

James Webb Space Telescope (12 points)

Part A. Imaging a Star (1.8 points)

A.1 (0.4 pt)

Numerical Value for d_{image} =

A.2 (0.4 pt)

Numerical value for d_{diff} =

A.3 (1.0 pt)

Formula for T_{image}

Numerical value T_{image} =

Part B. Counting Photons (1.8 points)

B.1 (0.4 pt)

Numerical value for T_{source} =

B.2 (0.4 pt)

Formula for σ_t

B.3 (0.5 pt)

Numerical value for p =

B.4 (0.5 pt)

Numerical value for intensity

Part C. Passive Cooling (4.4 points)

C.1 (2.4 pt)

Expression for T_1

Expression for T_5

C.2 (1.6 pt)

Numerical estimate $\alpha =$

Numerical estimate $\beta =$

C.3 (0.4 pt)

Numerical value $T_1 =$

Numerical value $T_5 =$

Part D. Cryo-cooler (4 points)

D.1 (1.0 pt)

Quantity Name	State 1	Compare using ">", "<", "=", or "?"	State 2
Internal Energy	U_1		U_2
Temperature	T_1		T_2
Entropy	S_1		S_2
Pressure	P_1		P_2
Volume	V_1		V_2

D.2 (0.6 pt)

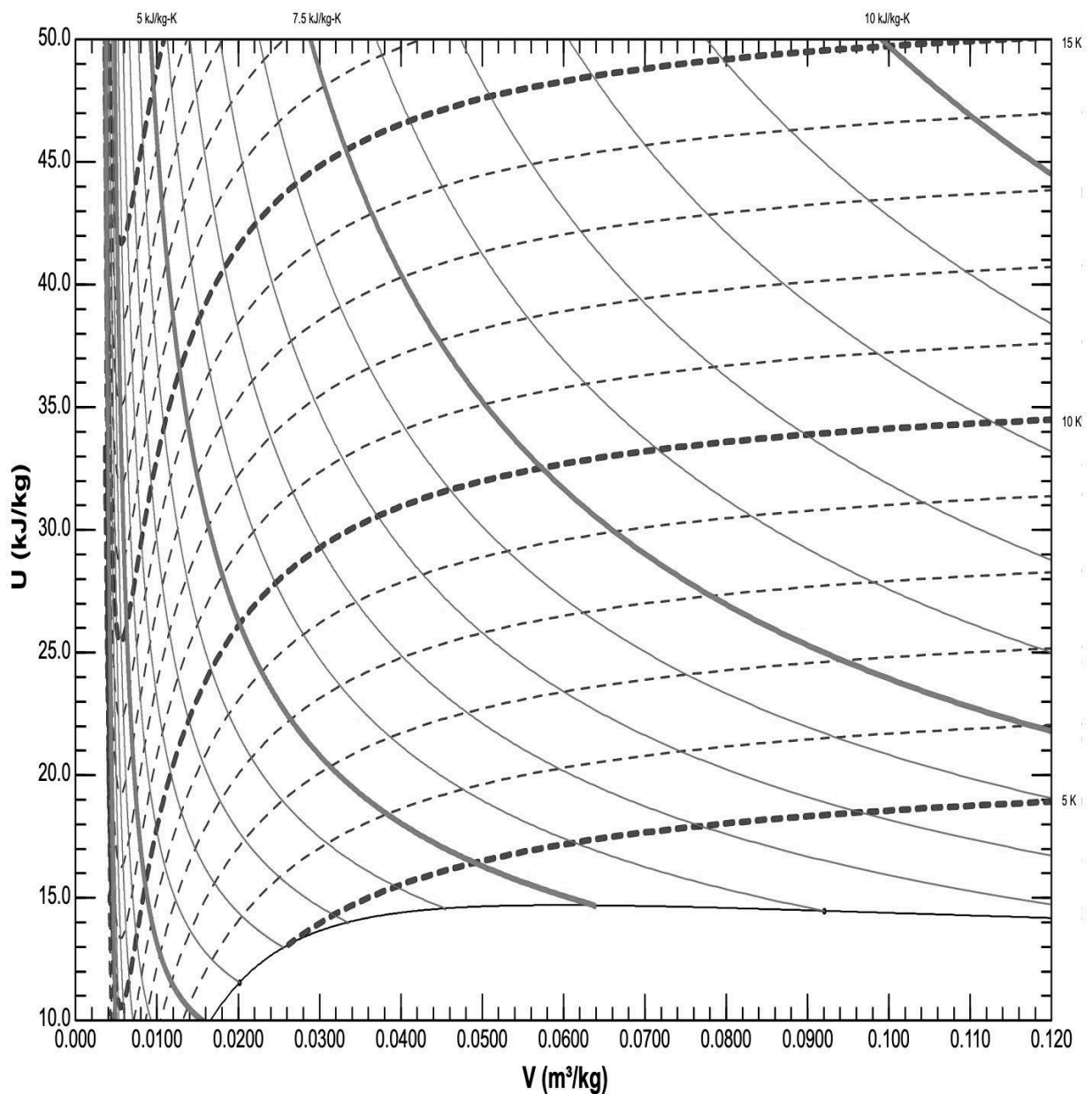
Formula for conserved quantity

D.3 (1.4 pt)

