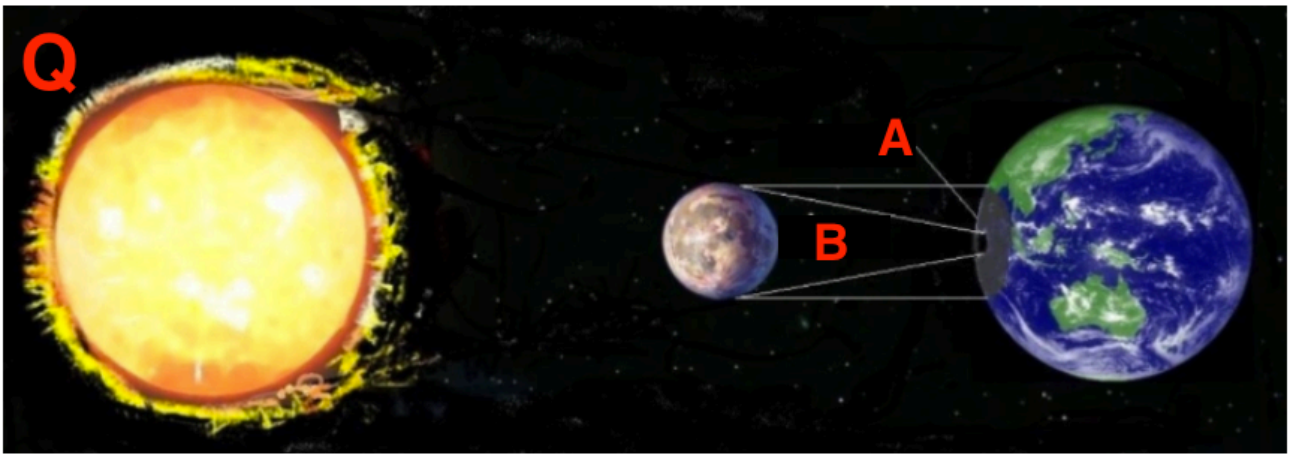
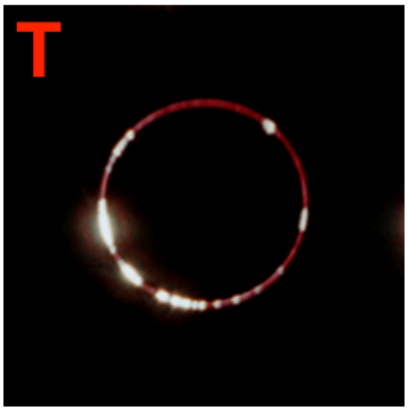
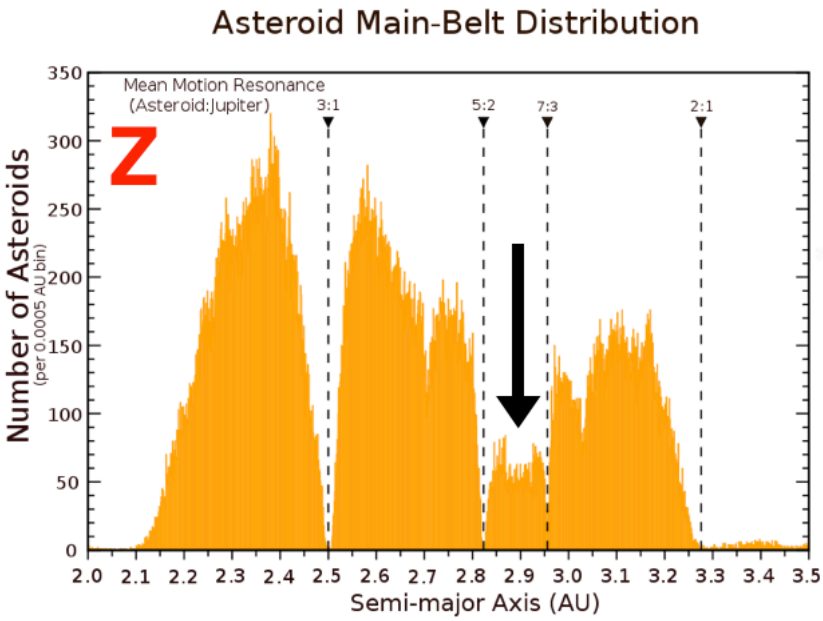
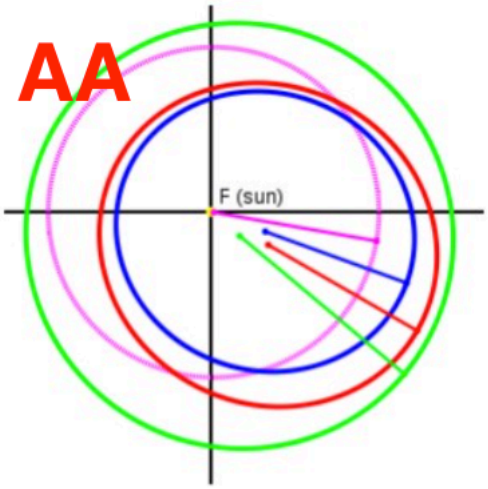


