Thermodynamics An Engineering Approach 8th Edition Cengel Test Bank
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Multiple-Choice Test Problems

Chapter 2: *Energy, Energy Transfer, and General Energy Analysis*

Çengel/Boles - Thermodynamics: An Engineering Approach, 8th Edition

(Numerical values for solutions can be obtained by copying the EES solutions given and pasting them on a blank EES screen, and pressing the Solve command. Similar problems and their solutions can be obtained easily by modifying numerical values.)

Chap2-1 Heating by Resistance Heater
A 1.5-kW electric resistance heater in a room is turned on and kept on for 20 min. The amount of energy transferred to the room by the heater is

(a) 1.5 kJ (b) 60 kJ (c) 750 kJ (d) 1800 kJ (e) 3600 kJ

Answer (d) 1800 kJ

Solution Solved by EES Software. Solutions can be verified by copying-and-pasting the following lines on a blank EES screen.

We= 1.5 "kJ/s"
time=20*60 "s"
E_total=We*time "kJ"

"Some Wrong Solutions with Common Mistakes:"
W1_Etotal=We*time/60 "using minutes instead of s"
W2_Etotal=We "ignoring time"

Chap2-2 Heat Supplied by Vacuum Cleaner
A 200 W vacuum cleaner is powered by an electric motor whose efficiency is 70%. (Note that the electric motor delivers 200 W of net mechanical power to the fan of the cleaner). The rate at which this vacuum cleaner supplies energy to the room when running is

(a) 140 W (b) 200 W (c) 286 W (d) 360 W (e) 86 W

Answer (c) 286 W

Solution Solved by EES Software. Solutions can be verified by copying-and-pasting the following lines on a blank EES screen.

Eff=0.70
W_vac=0.2 "kW"
E=W_vac/Eff "kJ/s"

"Some Wrong Solutions with Common Mistakes:"
W1_E=W_vac*Eff "Multiplying by efficiency"
W2_E=W_vac "Ignoring efficiency"
W3_E=E-W_vac "Heat generated by the motor"

Chap2-3 Heat Convection
A 40-cm-long, 0.6-cm-diameter electric resistance wire is used to determine the convection heat transfer coefficient in air at 25°C experimentally. The surface temperature of the wire is measured to be 150°C

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when the electric power consumption is 90 W. If the radiation heat loss from the wire is calculated to be 30 W, the convection heat transfer coefficient is

(a) 0.48 W/m^2.°C (b) 127 W/m^2.°C (c) 63.7 W/m^2.°C (d) 95 W/m^2.°C (e) 200 W/m^2.°C "

Answer (c) 63.7 W/m^2.°C

Solution Solved by EES Software. Solutions can be verified by copying-and-pasting the following lines on a blank EES screen.

```
L=0.4 "m"
D=0.006 "m"
A=pi*D*L "m^2"
We=90 "W"
Ts=150 "C"
Tf=25 "C"
We-30= h*A*(Ts-Tf) "W"

“Some Wrong Solutions with Common Mistakes:”
We-30= W1_h*(Ts-Tf) "Not using area"
We-30= W2_h*(L*D)*(Ts-Tf) "Using D*L for area"
We+30= W3_h*A*(Ts-Tf) "Adding Q_rad instead of subtracting"
We= W4_h*A*(Ts-Tf) "Disregarding Q_rad"
```

Chap2-4 Heat Convection and Radiation

A 1.5-m^2 black surface at 120°C is losing heat to the surrounding air at 30°C by convection with a convection heat transfer coefficient of 18 W/m^2.°C, and by radiation to the surrounding surfaces at 10°C. The total rate of heat loss from the surface is

(a) 1483 W (b) 2430 W (c) 2448 W (d) 3913 W (e) 2609 W

Answer (d) 3913 W

Solution Solved by EES Software. Solutions can be verified by copying-and-pasting the following lines on a blank EES screen.

```
sigma=5.67E-8 "W/m^2.K^4"
eps=1
A=1.5 "m^2"
h_conv=18 "W/m^2.C"
Ts=120 "C"
Tf=30 "C"
Tsurr=10 "C"
Q_conv=h_conv*A*(Ts-Tf)  "W"
Q_rad=eps*sigma*A*((Ts+273)^4-(Tsurr+273)^4) "W"
Q_total=Q_conv+Q_rad "W"

“Some Wrong Solutions with Common Mistakes:”
W1_Ql=Q_conv "Ignoring radiation"
W2_Q=Q_rad "ignoring convection"
W3_Q=Q_conv+eps*sigma*A*(Ts^4-Tsurr^4) "Using C in radiation calculations"
W4_Q=Q_total/A "not using area"
```

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Chap2-5 Heat Conduction
Heat is transferred steadily through a 0.15-m thick 3 m by 5 m wall whose thermal conductivity is 1.2 W/m.°C. The inner and outer surface temperatures of the wall are measured to be 18°C to 4°C. The rate of heat conduction through the wall is

(a) 112 W (b) 3360 W (c) 2640 W (d) 38 W (e) 1680 W

Answer (e) 1680 W

Solution Solved by EES Software. Solutions can be verified by copying-and-pasting the following lines on a blank EES screen.

```
A=3*5 "m^2"
L=0.15 "m"
T1=18 "C"
T2=4 "C"
k=1.2  "W/m.C"
Q=k*A*(T1-T2)/L "W"

"Some Wrong Solutions with Common Mistakes:"
W1_Q=k*(T1-T2)/L "Not using area"
W2_Q=k*2*A*(T1-T2)/L  "Using areas of both surfaces"
W3_Q=k*A*(T1+T2)/L  "Adding temperatures instead of subtracting"
W4_Q=k*A*L*(T1-T2) "Multiplying by thickness instead of dividing by it"
```

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