Equations for calculating daily requirements of horses

I. Estimation of digestible energy (DE) requirements (Mcal of DE/day)

A. Maintenance:

1. 200-600 kg of BW : DE= 1.4+ 0.03 BW
2. Greater than 600kg of BW: DE= 1.82+0.0383BW- 0.000015 BW^2

B. Stallions (breeding seasons): DE= 1.25 (Maintenance DE)

C. Pregnant mares:

1. 9 months DE= 1.11 (Maintenance DE)
2. 10 months DE= 1.13 (Maintenance DE)
3. 11 months DE= 1.20 (Maintenance DE)

D. Lactating mares:

1. **Foaling to 3 months**
   a. 200-299 kg of BW DE= (Maintenance DE) + (0.04BW×0.792)
   b. 300-900 kg of BW DE= (Maintenance DE) + (0.03BW×0.792)
2. **3 months of weaning**
   a. 200-299kg of body weight DE= (Maintenance DE) + (0.03 BW ×0.792)
   b. 300-900kg of body weight DE= (Maintenance DE) + (0.02 BW ×0.792)

E. Working horses

1. Light work DE = 1.25 (Maintenance DE)
2. Moderate work DE= 1.50 (Maintenance DE)
3. Intense work DE= 2.00 (Maintenance DE)

F. Growing horses (4-24 months of age)

1. Not in training DE= (Maintenance DE) + (4.81+1.17X- 0.023X^2) (ADG)
2. In training (Moderate Work) DE= 1.5 (maintenance DE) + (4.81+1.17X- 0.023X^2)(ADG)

Where X is the age (Months) and ADG is the average daily gain (kg/day)

II. Estimation of Crude Protein (CP) requirement (g/day)

A. Maintenance: CP= (40) (Mcal of DE/day)

B. Stallion: CP= (40) (Mcal of DE/day)

C. Pregnant mares

(9-11 months): CP= (44) (Mcal of DE/day)

D. Lactating mares:

1. Foaling to 3 months

a. 200-299 kg of BW $\underline{\text{CP= (Maintenance DP}^{!}\text{) + [(0.04 BW}\times 0.021\times 1.000)/0.65]}{0.55\#}$

b. 300-900 kg of BW $\underline{\text{CP= (Maintenance DP}^{!}\text{) + [(0.03 BW}\times 0.021\times 1.000)/0.65]}{0.55\#}$

2. 3 months to weaning

a. 200-299 kg of BW $\underline{\text{CP= (Maintenance DP}^{!}\text{) + [(0.03 BW}\times 0.018\times 1.000)/0.65]}{0.55\#}$

b. 300-900 kg of BW $\underline{\text{CP= (Maintenance DP}^{!}\text{) + [(0.02 BW}\times 0.018\times 1.000)/0.65]}{0.55\#}$

E. Working horses: CP= (40) (Mcal of DE/day)

F. Growing horses:

1. Weanling CP= (50) (Mcal of DE/day)

2. Yearlings and long yearlings CP= (45) (Mcal of DE/day)

3. 2 year olds CP= (42.5) (Mcal of DE/day)

*** All values are on a dry matter basis. BW= body weight (kg)**

 # Crude Protein digestibility

[!] DP (Digestible Protein, value worked out as 0.6 g/kg body weight)

Calculation of DE and CP requirements for different category of horses

Question1: Calculate the daily DE and CP requirement of an adult horses weighing 200kg.

DE (Mcal /d) = 1.4+ (0.03× BW)
DE = 1.4 + (0.03× 200)
DE = 1.4 + 6
= 7.4 Mcal /d

CP (g/d) = 40 × (Mcal of DE/d)
= 40 × 7.4
= 296 g/d

Question2: Calculate the daily DE and CP requirement of an adult horse weighing 400kg.

DE (Mcal/d) =1.4+ (0.03× BW)
DE =1.4 + (0.03×400)
=13.4 (Mcal/d)

CP (g/d) = 40 × (Mcal of DE/d)
= 40×13.4
= 536 g/d

Question 3: Calculate the daily DE and CP requirement of an adult horses weighing 700kg.

DE (Mcal/d) = $1.82 + 0.0383BW - 0.000015BW^2$
= $1.82 + (0.0383\times700) - (0.000015\times700^2)$
= 1.82 + (26.81 – 7.35)
= 1.82+19.46
= 21.28 (Mcal/d)

CP (g/d) = 40 × (Mcal of DE/d)
= 40× 21.28
= 851.2 g/d

Question 4: Calculate the daily DE and CP requirement of an adult stallion weighing 400kg.

