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DPP – 6

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Q 1. A Carnot engine working between 300K and 600K has work output of 800 J per cycle. What is amount of heat energy supplied to the engine from source per cycle
(a) 1800 J/cycle (b) 1000 J/cycle
(c) 2000 J/cycle (d) 1600 J/cycle

Q 2. A Carnot engine works between 27 °C and 127 °C. Heat supplied by the source is 500J. Then heat ejected to the sink is?
(a) 1000 J (b) 667 J
(c) 375 J (d) 500 J

Q 3. A Carnot engine is working in such a temperature of sink that is efficiency is maximum and never changes with any non-zero temperature of source. The temperature of sink will most likely to be
(a) 0 K (b) 0 °C
(c) 0 °C (d) -273 K

Q 4. The efficiency of Carnot engine is 50% and temperature of sink is 500K. If temperature of source is kept constant and its efficiency raised to 60%, then the required temperature of the sink will be : -
(a) 100 K (b) 600 K
(c) 400 K (d) 500 K

Q 5. A Carnot engine operates between two reservoirs of temperature 900K and 300K. The engine performs 1200 J of work per cycle. The heat energy delivered by the engine to the low temperature reservoir in a cycle is:
(a) 600 J (b) 900 J
(c) 2400 J (d) 800 J

Q 6. If the door of a refrigerator is kept open, then which of the following is true
(a) Room is cooled
(b) Room is heated
(c) Room is either cooled or heated
(d) Room is neither cooled nor heated

Q 7. In a cyclic process, work done by the system is
(a) Zero

(b) Equal to heat given to the system
(c) More than the heat given to system
(d) Independent of heat given to the system

Q 8. An ideal refrigerator has a freezer at a temperature of −13 °C. The coefficient of performance of the engine is 5. The temperature of the air (to which heat is rejected) will be
(a) 325 °C (b) 325 K
(c) 39 °C (d) 320 °C

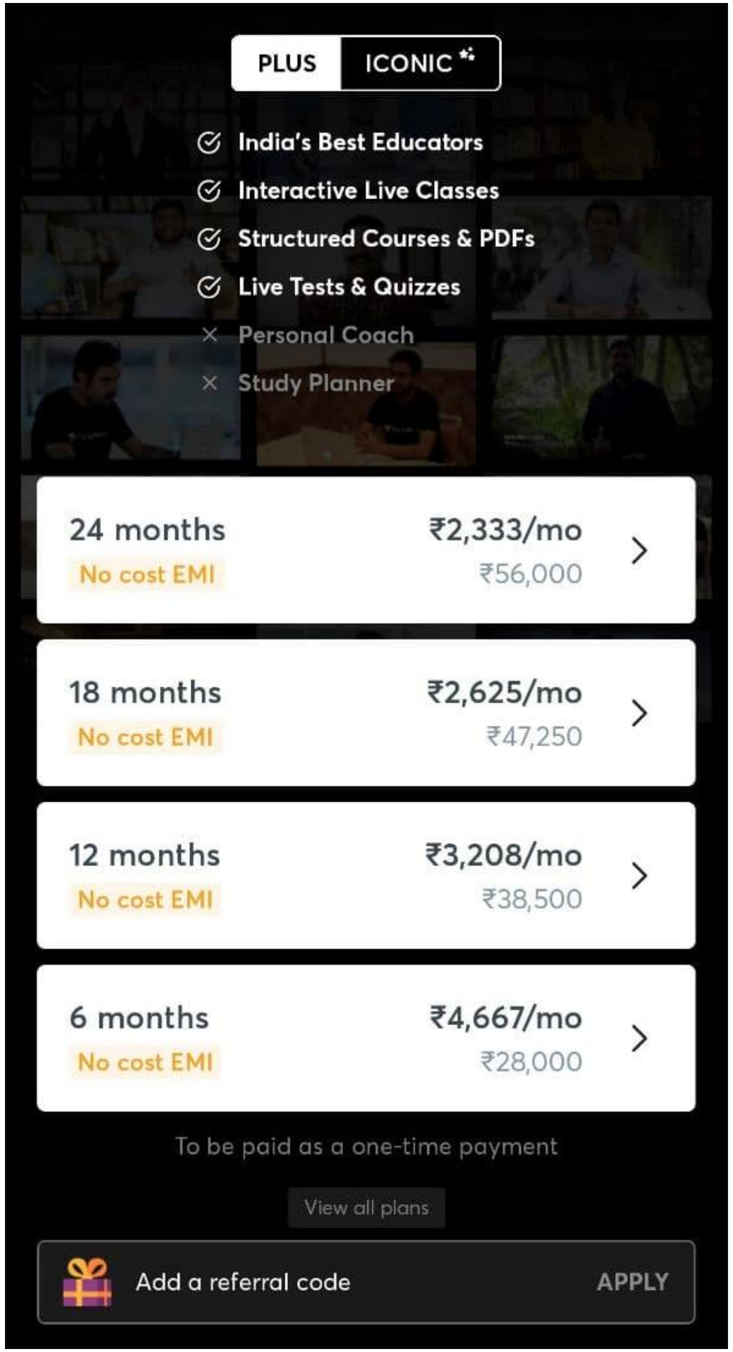
Q 9. An ideal heat engine working between source and sink temperature T_1 and T_2 respectively, has an efficiency η, the new efficiency if both the source and sink temperature are doubled, will be
(a) $\frac{\eta}{2}$ (b) η
(c) 2η (d) 3η

