1 pt

An automobile driver fills his 17.1-L steel gasoline tank in the cool of the morning when the temperature of the tank and the gasoline is 15.0°C and the pressure is 1.09 atm. The can is completely full. The temperature climbs to 29.3°C by 1 p.m., but the steel tank is reinforced so that it cannot expand and there is a tight-fitting gas cap with no allowance for an air space or pressure release. What is the pressure on the tank from the heated gasoline, which cannot expand in volume? The bulk modulus for gasoline is 1.00 x 10^9 N/m^2.
(in `atm`*)*

1.A◯ 1.35×10^2 **B**◯ 1.96×10^2 **C**◯ 2.84×10^2 **D**◯ 4.12×10^2 **E**◯ 5.98×10^2

1)	• A • 1.35E+02 [132.492681737414 137.900546298124] Sig 0 - 15 • Unit: atm

1 pt

The alveoli have an average radius of 0.130 mm and are approximately spherical. If the pressure in the sacs is 1.05×10^5 Pa, and the temperature is 310 K (average body temperature), how many air molecules are in an alveolus?

2.A◯ 1.41×10^{14} **B**◯ 1.65×10^{14} **C**◯ 1.93×10^{14} **D**◯ 2.26×10^{14} **E**◯ 2.64×10^{14}

2)	• D • 2.26E+14 [221357000239207 230391979840807] Sig 0 - 15

1 pt

In plants, water diffuses out through small openings known as stomatal pores. If $D = 2.42 \times 10^{-5}$ m^2/s for water vapor in air, and the length of the pores is 2.58×10^{-5} m, how long does it take for a water molecule to diffuse out through the pore?
(in `s`*)*

3.A◯ 9.48×10^{-6} **B**◯ 1.38×10^{-5} **C**◯ 1.99×10^{-5} **D**◯ 2.89×10^{-5} **E**◯ 4.19×10^{-5}

3)	• B • 1.38E-05 [1.34778347107438e-05 1.40279504132232e-05] Sig 0 - 15 • Unit: s

1 pt

A bubble with a volume of 1.00 cm^3 forms at the bottom of a lake that is 37.8 m deep. The temperature at the bottom of the lake is 9.42°C. The bubble rises to the surface where the water temperature is 26.9°C. Assume that the bubble is small enough that its temperature always matches that of its surroundings. What is the volume of the bubble just before it breaks the surface of the water? Ignore surface tension.
(in `cm^3`*)*

4.A◯ 1.62 **B**◯ 2.35 **C**◯ 3.41 **D**◯ 4.94 **E**◯ 7.17

4)	• D • 4.94 [4.84603908470766 5.0438365983692] Sig 0 - 15 • Unit: cm^3

1 pt

A hydrogen balloon at the Earth's surface has a volume of 5.13 m^3 on a day when the temperature is 24.3°C and the pressure is 1.00 x 10^5 N/m^2. The balloon rises and expands as the pressure drops. What would the volume of the same number of moles of hydrogen be at an altitude of 39.6 km where the pressure is 0.339 x 10^3 N/m^2 and the temperature is -12.6°C?
(in `m^3`*)*

5.A◯ 6.30×10^2 **B**◯ 9.14×10^2 **C**◯ 1.33×10^3 **D**◯ 1.92×10^3 **E**◯ 2.79×10^3

5)	• C • 1.33E+03 [1299.03498319789 1352.05681924679] Sig 0 - 15 • Unit: m^3

1 pt

Find the rms speed in air at 2.50°C and 1.00 atm of the Cl_2 molecules.
(in `m/s`*)*

6.A◯ 2.15×10^2 **B**◯ 3.11×10^2 **C**◯ 4.51×10^2 **D**◯ 6.55×10^2 **E**◯ 9.49×10^2

1 pt Find the rms speed in air at 2.50°C and 1.00 atm of the NO_2 molecules.
(in `m/s`*)*

7.A◯ 8.74×10^1 **B**◯ 1.27×10^2 **C**◯ 1.84×10^2
D◯ 2.67×10^2 **E**◯ 3.87×10^2

6)	• B • 3.11E+02 [305.148714652334 317.60376422998] Sig 0 - 15 • Unit: m/s
7)	• E • 3.87E+02 [378.831544216945 394.294056225799] Sig 0 - 15 • Unit: m/s

1 pt What is the total translational kinetic energy of the gas molecules of 0.420 mol of air at atmospheric pressure that occupies a volume of 3.80 L (0.00380 m^3)?
(in `J`*)*

