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PHYSICS WORKSHEET

Heat Engines

Chapter: Thermodynamics · Level ★★★ · Time: 30 min

SCORE ___ / 20

Name _____ Class _____ Date _____

AFTER THIS WORKSHEET YOU CAN

✓ Understand: How a Heat Engine Works
✓ Understand: Efficiency of a Heat Engine
✓ Understand: The Carnot Engine
✓ Understand: Why Real Engines Are Less Efficient

Section A · Concept Check • BEGINNER 4 × 1 = 4

1 A heat engine absorbs 2000 J and produces 600 J of work. Find its efficiency.

2 Find the Carnot efficiency between Th=800K and Tc=400K.

3 Find the Carnot efficiency between Th=1000K and Tc=250K.

4 Why does increasing the temperature difference (Th−Tc) generally increase a heat engine's maximum possible efficiency?

Section B · Problem Solving • INTERMEDIATE 4 × 3 = 12

5 A real engine has efficiency 25%, while its Carnot limit is 40%. What does this gap represent?

6 If a heat engine absorbs 1200 J and its efficiency is 35%, find the useful work output.

7 Using the previous engine, find how much heat is expelled to the cold reservoir.

8 Why must every cyclic heat engine expel some heat to a cold reservoir?

Section C · Challenge • CHALLENGE 2 × 2 = 4

9 What happens to a heat engine's theoretical maximum efficiency as Tc approaches Th?

10 Why are power plants often built near rivers or large bodies of water?

Reflection — the most useful thing I learned: _____

A ___/4 B ___/12 C ___/4 **Total ___/20**

Teacher's Signature

Parent's Signature

✂ ANSWER KEY — FOLD OR CUT BEFORE HANDING OUT

1 = 0.3 or 30% 2 = 1-(400/800)=0.5 or 50% 3 = 1-(250/1000)=0.75 or 75% 4 = The ratio Tc/Th decreases as the temperature difference grows, increasing 1-(Tc/Th) | 5 = Losses due to friction, heat leakage, and other non-ideal (irreversible) effects in the real engine 6 = W=0.35*1200=420 J 7 = Qc=Qh-W=1200-420=780 J 8 = The second law of thermodynamics prevents 100% conversion of heat into work in a repeating cycle | 9 = It approaches 0% efficiency, since the temperature difference driving the engine vanishes 10 = To provide a large, stable cold reservoir for expelling waste heat, improving the practical efficiency of the heat engine cycle