Q 10. A refrigerator works between 0 °C and 27 °C. Heat is to be removed from refrigerated space at the rate of 50 kcal/min, the power of the motor of the refrigerator is:
(a) 0.346 KW (b) 3.46 KW
(c) 34.6 KW (d) 346 KW

Q 11. A Carnot engine takes in 1000Kcal of heat from a reservoir at 627 °C and exhausts heat to sink at 27 °C. What is useful work done/cycle by the engine
(a) 666.67 J (b) 666.67 KJ
(c) 2.8×10^6 J (d) 2.8 KJ

Answer Key

Q.1 d	**Q.2 c**	**Q.3 a**	**Q.4 c**	**Q.5 a**
Q.6 b	**Q.7 b**	**Q.8 c**	**Q.9 b**	**Q.10 a**
Q.11 c				



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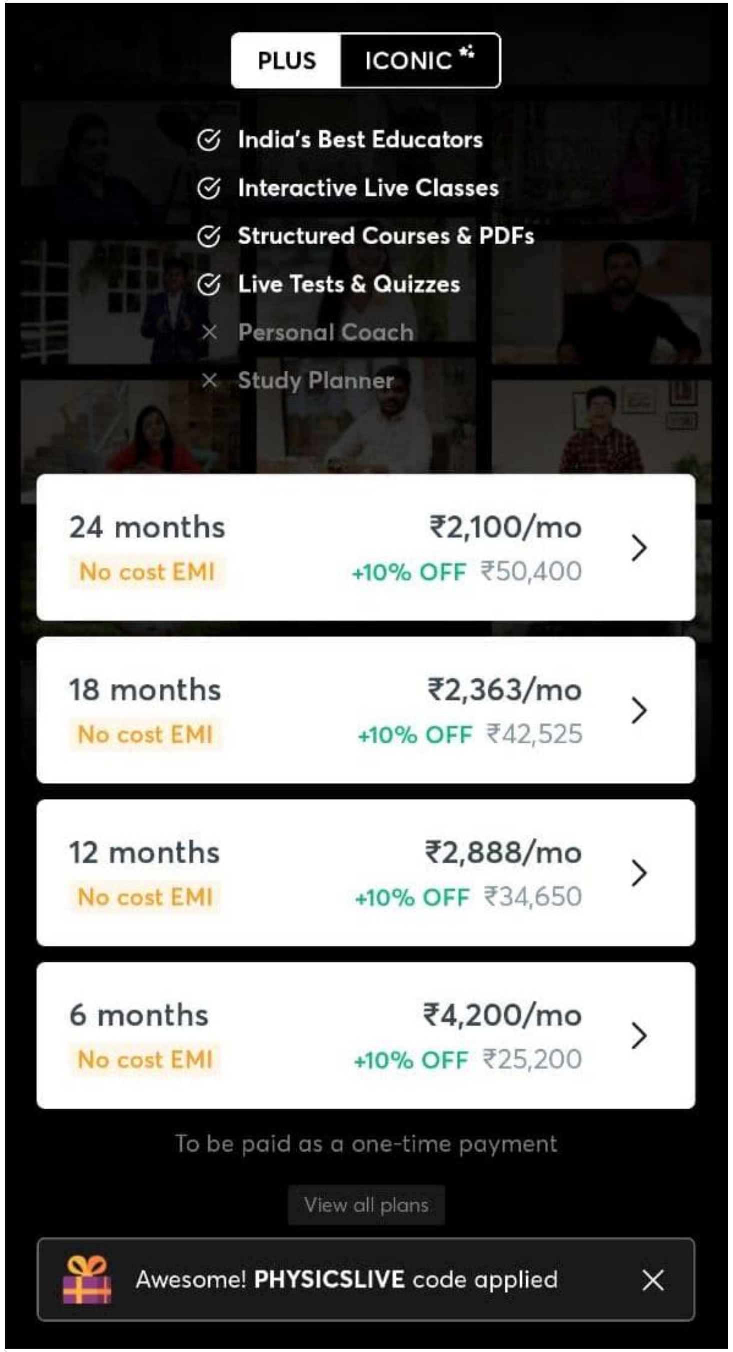

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NEET & JEE Main
Physics DPP- Solution

DPP- 6 Thermodynamics- Efficiency, heat engine, refrigerator

By Physicsaholics Team

Solution 1:

Efficiency of Carnot Engine

$$\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{300}{600} = 1 - \frac{1}{2} = 0.5$$

Let, heat Energy supplied to Engine is Q

then $\eta = \frac{W}{Q}$; W = work output

