

Midterm Study Sheet

1. Which Pre-Socratic philosopher proposed that water is the fundamental substance underlying all of nature?
2. What concept is Heraclitus best known for emphasizing in his natural philosophy?
3. How did the Pythagoreans describe the ultimate reality underlying nature?
4. Which Pre-Socratic thinkers proposed that reality consists of infinitely small, indivisible particles?
5. How many fundamental elements did Empedocles propose as the constituents of all matter?
6. What position does the Earth occupy in the classical geocentric model?
7. According to Aristotle, what is the natural motion of earthly objects?
8. How did Aristotle characterize the celestial spheres in his cosmology?
9. Which ancient Greek work, later adopted by medieval Europe, presented a fully mathematical geocentric system?
10. In Plato's allegory of the cave (*Republic*, Book VII), prisoners mistake shadows for reality. What does this allegory illustrate in the history of science?
11. How did Ptolemy's model explain the apparent backward (retrograde) motion of planets?
12. Why was the *equant* point introduced by Ptolemy considered controversial?
13. What was the primary source of observational data Ptolemy used to construct his planetary model?
14. In the Ptolemaic system, what is the order of the Moon, Sun, and planets moving outward from Earth?
15. Which body did Copernicus place at the center of the cosmos in his heliocentric model?
16. In which work did Copernicus publish his heliocentric theory?
17. What was one of the main observational motivations for Copernicus to prefer heliocentrism over the Ptolemaic system?
18. What shape does Kepler's First Law assign to planetary orbits?
19. What does Kepler's Second Law (equal areas in equal times) tell us about how a planet's speed varies along its orbit?
20. State Kepler's Third Law relating a planet's orbital period T to its average distance from the Sun a .

21. Why was Galileo's telescopic observation of the moons of Jupiter significant for the debate over geocentrism?
22. What did Galileo's observation of the full set of phases of Venus indicate about Venus's orbit?
23. What did Galileo conclude about the motion of an object moving horizontally on a frictionless surface?
24. What did Galileo's inclined-plane experiments reveal about freely falling objects?
25. Why was Galileo brought before the Inquisition?
26. State Newton's First Law of Motion.
27. State Newton's Law of Universal Gravitation.
28. How did Newton define *inertia*?
29. State Newton's Third Law of Motion.
30. What is Laplace's *demon*, and what could such an intellect accomplish according to Laplace?
31. How did Laplace define the probability of an event?
32. What did Laplace's nebular hypothesis propose about the origin of the Solar System?
33. What is the philosophical significance of Laplacian determinism?
34. How did Laplace's worldview extend or build upon Newton's mechanics?
35. According to the phlogiston theory, what happens to phlogiston during combustion?
36. Which chemist is most closely associated with the systematic development of the phlogiston theory?
37. Metals gain mass when calcined — a problem for the phlogiston theory. How did phlogiston theorists attempt to explain this?
38. What component of air did Lavoisier identify as necessary for combustion?
39. How did Lavoisier's oxygen theory explain the weight gain of metals during calcination?
40. How did the caloric theory characterise the nature of heat?
41. Which scientist is most associated with the caloric theory of heat as a dominant framework in late 18th-century chemistry?
42. What did Count Rumford conclude about the nature of heat from his cannon-boring experiments?
43. Give an example of a phenomenon the caloric theory successfully accounted for.

44. What is the name of the result established by Joule's 1840s experiments, and what does it relate?
45. With what physical quantity does the kinetic theory of heat identify temperature?
46. In Rumford's cannon-boring experiment, heat appeared to be generated without limit. Why did this pose a fundamental problem for the caloric theory?
47. State the first law of thermodynamics as it emerged from the work of Joule and Helmholtz.
48. What does Carnot's analysis of ideal heat engines reveal about the factors that determine their efficiency?
49. How did Rumford use the boiling-water measurement in his cannon-boring experiment to argue against the caloric theory?
50. Write the expression for the efficiency η of an ideal Carnot heat engine in terms of the reservoir temperatures T_H and T_C .
51. What is the key conceptual difference between the caloric theory and the kinetic theory of heat?
52. In Borges's "The Library of Babel," the Library contains books contradicting every conceivable proposition. What philosophical conclusion does the narrator draw from this?
53. Who is Hillalum in Ted Chiang's "Tower of Babylon," and what is his role in the story?
54. What does Hillalum discover when he breaks through the vault of heaven at the end of "Tower of Babylon"?
55. In "Exhalation," the narrator discovers that consciousness depends on a pressure gradient between argon chambers. What does this imply for the future of their world?
56. How would you describe the narrator's tone at the close of "Exhalation," as they address future explorers?
57. In Borges's "The Library of Babel," every possible arrangement of letters exists in books of a fixed format. What is one notable consequence of this for the value of the Library's contents?
58. In "Tower of Babylon," Hillalum spends years climbing to reach the vault of heaven. What does he find when he finally breaks through?
59. In Ted Chiang's "Exhalation," the pressure difference driving all thought and life in the narrator's world is gradually equalising. Which concept from the history of physics does this most directly parallel?