Maintenance DE (Mcal/day) = 1.4 + (0.03×BW)
=1.4 + (0.03×400)
=1.4+12
=13.4 Mcal/day
DE (Mcal/d) =1.25 (Maintenance DE)
=1.25×13.4
=16.75 DE (Mcal/d)
CP (g/d) = 40× (Mcal of DE/day)
= 40×16.75
= 670 g/d

Question 5: Calculate DE and CP requirement of a pregnant mare weighing 300kg under five month of pregnancy.

DE (Mcal/d) = 1.11 (Maintenance DE)

Maintenance DE =1.4+ (0.03 × BW)

= 1.4 + (0.03×400)

=1.4+9

=10.4 (Mcal/day)

DE (Mcal/d) = 1.11 (Maintenance DE)

= 1.11×10.4

= 11.55 Mcal/d

CP (g/d) = 44(Mcal of DE /d)

= 44×11.55

= 507.94 (g/d)

Question6: Calculate the daily DE and CP requirement of a lactating mare (foaling to 3 month) weighing 400kg.

DE (Mcal/day) = (Maintenance DE) + (0.03BW×0.792)

Maintenance DE = 1.4 + (0.03×400)

=1.4+12

=13.4 (Mcal/d)

DE (Mcal/d) =13.4+ (0.03×400×0.792)

= 13.4 +9.504

= 22.904 (Mcal/d)

$$\text{CP (g/d)} = \frac{\text{(Maintenance DP)} + [(0.03\ \text{BW}\times 0.021\times 1.000)/0.65]}{0.55}$$

Maintenance DP = 0.60g × BW

= 0.60 ×400

= 240

$$\text{CP (g/d)} = \frac{240+ [0.03\times 400\times 0.021\times 1000)/0.65]}{0.55}$$

$$= \frac{240+ 252/0.65}{0.55}$$

$$= \frac{240+387.69}{0.55}$$

= 627.69/0.55

CP (g/d) = 1141.258 g/d

Question7: Calculate daily DE and CP requirement of a moderate working adult horse weighing 400kg.

DE (Mcal/d) = 1.50 (Maintenance DE)
Maintenance DE = 1.4 + (0.03×BW)
= 1.4(0.03×400)
= 13.4 Mcal/d
DE (Mcal/d) = 1.50 (Maintenance DE)
= 1.50×13.4
DE = 20.1 Mcal/d
CP (g/day) = 40× (Mcal of DE/d)
= 40× 20.1
= 804 g/day

Question 8: Calculate daily DE and CP requirement for a growing under training horse, 20 months of age, having 330 kg body weight and gaining weight @ 0.25 kg/d

DE (Mcal/d) for growing horse = 1.5 (Maintenance DE) + $(4.81+1.17x - 0.023x^2)$ ×ADG

Maintenance DE (Mcal/d) = 1.4 + (0.03×BW)
= 1.4 + (0.03 ×330)
= 11.3

DE (Mcal/d) = 1.5 (Maintenance DE) + $(4.81+1.17x - 0.023x^2)$ ×ADG

= 1.5 (11.3) + $(4.81+1.17\times20 - 0.023\times (20)^2)$ × 0.25

= 16.95 + (4.81+ 23.4 - 9.2) ×0.25

= 16.95 + (4.81+14.2) × 0.25

= 16.95 + (19.01) × 0.25

= 16.95 + 4.7525

= 21.7025 (Mcal/d)

CP (g/d) = 45 × (Mcal of DE/d)

= 45 × 21.7025

= 976.6125

Formulation of Ration for horses

The following tables (Tab 1-4) can be used as guide lines for formulation of ration for horses

Table 1: DE and CP content of some of the common feeds of horse

Feedstuffs	DM (%)	DE (Mcal/kg)	CP (%)
Alfalfa hay	90.5 100	2.24 2.48	18.0 19.9
Oat hay	90.7	1.75	8.60
Oat grain	89.2 100	2.85 3.20	11.8 13.3
Wheat bran	89.0 100	2.94 3.30	15.4 17.4
Soybean meal (solvent extracted)	89.9 100	3.36 3.73	48.5 54.0

Table 2: Guide lines for roughage to Concentrate ratio in feeding of horse

Work level	% Roughage	% Concentrate
Resting	90-100	0-10
Light work	75-80	20-25
Moderate work	65-70	30-35
Hard work	55-65	35-45
Intense work	40-50	50-60