so, $\eta = \frac{W}{Q} \Rightarrow \frac{1}{2} = \frac{800}{Q}$

$$\boxed{Q = 1600\ J}$$ Ans.

Ans. d

Solution 2:

Let; Heat Ejected $= Q_2$

given; Heat supplied $= Q_1 = 500\,J$

$T_1 = 127^\circ C = 400\,K$

$T_2 = 27^\circ C = 300\,K$

From Carnot theorem

$$\frac{Q_2}{Q_1} = \frac{T_2}{T_1} \Rightarrow Q_2 = \frac{T_2}{T_1} \times Q_1$$

$$\Rightarrow Q_2 = \left(\frac{300}{400}\right)(500) = \frac{3}{4} \times 500$$

$$\boxed{Q_2 = 375\,J}$$ Ans.

Ans. c

Solution 3:

Efficiency of carnot Engine

$\eta = 1 - \frac{T_2}{T_1}$; T_2 = Temp. of sink (in K)

T_1 = Temp. of source (in K)

$\eta_{max} = 1$

$\Rightarrow 1 = 1 - \frac{T_2}{T_1} \Rightarrow \frac{T_2}{T_1} = 0$

$\Rightarrow \boxed{T_2 = 0\,K}$ Ans.

Ans. a

Solution 4:

Efficiency of carnot Engine

$\eta = 1 - \frac{T_2}{T_1}$; T_2 = Temp. of sink (in K)

T_1 = Temp. of source (in K)

when; Efficiency is 50%

$\eta = 0.5 = 1 - \frac{500}{T_1} \Rightarrow$ $\boxed{T_1 = 1000\ K}$

Now; when efficiency is 60%

$\eta = 0.6 = 1 - \frac{T_2}{1000} \Rightarrow 0.4 = \frac{T_2}{1000}$

$\boxed{T_2 = 400\ K}$ Ans.