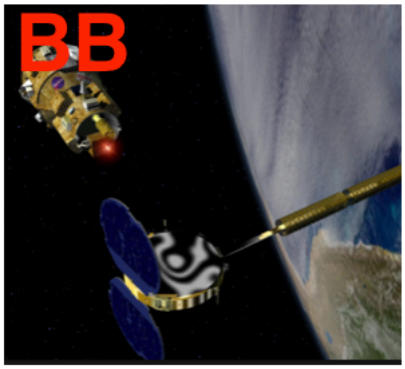
IMAGE SHEET B

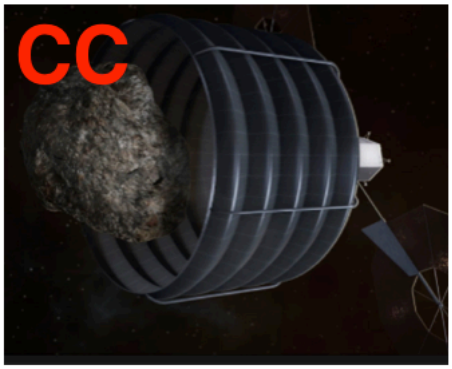












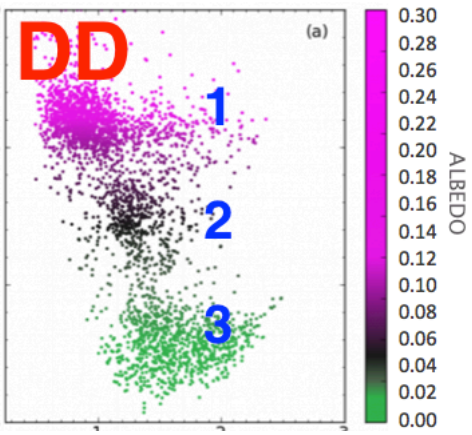
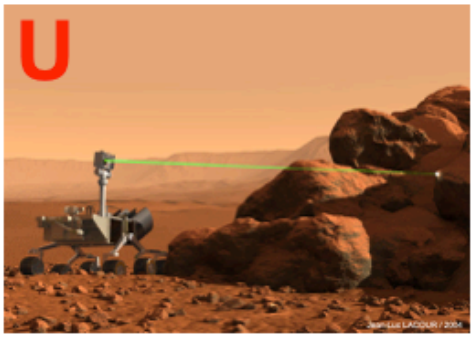