Table 3: Relationship between body weight, work level and appetite in horse

Work level and appetite	Body Weights (kg)					
	200	400	450	500	550	600
Resting (1.5 % BW)	3	6	7.00	7.50	8.00	9.00
Light work (2.0 % BW)	4	8	9.00	10.0	11.0	12.0
Moderate work (2.5 % BW)	5	10	11.5	12.5	13.5	14.5
Intense work (2.5-3.0 % BW)	6	12	13.5	15.0	16.5	18.0

Table 4: Expected Feed Consumption by horses (% Body weight)
[as dry feed (about 90 % DM)]

Category	Forage	Concentrate	Total
MATURE HORSES			
Maintenance	**1.5-2.0**	**0.0-0.5**	**1.5-2.0**
Mares, late gestation	**1.0-1.5**	**0.5-1.0**	**1.5-2.0**
Mares, early lactation	**1.0-2.0**	**1.0-2.0**	**2.0-3.0**
Mares, late lactation	**1.0-2.0**	**0.5-1.5**	**2.0-2.5**
WORKING HORSES			
Light work	**1.0-2.0**	**0.5-1.0**	**1.5-2.5**
Moderate work	**1.0-2.0**	**0.75-1.5**	**1.75-2.5**
Intense work	**0.75-1.5**	**1.0-2.0**	**2.0-3.0**
YOUNG HORSES			
Nursing foal, 3 mths	**0.0**	**1.0-2.0**	**2.5-3.5**
Weanling foal, 6mths	**0.5-1.0**	**1.5-3.0**	**2.0-3.5**
Yearling foal, 12 mths	**1.0-1.5**	**1.0-2.0**	**2.0-3.0**
Long yearling, 18 mths	**1.0-1.5**	**1.0-1.5**	**2.0-2.5**
Two years old 24 mths)	**1.0-1.5**	**1.0-1.5**	**1.75-2.5**

Problem 1: a) Calculate DE and CP requirement for a moderate working horse having 400kg body weight.

b) Compute the ration for the same horse using oat hay, oat grain and wheat bran.

Solution: a) 1. Calculation of DE requirement (Mcal/Day)

= 1.5 (Maintenance DE)
= 1.5 × [1.4 + (0.03× BW)]
= 1.5 × [1.4 + (0.03× 400)]
= 1.5 × [1.4+12]
= 1.5 × 13.4
DE = 20.1 Mcal/day

CP= (40) (Mcal of DE/day)
CP = 40 × 20.1
= 804 g/day

Answer: DE requirement = 20.1 Mcal/d
CP requirement = 804 g/d

b) Formulation of ration

Ingredients	Quantity (kg)	DE (Mcal)	CP (kg)
Oat hay (1.75, 8.6)	07	12.25	0.602
Oat grain (2.85, 14.8)	02	5.70	0.236
Wheat bran (2.94, 15.40)	01	2.94	0.154
Total	**10**	**20.89**	**0.992**

Parenthesis (DE Mcal/kg and CP %)

Answer: Available feeds can be given daily as follow :

Oat hay- 7kg,

Oat grain- 2kg

Wheat bran- 1kg

to fulfill the requirement for a 400kg body weight moderate working horse.

Problem 2: a) Calculate DE and CP requirement for a 400kg intense working horse.

b) Compute ration for the same horse, using following feedstuffs oat hay, oat grain, wheat bran.

a) DE requirement (Mcal/d) = 2 (Maintenance DE)

$= 2\times [1.4+ (0.03\times 400)]$

$= 2 \times 13.4$

$= 26.8$

CP (g/day) = 40× Maintenance DE

$= 40\times 26.8$

$= 1072$

b) Formulation of ration: For intense working horse, body weight 400 kg, feed requirement will be about 10-12kg (7.2 kg concentrate + 4.8 kg roughage)

Ingredients	Quantity (Kg)	DE (Mcal)	CP (g)
Oat hay (1.75, 8.6)	4.8	08.40	412
Oat grain (2.85, 11.8)	4.5	12.82	531
Wheat bran (2.94, 15.40	2.7	07.93	415
Total	**12.0**	**28.6**	**1358**

Parenthesis (DE Mcal/kg and CP %)

Answer: To fulfill the requirement for intense working horse of body weight 400kg, the available feeds can be offered as follows (per day).

Oat hay- 4.8kg
Oat grain- 4.5kg
and Wheat bran- 2.7kg