8.A◯ 5.11×10^2 **B**◯ 5.77×10^2 **C**◯ 6.52×10^2
D◯ 7.37×10^2 **E**◯ 8.33×10^2

8)	• B • 5.77E+02 [565.8618 588.9582] Sig 0 - 15 • Unit: J

1 pt
During basketball practice Shane made a jump shot, releasing a 0.690-kg basketball from his hands at a height of 1.81 m above the floor with a speed of 7.18 m/s. The ball swooshes through the net at a height of 3.00 m above the floor and with a speed of 4.64 m/s. How much energy was dissipated by air drag from the time the ball left Shane's hands until it went through the net?
(in `J`*)*

9.A◯ 1.48 **B**◯ 1.85 **C**◯ 2.31 **D**◯ 2.89
E◯ 3.61

9)	• C • 2.31 [2.26486428 2.35730772] Sig 0 - 15 • Unit: J

1 pt If 4.70 g of steam at 100.0°C condenses to water on a burn victim's skin and cools to 43.4°C, how much heat is given up by the steam?
(in `J`*)*

10.A◯ 1.17×10^4 **B**◯ 1.56×10^4 **C**◯ 2.07×10^4
D◯ 2.76×10^4 **E**◯ 3.67×10^4

1 pt If the skin was originally at 37.5°C, how much tissue mass was involved in cooling the steam to water? The specific heat of human tissue is 3.50 kJ/(kg · K).
(in `g`*)*

11.A◯ 1.81×10^2 **B**◯ 2.41×10^2 **C**◯ 3.21×10^2
D◯ 4.27×10^2 **E**◯ 5.67×10^2

10)	• A • 1.17E+04 [11482.4245256 11951.0949144] Sig 0 - 15 • Unit: J
11)	• E • 5.67E+02 [556.049613830509 578.745516435835] Sig 0 - 15 • Unit: g

1 pt
Many species cool themselves by sweating, because as the sweat evaporates, heat is given up to the surroundings. A human exercising strenuously has an evaporative heat loss rate of about 664 W. If a person exercises strenuously for 47.0 min, how much water must he drink to replenish his fluid loss? The heat of vaporization of water is 2430 J/g at normal skin temperature.
(in `g`*)*

12.A◯ 5.79×10^2 **B**◯ 7.71×10^2 **C**◯ 1.02×10^3
D◯ 1.36×10^3 **E**◯ 1.81×10^3

12)	• B • 7.71E+02 [755.156543209877 785.979259259259] Sig 0 - 15 • Unit: g

1 pt On a very hot summer day Daphne is off to the park for a picnic. She puts 0.120 kg of ice at 0°C in a thermos and then adds a grape-flavored drink, which she has mixed from a powder, using room temperature water (22.5°C). How much grape flavored drink will just melt all the ice?
(in `kg`*)*

13.A◯ 2.61×10^{-1} **B**◯ 2.95×10^{-1} **C**◯ 3.33×10^{-1}
D◯ 3.76×10^{-1} **E**◯ 4.25×10^{-1}

13)	• E • 4.25E-01 [0.412408345277911 0.437918139831183] Sig 0 - 15 • Unit: kg

1 pt
The power expended by a cheetah is 165 kW while running at 101 km/h, but its body temperature cannot exceed 40.8°C. If 70.9 % of the energy expended is dissipated within its body, how far can it run before it overheats? Assume that the initial temperature of the cheetah is 37.6°C, its specific heat is 3.50 kJ/(kg·°C), and its mass is 58.8 kg.
(in `m`*)*

14.A◯ 1.26×10^{2} **B**◯ 1.58×10^{2} **C**◯ 1.97×10^{2}
D◯ 2.47×10^{2} **E**◯ 3.08×10^{2}

14)	• B • 1.58E+02 [154.778316308359 161.095798606659] Sig 0 - 15 • Unit: m

1 pt You are given 231 g of coffee (same specific heat as water) at 83.8°C (too hot to drink). In order to cool this to 60.0°C, how much ice (at 0.0°C) must be added? Neglect heat content of the cup and heat exchanges with the surroundings.