Ans. c

Solution 5:

Let; heat supplied to the reservoir from engine = Q_2

and heat supplied to engine from source = Q_1

work done by engine = W = 1200 J.

$T_1 = 900K$ (source) ; $T_2 = 300K$ (sink)

$$\eta = 1 - \frac{T_2}{T_1} = \frac{W}{Q_1} = \frac{W}{W+Q_2} \Rightarrow 1 - \frac{T_2}{T_1} = \frac{W}{W+Q_2}$$

$$\Rightarrow 1 - \frac{300}{900} = \frac{1200}{1200+Q_2} \Rightarrow \frac{2}{3} = \frac{1200}{1200+Q_2} \Rightarrow 2Q_2 = 1200$$

$$\boxed{Q_2 = 600\ J}$$ Ans.

Ans. a

Solution 6:

In a refrigerator, the heat dissipated in the atmosphere is more than that taken from the cooling chamber, therefore the room is heated if the door of a refrigerator is kept open.

Ans. b

Solution 7:

in a cyclic Process; $U_i = U_f$

$$\boxed{\Delta U = 0}$$

so; from $dQ = \Delta U + dW$

$$\boxed{dQ = dW}$$

$\Rightarrow$ work done by system is equal to heat given to system.

Ans. b

Solution 8:

Coeff. of Performance of Refrigerator = 5

$$K = 5 = \frac{Q_2}{W} = \frac{Q_2}{Q_1 - Q_2} = \frac{T_2}{T_1 - T_2}$$

$T_2 = -13°C = 260K$

$T_1 = ?$

$$K = 5 = \frac{260}{T_1 - 260} \Rightarrow 5T_1 - 1300 = 260$$

$5T_1 = 1560$

$T_1 = \frac{1560}{5}$

$T_1 = 312\,K = 39°C$

Ans. c

Solution 9:

$$\eta = 1 - \frac{T_2}{T_1}$$

Now $T_2' = 2T_2$; $T_1' = 2T_1$

$$\eta' = 1 - \frac{T_2'}{T_1'} = 1 - \frac{2T_2}{2T_1} = 1 - \frac{T_2}{T_1}$$

$$\boxed{\eta' = \eta}$$

Ans. b

Solution 10:

Power of Motor of refrigerator = $\frac{W}{t}$

$T_1 = 27^\circ C = 300 K$

$T_2 = 0^\circ C = 273 K$

$W = Q_2 \left(\frac{T_1}{T_2} - 1\right) = (50 \text{ K cal/min})\left(\frac{300}{273} - 1\right)$

$W = 4.95 \text{ kcal/min} = 4.95 \times 4.2 \times 1000 \text{ J/}60 \text{ sec}$

↳ work done in one minute

$W = 346.5 \text{ J/sec}$ = rate of doing work = Power

∴ Power of motor; $P = 346.5 \text{ J/sec}$

$P \simeq 346 \text{ watt} = 0.346 \text{ kW}$ Ans.

Ans. a

Solution 11:

$$\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$$; given: $Q_1 = 1000$ Kcal

$T_1 = 627°C = 900\,K$

$T_2 = 27°C = 300\,K$

So, $$\frac{1000\text{ kcal}}{Q_2} = \frac{900}{300} \Rightarrow Q_2 = \frac{1000}{3}\text{ kcal}$$

So, work: $W = Q_1 - Q_2$

$$W = \left(1000 - \frac{1000}{3}\right)\text{ kcal}$$

$$W = 2 \times \frac{1000}{3} = \frac{2000}{3}\text{ kcal}$$

$$W = \frac{2000}{3} \times 1000 \times 4.2\text{ J}$$

work done in one cycle:

$$\boxed{W = 2.8 \times 10^6\text{ J}}$$ Ans.

Ans. c

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Chalo Niklo