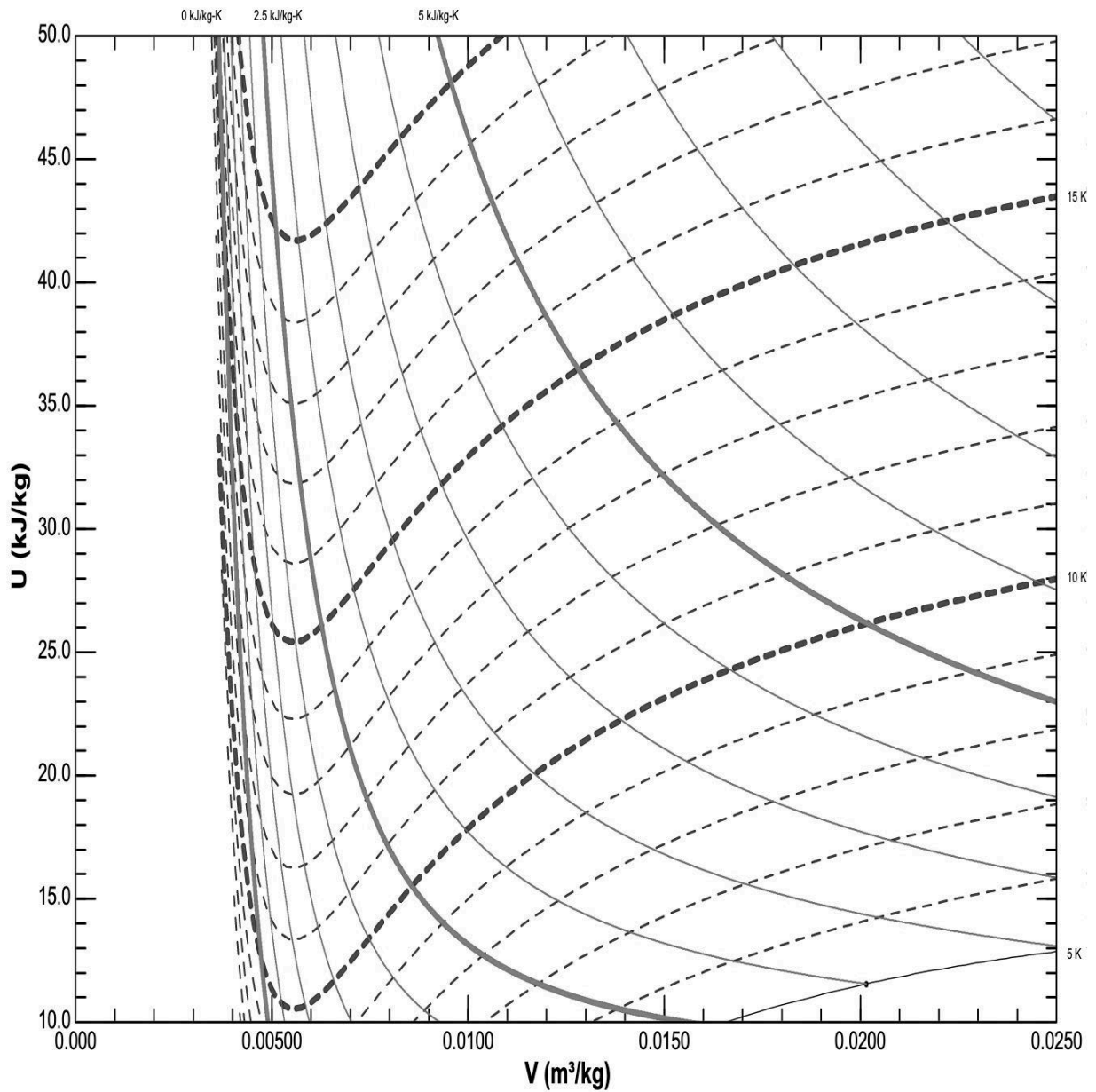
Solid curves (trending down with increasing volume) are constant entropy S ; values for the bold curves are on top.

Dashed curves (trending up with increasing volume) are constant temperature T ; values for the bold curves are on right.

Internal energy (per kg) U is on vertical axis; volume (per kg) V is on horizontal axis



D.4 (0.8 pt)



D.5 (0.2 pt)

Numerical value for $P_1 =$