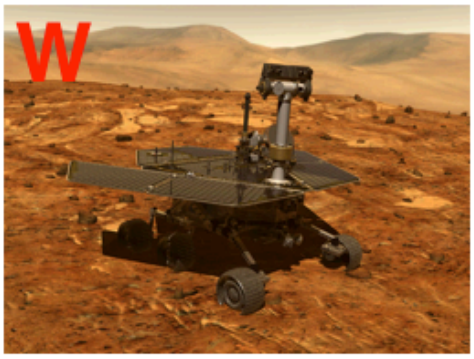
IMAGE SHEET C

U

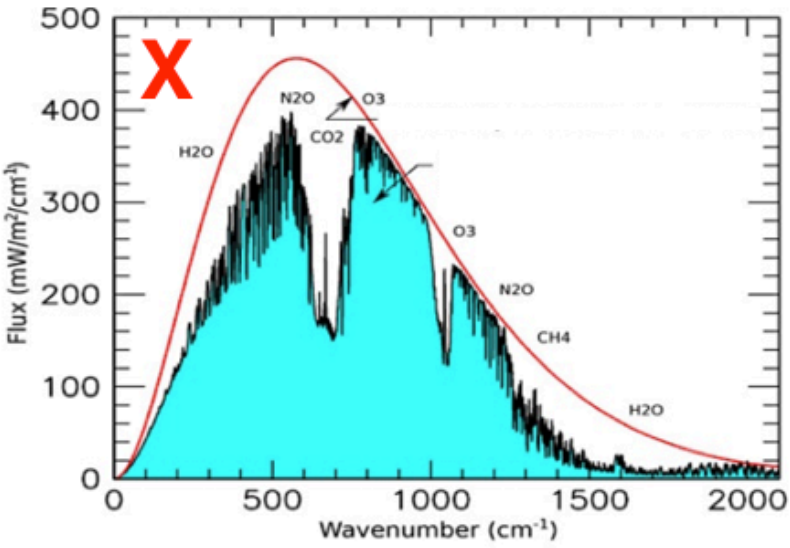


V

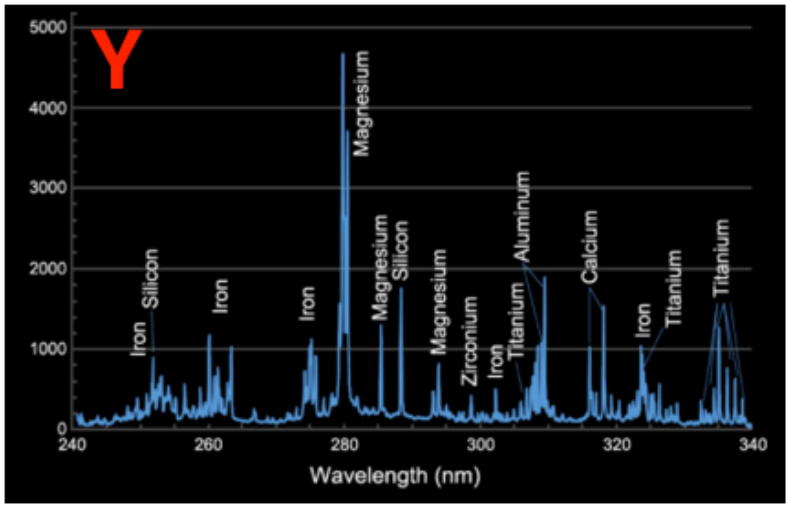
W



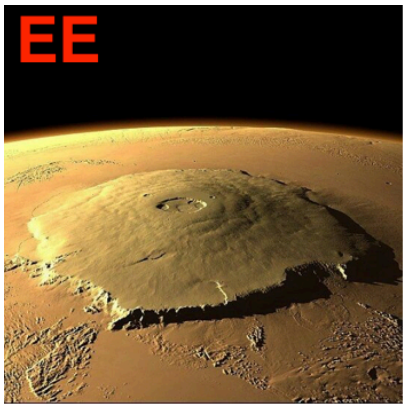
X



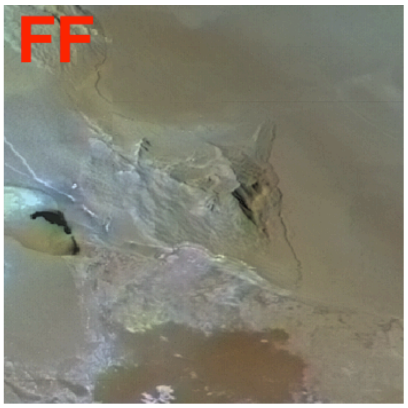
Y



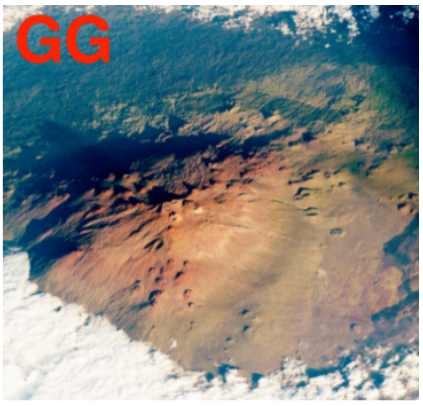
EE



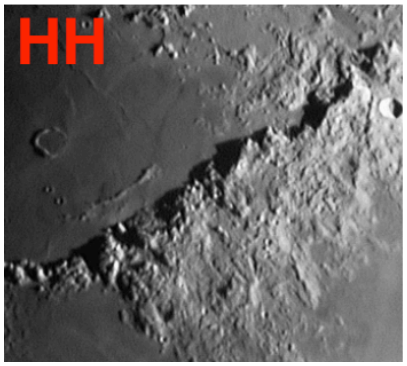
FF



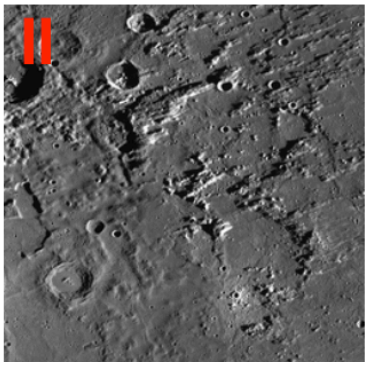
GG



HH



II



JJ

SECTION A

Questions 1-34 in Section A refer to Image Sheet A.

1. Which image shows one full hemisphere of the planet closest to the Sun?
2. Which image shows this planet's largest crater?
3. What is the name of the crater indicated in Question #2?

4. Which image shows Phobos?
5. Phobos has one large crater, named for the wife of the astronomer who discovered Phobos. What is the name of this crater?
6. What is the name of Mars's other moon?
7. Does Phobos orbit closer to Mars or further from Mars than Mars's other moon?
8. Scientists have long believed that Mars's moons are gravitationally captured asteroids, but recent evidence suggests that they may be another type of solar system object that originated beyond the Asteroid Belt. What kind of objects may Mars's moons be?

9. Which images show the object closest to Earth?
10. Which image shows the object furthest from Earth?
11. Who discovered the object indicated in Question #10?

12. Which image shows a crater on the surface of Venus?
13. What kind of imaging was used to generate the image indicated in Question #12?
14. What mission generated the image indicated in Question #12?
15. Venus has a thin crust compared to Earth and an extremely active tectonic cycle, resulting in relatively rapid surface recycling. What is the name for the highly deformed oldest regions of Venus's crust?

16. Which image shows the lunar crater Plato?
17. Plato's basin is relatively flat compared to other lunar craters, with very few secondary craters within it. Does this indicate that it is relatively old or young?
18. What lunar feature is shown in image D?
19. What is the name for the large plains on the moon (shown in image N) that are darker and smoother than their surrounding terrain?
20. What kind of rock is present in the plains indicated in Question #19?
21. What was the first mission to return lunar samples to Earth?
