22. 2000 gal/min (125 L/s) of brine with a specific gravity of 1.2 passes through an 85% efficient pump. The centerlines of the pump's 12 in inlet and 8 in outlet are at the same elevation. The inlet suction gauge indicates 6 in (150 mm) of mercury below atmospheric. The discharge pressure gauge is located 4 ft (1.2 m) above the centerline of the pump's outlet and indicates 20 psig (138 kPa). All pipes are schedule-40. The input power to the pump is most nearly

(A) 12 hp (8.9 kW)

(B) 36 hp (26 kW)

(C) 52 hp (39 kW)

(D) 87 hp (65 kW)

23. 100 ft^3/sec (2.6 m^3/s) of water passes through a horizontal turbine. The water's pressure is reduced from 30 psig (210 kPa) to 5 psig (35 kPa) vacuum. Disregarding friction, velocity, and other factors, the power generated is most nearly

(A) 110 hp (82 kW)

(B) 380 hp (280 kW)

(C) 730 hp (540 kW)

(D) 920 hp (640 kW)

24. A refrigeration truck is driven at 65 mph into a 15 mph headwind. The frontal area of the truck is 100 ft^2. The coefficient of drag is 0.5. When calculating the drag force on the truck, the velocity that should be used is most nearly

(A) 50 mph

(B) 65 mph

(C) 73 mph

(D) 80 mph

25. A dish-shaped antenna faces directly into a 60 mph wind. The projected area of the antenna is 0.8 ft^2; the coefficient of drag, C_D, is 1.2; and the density of air is 0.076 lbm/ft^3. The total amount of drag force experienced by the antenna is most nearly

(A) 9.0 lbf

(B) 10 lbf

(C) 14 lbf

(D) 16 lbf

26. A car traveling through 70°F (20°C) air has the following characteristics.

frontal area	28 ft^2 (2.6 m^2)
mass	3300 lbm (1500 kg)
drag coefficient	0.35
rolling resistance	1% of weight
engine thermal efficiency	28%
fuel heating value	115,000 Btu/gal (32 MJ/L)

Assume the car is traveling at 55 mi/hr (90 km/h). Considering only the drag and rolling resistance, the fuel consumption of the car is most nearly

(A) 0.026 gal/mi (0.062 L/km)

(B) 0.038 gal/mi (0.087 L/km)

(C) 0.051 gal/mi (0.12 L/km)

(D) 0.13 gal/mi (0.30 L/km)

27. A 1/20th airplane model is tested in a wind tunnel at full velocity and temperature. What is the approximate ratio of the wind tunnel pressure to normal ambient pressure?

(A) 5

(B) 10

(C) 20

(D) 40

28. 68°F (20°C) castor oil (kinematic viscosity at 68°F (20°C) of 1110×10^{-5} ft^2/sec (103×10^{-5} m^2/s)) flows through a pump whose impeller turns at 1000 rpm. A similar pump twice the first pump's size is tested with 68°F (20°C) air. Theoretically, what should be the approximate speed of the second pump's impeller to ensure similarity?

(A) 3.6 rpm

(B) 88 rpm

(C) 250 rpm

(D) 1600 rpm

18. Equipment that is purchased for $12,000 now is expected to be sold after ten years for $2000. The estimated maintenance is $1000 for the first year, but it is expected to increase $200 each year thereafter. The effective annual interest rate is 10%. The present worth is most nearly

(A) $16,000

(B) $17,000

(C) $21,000

(D) $22,000

19. A new grain combine with a 20-year life can remove seven pounds of rocks from its harvest per hour. Any rocks left in its output hopper will cause $25,000 damage in subsequent processes. Several investments are available to increase the rock-removal capacity, as listed in the table. The effective annual interest rate is 10%. What should be done?

rock removal rate	annual probability of exceeding rock removal rate	required investment to achieve removal rate
7	0.15	0
8	0.10	$15,000
9	0.07	$20,000
10	0.03	$30,000

(A) Do nothing.

(B) Invest $15,000.

(C) Invest $20,000.

(D) Invest $30,000.

20. A mechanism that costs $10,000 has operating costs and salvage values as given. An effective annual interest rate of 20% is to be used.

year	operating cost	salvage value
1	$2000	$8000
2	$3000	$7000
3	$4000	$6000
4	$5000	$5000
5	$6000	$4000

The economic life of the mechanism is most nearly

(A) one year

(B) two years

(C) three years

(D) five years

21. A salesperson intends to purchase a car for $50,000 for personal use, driving 15,000 miles per year. Insurance for personal use costs $2000 per year, and maintenance costs $1500 per year. The car gets 15 miles per gallon, and gasoline costs $1.50 per gallon. The resale value after five years will be $10,000. The salesperson's employer has asked that the car be used for business driving of 50,000 miles per year and has offered a reimbursement of $0.30 per mile. Using the car for business would increase the insurance cost to $3000 per year and maintenance to $2000 per year. The salvage value after five years would be reduced to $5000. If the employer purchased a car for the salesperson to use, the initial cost would be the same, but insurance, maintenance, and salvage would be $2500, $2000, and $8000, respectively. The salesperson's effective annual interest rate is 10%. With a reimbursement of $0.30 per mile, approximately how many miles must the car be driven per year to justify the employer buying the car for the salesperson to use?

(A) 20,000 mi

(B) 55,000 mi

(C) 82,000 mi

(D) 150,000 mi

22. Alternatives A and B are being evaluated. The effective annual interest rate is 10%.

	alternative A	alternative B
first cost	$80,000	$35,000
life	20 years	10 years
salvage value	$7000	0
annual costs		
years 1–5	$1000	$3000
years 6–10	$1500	$4000
years 11–20	$2000	0
additional cost		
year 10	$5000	0