(in `kg`*)*

15.A◯ 3.08×10^{-2} **B**◯ 3.48×10^{-2} **C**◯ 3.93×10^{-2}
D◯ 4.45×10^{-2} **E**◯ 5.02×10^{-2}

15)	• C • 3.93E-02 [0.0385622456382724 0.0401362148479978] Sig 0 - 15 • Unit: kg

1 pt
A dog loses a lot of heat through panting. The air rushing over the upper respiratory tract causes evaporation and thus heat loss. A dog typically pants at a rate of 662 pants per minute. As a rough calculation, assume that one pant causes 0.0167 g of water to be evaporated from the respiratory tract. What is the rate of heat loss for the dog through panting?
(in `W`*)*

16.A◯ 2.66×10^{2} **B**◯ 3.33×10^{2} **C**◯ 4.16×10^{2}
D◯ 5.20×10^{2} **E**◯ 6.50×10^{2}

16)	• C • 4.16E+02 [407.3693792 423.9967008] Sig 0 - 15 • Unit: W

1 pt
A lizard of mass 2.93 g is warming itself in the bright sunlight. It casts a shadow of 1.67 cm^2 on a piece of paper held perpendicularly to the Sun's rays. The intensity of sunlight at the Earth is 1.40×10^3 W/m^2 but only half of this energy penetrates the atmosphere and is absorbed by the lizard. If the lizard has a specific heat of 4.20 J/(g · °C), what is the rate of increase of the lizard's temperature? Do not enter unit (°C/s).

17.A◯ 5.83×10^{-3} **B**◯ 6.58×10^{-3} **C**◯ 7.44×10^{-3}
D◯ 8.41×10^{-3} **E**◯ 9.50×10^{-3}

1 pt Assuming that there is no heat loss by the lizard (to simplify), how long must the lizard lie in the Sun in order to raise its temperature by 3.25°C?
(in `s`*)*

18.A◯ 2.68×10^{2} **B**◯ 3.03×10^{2} **C**◯ 3.42×10^{2}
D◯ 3.87×10^{2} **E**◯ 4.37×10^{2}

17)	• E • 9.50E-03 [0.0093094425483504 0.00968941979522184] Sig 0 - 15
18)	• C • 3.42E+02 [335.283233532934 348.968263473054] Sig 0 - 15 • Unit: s

1 pt The inner vessel of a calorimeter contains 44.8 g of ammonia, NH_3, at 40.0°C. The vessel is surrounded by 2.00 kg of water at 18.02°C. After a time, the NH_3 and the water reach the equilibrium temperature of 18.56°C. What is the specific heat of NH_3? Do not enter unit (kJ/(kg·°C).

19.A◯ 3.76 **B**◯ 4.70 **C**◯ 5.88 **D**◯ 7.34
E◯ 9.18

19)	• B • 4.70 [4.606 4.794] Sig 0 - 15

1 pt
The United States generates about 5.35×10^{16} J of electric energy a day. This energy is equivalent to work, since it can be converted into work with almost 100% efficiency by an electric motor. If this energy is generated by power plants with an average efficiency of 0.302, how much heat is dumped into the environment each day?
(in `J`*)*

20.A◯ 1.24×10^{17} **B**◯ 1.79×10^{17}
C◯ 2.60×10^{17} **D**◯ 3.77×10^{17}
E◯ 5.47×10^{17}

1 pt How much water would be required to absorb this heat if the water temperature is not to increase more than 2.09°C?

(in `kg`*)*

21.A◯ 1.13×10^{13} **B**◯ 1.41×10^{13}
C◯ 1.77×10^{13} **D**◯ 2.21×10^{13}
E◯ 2.76×10^{13}

20)	• A • 1.24E+17 [1.21179271523179e+17 1.26125364238411e+17] Sig 0 - 15 • Unit: J
21)	• B • 1.41E+13 [13851054154447.2 14416403303608.4] Sig 0 - 15 • Unit: kg

1 pt
Suppose 1.87 mol of oxygen is heated at constant pressure of 1.00 atm from 13.1°C to 23.3°C. How much heat is absorbed by the gas?
(in `J`*)*

22.A◯ 5.55×10^{2} **B**◯ 6.94×10^{2} **C**◯ 8.67×10^{2}
D◯ 1.08×10^{3} **E**◯ 1.36×10^{3}

1 pt Using the ideal gas law, calculate the change of volume of the gas in this process.
(in `dm^3`*)*

23.A◯ 7.45×10^{-1} **B**◯ 1.08 **C**◯ 1.57
D◯ 2.27 **E**◯ 3.29

1 pt What is the work done by the gas during this expansion?
(in J)

24.A◯ 6.74×10^{1} **B**◯ 8.96×10^{1} **C**◯ 1.19×10^{2}
D◯ 1.59×10^{2} **E**◯ 2.11×10^{2}

1 pt From the first law, calculate the change of internal energy of the gas in this process.
(in J)

25.A◯ 3.51×10^{2} **B**◯ 3.96×10^{2} **C**◯ 4.48×10^{2}
D◯ 5.06×10^{2} **E**◯ 5.72×10^{2}

22)	• A • 5.55E+02 [543.93363948 566.13501252] Sig 0 - 15 • Unit: J
23)	• C • 1.57 [1.53415213504443 1.59677058953603] Sig 0 - 15 • Unit: dm^3
24)	• D • 1.59E+02 [155.40961128 161.75286072] Sig 0 - 15 • Unit: J
25)	• B • 3.96E+02 [388.5240282 404.3821518] Sig 0 - 15 • Unit: J

1 pt
Calculate the efficiency of a reversible engine that operates between the temperatures 603°C and 325°C.