22. During what period of solar system evolution did most lunar cratering occur?
23. How long ago did this extensive period of cratering indicated in Question #22 take place?

24. Which planet is nicknamed "The Red Planet"?
25. The presence of what element in the surface material of this planet is responsible for its red color?
26. Which image shows this planet's largest crater?
27. What is the name for this crater?

28. On which planet is the crater in image H found?
29. Craters on this planet are named after famous individuals who held what profession?

30. The majority of observations of this planet were performed by which mission, which orbited this planet from 2011 to 2015?

31. Which lunar crater is shown on the cover of this test?
32. How many years after the formation of the Earth was the moon formed?
33. What is the name for the leading formation hypothesis of the moon? In this scenario, a large protoplanet collided with the Earth early in its history and broke off a large amount of material that then fell into orbit around Earth and coalesced into the Moon.
34. What is the name for the large protoplanet included in the above theory?

SECTION B

Questions 35-48 reference in Section B refer to Image Sheet B.

35. What kind of eclipse is shown in Image Q?
36. What part of the moon's shadow is indicated by the letter A in Image Q?
37. What part of the moon's shadow is indicated by the letter B in Image Q?
38. On what date was the last eclipse of this kind?
39. What step in this eclipse is shown in Image T?
40. What feature of the Sun and/or Moon is responsible for the irregular brightness shown in Image T?
41. What kind of eclipse is shown in Image S?

42. What kind of tides would be experienced during an eclipse such as shown in Image Q?
43. The moon orbits such that the same side is always facing Earth. What is the name for the gravitational phenomenon that causes this?
44. Over time, greater than 50% of the Moon's surface is actually visible from Earth as it wobbles in its orbit. To the nearest percent, how much of the Moon's surface can be seen from Earth?
45. What specific type of libration is caused by the inclination between the Moon's orbital plan and its rotational axis? This effect is the same that causes season's for Earth in its orbit around the Sun.

