Metabolic Scope, Energy and Efficiency Problems[i]

SOLUTION

Biology 390 -- Physiology

A short-tailed cricket, *A. arboreus*, has a metabolic rate of about 0.5 $mlO_2\ g^{-1}\ h^{-1}$ at rest. Their mass is about 0.4 g. When singing they raise their rate of metabolism to about 3.6 $mlO_2\ g^{-1}\ h^{-1}$.
What is the net cost of singing in $mlO_2\ g^{-1}\ h^{-1}$?

SUBTRACT THE RESTING FROM THE ACTIVE RATE:

NET = 3.6 - 0.5 = **3.1** ml O_2 / gh

-- this supposedly represents the actual cost of producing sound

What is their factorial metabolic scope when singing?

RATIO OF ACTIVE TO RESTING $\dot{V}_{O_2}$

METABOLIC SCOPE = 3.6 / 0.5 = **7.2 X**

-- THIS REPRESENTS THE NUMBER OF TIMES THE ACTIVITY IS MORE INTENSE METABOLICALLY THAN REST

Their RQ while singing is approximately 0.85. What is their net power for singing (in mw)?

FROM REFERENCE TABLE, IF RQ = 0.85 THEN 1 L O_2 = 20.34 KJ; 1 ML O_2 = 20.34 J

THUS, NET POWER =

NET $\dot{V}_{O_2}$ * ENERGY EQUIVALENT * TIME CONVERSION * MASS

= 3.1 mlO2/(gh) * 20.34 J/ml O_2 * 1 h / 3600 s * 0.4 g = 0.0071 w = **7.0 mw**

The song of the cricket described above is a loud continuous trill of approximately 48 μw. How efficient (%) is this cricket at producing sound?

EFFICIENCY = USEFUL POWER (POWER OUTPUT) / METABOLIC POWER

= 0.000048 W / 0.0070 W *100 = ~ **0.69%**

(this time I have given you real numbers)