26.A◯ 1.62×10^{-1} **B**◯ 2.03×10^{-1} **C**◯ 2.54×10^{-1}
D◯ 3.17×10^{-1} **E**◯ 3.97×10^{-1}

1 pt If the engine absorbs 450 kJ of heat from the hot reservoir, how much does it exhaust to the cold reservoir?
(in kJ)

27.A◯ 3.07×10^{2} **B**◯ 3.47×10^{2} **C**◯ 3.92×10^{2}
D◯ 4.43×10^{2} **E**◯ 5.01×10^{2}

26)	• D • 3.17E-01 [0.310951321120813 0.323643211778805] Sig 0 - 15
27)	• A • 3.07E+02 [301.071905495634 313.360554699538] Sig 0 - 15 • Unit: kJ

1 pt
In a certain steam engine, the boiler temperature is 110°C and the cold reservoir temperature is 25.0°C. While this engine does 8.34 kJ of work, what minimum amount of heat must be discharged into the cold reservoir?
(in kJ)

28.A◯ 1.65×10^{1} **B**◯ 2.20×10^{1} **C**◯ 2.93×10^{1}
D◯ 3.89×10^{1} **E**◯ 5.17×10^{1}

28)	• C • 2.93E+01 [28.6687009411764 29.838852] Sig 0 - 15 • Unit: kJ

1 pt

An oil-burning electric power plant uses steam at 830 K to drive a turbine, after which the steam is expelled at 422 K. The engine has an efficiency of 0.423. What is the theoretical maximum efficiency possible at those temperatures?

29.A◯ 2.78×10^{-1} **B**◯ 3.70×10^{-1} **C**◯ 4.92×10^{-1} **D**◯ 6.54×10^{-1} **E**◯ 8.70×10^{-1}

29)	• C • 4.92E-01 [0.481734939759036 0.501397590361446] Sig 0 - 15

1 pt

A reversible refrigerator has a coefficient of performance of 3.04. How much work must be done to freeze 1.05 kg of liquid water initially at 0°C?'
(in `kJ`*)*

30.A◯ 7.95×10^{1} **B**◯ 1.15×10^{2} **C**◯ 1.67×10^{2} **D**◯ 2.42×10^{2} **E**◯ 3.51×10^{2}

30)	• B • 1.15E+02 [112.953059210527 117.563388157895] Sig 0 - 15 • Unit: kJ

1 pt The efficiency of a muscle during weight lifting is equal to the work done in lifting the weight divided by the total energy output of the muscle (work done plus internal energy dissipated in the muscle). Determine the efficiency of a muscle that lifts a 154-N weight through a vertical displacement of 0.571 m and dissipates 140 J in the process. Give answer in %. Do not enter unit.

31.A◯ 3.86×10^{1} **B**◯ 4.51×10^{1} **C**◯ 5.28×10^{1} **D**◯ 6.18×10^{1} **E**◯ 7.23×10^{1}

31)	• A • 3.86E+01 [37.8071371537375 39.3502856089921] Sig 0 - 15

1 pt

A heat engine uses the warm air at the ground as the hot reservoir and the cooler air at an altitude of several thousand meters as the cold reservoir. If the warm air is at 35.5°C and the cold air is at 25.7°C, what is the maximum possible efficiency for the engine?

32.A◯ 2.20×10^{-2} **B**◯ 2.49×10^{-2} **C**◯ 2.81×10^{-2} **D**◯ 3.18×10^{-2} **E**◯ 3.59×10^{-2}

32)	• D • 3.18E-02 [0.0311161509800745 0.0323861979588531] Sig 0 - 15

1 pt

An ideal refrigerator removes heat at a rate of 0.161 kW from its interior (+2.46°C) and exhausts heat at 41.4°C. How much electrical power is used?
(in `W`*)*

33.A◯ 1.16×10^{1} **B**◯ 1.46×10^{1} **C**◯ 1.82×10^{1} **D**◯ 2.27×10^{1} **E**◯ 2.84×10^{1}

33)	• D • 2.27E+01 [22.2921998476107 23.2020855556765] Sig 0 - 15 • Unit: W