46. What phase of the Moon is shown in Image R?
47. If this moon is observed from the Northern Hemisphere (right-side-up), how many hours before or after midnight does it reach its highest position in the night sky?
48. If a new moon occurred on January 1st, on what day could a Northern Hemisphere observer see the moon in Image R?

Consider the following solar system objects:

A. Io
B. Mercury
C. Venus
D. Mars
E. The Moon

49. Rank the five objects (A-F) from highest to lowest surface atmospheric pressure.
50. Which of the five objects (A-F) have measurable intrinsic magnetic fields?
51. Which of the five objects (A-F) are satellites of solar system planets?
52. Successful surface landing missions have studied which of the five objects (A-F)?

SECTION C

Questions 53-65 in Section C refer to Image Sheet C.

53. Which Mars exploration mission is shown in Image U?
54. What is the name of the specific instrument shown at work in Image U?
55. Which Mars exploration mission is shown in Image V?
56. Which Mars exploration mission is shown in Image W?
57. Does the spectrum in Image X or Image Y show the composition of Mars's atmosphere?
58. Which Image (U,V,W) shows the mission that generated the spectrum in Image X?
59. Which Image (U,V,W) shows the mission that generated the spectrum in Image Y?
60. A rover on Mars samples surface regolith and finds the concentration of Potassium-40 in this material is 120 ppm (parts per million). This rover drives into a crater on Mars and samples the regolith there, finding the concentration of Potassium-40 to be only 12 parts per million. If the half-life of Potassium-40 is 1.2 billion years, how long ago was this crater formed?

A	A line that connects a planet to the sun sweeps out equal areas in equal times.
B	All planets move in elliptical orbits, with the sun at one focus.
C	The square of the period of any planet is proportional to the cube of the semimajor axis of its orbit.

61. Which of the above statements is known as Kepler's 1st law?
62. Which of the above statements is known as Kepler's 2nd law?
63. A planet orbits the sun with a semi major axis of 3 Astronomical Units. What is its orbital period, in years?
64. A planet orbiting the sun reaches perihelion at 4 Astronomical Units and aphelion at 7 Astronomical Units. What is the semi major axis of this planet's orbit, in Astronomical Units?
65. One Astronomical Unit is defined as the average distance between which two objects in the solar system?

SECTION D

Questions 66-81 in Section D refer to Image Sheet B.

66. Image Z shows the distribution of asteroids in distance from the Sun. The gravitational disturbance of which two planets causes the breaks seen in this distribution?
67. What is the name of these breaks?
68. Image DD shows a distribution of main-belt asteroids color-coded by albedo. What class of asteroids is indicated by the letter 1?
69. What class of asteroids is indicated by the letter 2?
70. What class of asteroids is indicated by the letter 3?
71. What number (1,2,3) indicates the class of asteroids orbiting closest to the Sun?
72. What number (1,2,3) indicates the class of the majority (75%) of asteroids in the asteroid belt?
73. Groups of asteroids with similar orbital elements are usually named for their largest member. What is the name of the relatively small family of asteroids orbiting between 2.8 and 3.0 Astronomical Units from the Sun? This family is indicated by the black arrow in Image Z.

Approximate orbital paths of several families of Near Earth Asteroids are shown in Image AA. The orbital path of the Earth is shown in pink.
74. Which family of Near Earth Asteroids is shown in green, with orbital paths that never intersect Earth's and perihelion distances greater than 1 AU?
75. Which family of Near Earth Asteroids is shown in red, with orbital paths that intersect Earth's with semimajor axes greater than 1 AU?
76. Which family of Near Earth Asteroids is shown in blue, with orbital paths that intersect Earth's with semimajor axes less than 1 AU?
77. Do the asteroids shown in blue or red take longer to orbit the Sun?
78. What is the name for the Near Earth Asteroid detection program run by the United States and Europe that scans specifically for objects that pose collision risk to the Earth?
79. The objects indicated in the previous question are considered to pose collision risk to Earth based on their size and the distance between their orbit and Earth's. What is the name for these objects?

NASA is in the design phases of its first Near Earth Asteroid deflection mission. The craft, which would be used to strike the asteroid at a speed 9 times greater than a bullet, would deliver enough impulse to change the asteroid's path and prevent it from colliding with Earth.
80. Which image shows this spacecraft?
81. What is the name for this method of Near Earth Asteroid redirection?

SECTION E

Questions 82-100 in Section D refer to Image Sheet C. Images EE-JJ show the highest peak on each of the objects of which the images were taken. Match the following 6 Images to the object in the solar system they show.

82. Image EE	A. Mercury
83. Image FF	B. Earth
84. Image GG	C. Venus
85. Image HH	D. Moon
86. Image II	E. Io
87. Image JJ	F. Mars

Match the following 6 Images to the name of the peak shown.

88. Image EE	U. Maat Mons
89. Image FF	V. Caloris Montes
90. Image GG	W. Boösaule Montes
91. Image HH	X. Mauna Kea
92. Image II	Y. Olympus Mons
93. Image JJ	Z. Mons Huygens

94. Which image (EE-JJ) shows an active volcano?
95. Which images (EE-JJ) show dormant volcanoes?
96. Which images (EE-JJ) do not show volcanoes?

Io is the most volcanically active object in the solar system. It has an especially strong magnetic field, which helps to drive its active magnetosphere and distribute volcanic ejecta.

97. Io's crust is recycled so frequently that it has a notable lack of what surface feature common to all the other geologic bodies in the solar system?
98. To the nearest 100, how many active volcanoes are present on Io?
99. What is the name of the donut-shaped cloud of gas magnetically trapped around Io by its interactions with Jupiter's magnetic field?
100. Allotropes (different physical forms of elements) of what element are responsible for the brightly colored regions of Io's surface?

SOLAR SYSTEM EXAMPLE EXAM 2017-2018 ANSWER KEY PAGE 1

Team #:_____Team Name:_____Score: 50/50

1	A	26	G
2	P	27	Hellas (Impact Basin)
3	Caloris (Planitia/Basin)	28	Mercury
4	M	29	artists/authors/composers
5	Stickney	30	MESSENGER
6	Deimos	31	Tycho
7	closer	32	20-100 million years
8	comets	33	Giant Impact Hypothesis (Big Splash)
9	D F K L N (any order)	34	Theia
10	O	35	Solar Eclipse
11	Galileo	36	penumbra
12	J	37	umbra
13	radar	38	August 21st, 2017
14	Magellan	39	Bailey's Beads
15	tessera	40	Lunar Craters
16	K	41	Lunar Eclipse
17	young	42	Spring Tides
18	wrinkle ridges	43	tidal locking
19	maria	44	59%
20	basalt	45	latitudinal libration
21	Apollo 11	46	third quarter
22	Late Heavy Bombardment	47	6 hours after midnight (6 AM)
23	3.8-4.1 billion years ago	48	January 20-22nd
24	Mars	49	C D A E B (correct order)
25	Iron	50	B E (any order)

SOLAR SYSTEM EXAMPLE EXAM 2017-2018 ANSWER KEY PAGE 2

Team #:_____Team Name:_____Score: 50/50

51	A E (any order)	76	Atens
52	C D E (any order)	77	red
53	Curiosity (Rover)	78	Spaceguard
54	ChemCam	79	PHO (Potentially Hazardous Objects)
55	MRO (Mars Reconnaissance Orbiter)	80	BB
56	Opportunity	81	Kinetic Impactor
57	X	82	F
58	V	83	E
59	U	84	B
60	4 billion years	85	D
61	B	86	A
62	A	87	C
63	5.0-5.3 years	88	Y
64	5-6 AU	89	W
65	Sun and Earth	90	X
66	Mars and Jupiter	91	Z
67	Kirkwood Gaps	92	V
68	S (Stony)	93	U
69	M (Metallic) or X (X-Group)	94	JJ
70	C (Carbonaceous)	95	EE, HH, GG (any order)
71	1	96	II, FF (any order)
72	3	97	craters
73	Koronis Family	98	400
74	Amors	99	plasma torus
75	Apollos	100	sulfur

SOLAR SYSTEM EXAMPLE EXAM 2017-2018 ANSWER SHEET PAGE 1

Team #:_____Team Name:_____Score:_____/50

1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

SOLAR SYSTEM EXAMPLE EXAM 2017-2018 ANSWER SHEET PAGE 2

Team #:_____Team Name:_____Score:_____/50

51		76	
52		77	
53		78	
54		79	
55		80	
56		81	
57		82	
58		83	
59		84	
60		85	
61		86	
62		87	
63		88	
64		89	
65		90	
66		91	
67		92	
68		93	
69		94	
70		95	
71		96	
72		97	
73		98	
74		99	
75		100	